

Vehicle Maintenance Pro

The A to Z Guide to Managing Your Vehicle Maintenance



J. J. Keller
& Associates, Inc.
Since 1953

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Vehicle Maintenance Pro

Introduction

This manual — Vehicle Maintenance Pro: The A to Z guide to managing your vehicle maintenance operation — takes a look at the tasks that could fall under the title of Maintenance Pro. The book is divided into two major topic areas — your operations and maintenance related activities, and dealing with compliance issues.

The operations topics covered in this manual place a strong emphasis on the importance of planning, establishing standards, and then living by those standards when it comes to maintenance, safety, and health.

The compliance sections include selected regulations and compliance guidance pertaining to Department of Transportation, Environmental Protection Agency, and Occupational Safety and Health Administration regulations.

Finally, a reference section includes pertinent information relating to the subjects covered in the manual, as well as contact information for the regulatory agencies discussed in the manual.

Revision bars, like the one at the left of this paragraph, are used in this publication to show where significant changes were made on update pages. The revision bar next to text on a page indicates that the text was revised. The date at the bottom of the page tells you when the revised page was issued.

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Introduction — Why a maintenance manual

Vehicle maintenance is a complicated business. Whatever kind of maintenance facility you are in charge of, if you manage the overall program of both operational and compliance related topics, you've got your hands full.

This manual is intended to be used by Maintenance Pros at all types of commercial carriers. Whenever the term "vehicle" is used, the requirement or concept is universal and applies to all types of commercial vehicles; large (CDL-required vehicles), small (non-CDL commercial vehicles), property-carrying, and passenger-carrying. When a vehicle-specific requirement or topic is being discussed, the type of vehicle the requirement or topic applies to will be specified. Examples include the emergency-exit requirements for passenger-carrying vehicles and the new brake distance requirements related to truck-tractors.

A Maintenance Pro, in the sense of this manual, has the task of managing maintenance operations, people, equipment, and regulatory compliance issues. Operational management involves finding the most efficient and effective way of keeping the fleet operating safely. Personnel management involves directing a group of different people toward a common goal. Employees must be encouraged to reach their full potential if the business is to be profitable. Equipment management means making sure that each unit "pays its way." If it doesn't, it has to be replaced or eliminated entirely. Managing compliance means trying to comply with regulations from DOT, OSHA, and EPA.

Fleet maintenance organization

The organization of a vehicle fleet depends a great deal on its size. Large for-hire fleets usually have a formal organization like any major business with trained people performing specialized tasks. The in-house maintenance shop staff may be equally specialized: equipment manager, shop supervisor, parts person, tire person, line mechanics, regulatory compliance person, etc. The company may also have a mix of shop facilities at various locations around the country, from very large and specialized, to very small and general.

Fleet management for the small fleet is naturally lean. People typically wear more than one hat in this kind of operation. Rather than being specialists, they will probably be generalists, possibly even bringing a background in a family business to their job. A few individuals must handle all the budgeting and accounting tasks, legal licensing and insurance paperwork, driver hiring and managing. They must also go out and get the business, and then service the customer.

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The private fleet's goals are not really the same as a for-hire operation. The corporation to which it belongs has created a fleet to meet price and service requirements that are not being met by outside carriers. Because of this, many times private fleets do not operate their own equipment and maintenance facilities. They lease equipment and have lease arrangements that require the leasing company to perform the maintenance. However, the private fleets must still have individuals who are well-versed in equipment maintenance and the associated regulations. Even though the private carrier does not own the vehicles, or maintain them, they are still legally responsible for them (including the inspection and maintenance of the equipment).

Also, private fleets may still have maintenance needs. The operation of a small maintenance facility to perform quick and easy repairs (fixing lights, airing tires, etc.) may be necessary if the leasing company's shop is too far away or not available all hours the fleet is operating. In some of these cases, the vehicle maintenance may be handled through the general maintenance department at the facility. If this is the case, the personnel performing the maintenance may need a considerable amount of guidance on vehicle maintenance.

While the maintenance department does not have to worry about "turning a profit," it does need to keep an eye on costs. It must be able to maintain and repair vehicles as economically as an outside shop. The conveniences of having an inside shop (no need to schedule shop time with an outside entity, the ability to prioritize work, control of manpower, faster turnaround times, in-depth knowledge of the equipment and maintenance schedules, etc.) can be outweighed if the shop becomes too expensive to operate.

Maintenance is a very labor-intensive part of fleet operations. Even the best diagnostic equipment is only as good as the technician who uses it. The shop can only be cost-effective when productive people are employed there. The challenge to maintain a safe, reliable vehicle at the lowest possible cost can only be achieved by people who really believe in this goal. The goals of the maintenance shop and the themes that will run throughout this manual are to increase productivity, reduce maintenance costs, and improve vehicle utilization to increase profitability.

The whole principle of an effective vehicle maintenance operation is to keep the vehicles rolling, so they have the maximum opportunity to make money for the company. Whether you work with a for-hire trucking operation, a for-hire motor coach company, a school bus company, a private fleet, or some other kind of transportation company, profit is at the bottom of most considerations.

Why have PM and schedules

PM, or preventive maintenance, involves scheduling inspections and maintenance to prevent vehicle breakdowns. The PM program, and the associated scheduling, are at the heart of any effective maintenance program. It is the logical place for a Maintenance Pro, as well as a manual intended for a Maintenance Pro, to begin.

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Present regulations require that every motor carrier shall systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles subject to its control (49 CFR §396.3). The full text of the DOT inspection requirements can be found in the DOT compliance management and regulations sections.

Regulations are not the only reason to run an effective PM program. A well-maintained vehicle is less likely to be involved in an accident, will be more productive, and require less unscheduled maintenance and repair, which is more expensive than PM. To sum it up, PM leads to less accidents, better customer relations, and a lower cost of operation.

Another strong incentive for a good PM program is the possibility that the vehicle will be pulled over for a roadside vehicle inspection. If the vehicle is found to have a mechanical condition that might result in a breakdown or an accident, it will be put out of service. The vehicle cannot resume its trip until the unsafe condition is corrected.

Preventive maintenance is also an attitude, a commitment. It doesn't mean simply getting a vehicle into the shop and fixing what you see. It means being constantly on the lookout for things that might go wrong. It means getting the best, most cost-effective equipment for the vehicle and then taking care of it. This is much like preventive medicine that stresses good eating habits and regular exercise as a continuing prescription for good health and long life.

The PM philosophy is widely used, not only because it reflects a modern attitude of conservation, of using what assets one has wisely, but because it saves money. No one can argue with the bottom line. As PM takes hold, the standard of excellence for a maintenance shop changes from getting the fastest repairs to getting the fewest repairs.

PM also requires careful recordkeeping of what is done. In addition to complying with regulations, PM records have another use. Once reliable PM schedules are established, they are refined for the individual vehicle and can be used to predict maintenance. Fleets that do not use records for more than simple documentation are not taking advantage of the goldmine of information that's there. And it's quite likely that those fleets are not managing their vehicles, the vehicles are controlling them.

To sum it up, vehicles that are put out of service or breakdown will require unscheduled maintenance (repairs). Repairs done on the road can be very costly both in lost productivity time and additional repair costs (commercial shops tend to have a considerably higher cost) when compared to the cost of operating a PM program. Using a "we'll fix it when it breaks" maintenance program can get very expensive.

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Determining PM intervals

Measuring the interval

The first decision that needs to be made when determining a PM schedule is what method of measurement you are going to use. There are several methods used to schedule vehicles for preventive maintenance. The three most common methods are:

- **Time** — This method is by far the easiest for management, but is often the most wasteful as far as technicians' time, parts, and cost. Scheduling vehicle preventive maintenance based on time means exactly what it says. A vehicle will be scheduled into the shop every x amount of days regardless of mileage or engine hours used since its last PM.
- **Miles** — Scheduling PMs based on vehicle miles driven is the most common method used for scheduling vehicle preventive maintenance. A vehicle will be scheduled into the shop after a predetermined amount of miles have been driven on the vehicle. There are, however, a few problems associated with this method. The biggest problem is that scheduling PMs based on mileage does not take into account engine idle time or PTO time that could be a large percent of the engine's running hours. To compensate for this, some carriers that use mileage shorten the mileage interval to compensate for excessive idling or PTO time.
- **Engine hours** — Scheduling PMs based on engine hours makes sense for vehicles that work hard during every mile, but do not do many miles. Waste trucks, concrete haulers, and gravel trucks are all good examples of vehicles that are typically scheduled for PMs based on engine hours. The reason these trucks are routed into the shop for PMs on the basis of engine hours is because they are constantly working hard — even though the truck may be averaging low miles per hour and miles per day.

The type of vehicles and the type of operation will determine the best type of PM scheduling for your individual company.

Methods for determining interval

This part of the maintenance program, the PM intervals, comes from several sources:

- The original equipment manufacturers' (engine, transmission, and other component OEMs) recommendations are the primary source and the most important ones. If the fleet has bought a new vehicle, that's the only reliable source of information. You should follow the recommendations exactly until your own experience proves otherwise. You can also get information about expected component life from those manufacturers and plan accordingly. You must be careful about deviating from the OEM's recommendations. If you deviate too far you may lose some, or all, of the warranty on the vehicle or vehicle components.

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- Your repair records (your history) are the second source. Even if you are planning PM for a new vehicle, past maintenance history on similar vehicles that do the same work can give you important clues about how the fleet vehicles have been operating and helps you plan the maintenance schedule for the new vehicle.
- Your own people (drivers, technicians, and other shop personnel) are your third source. Ask them for suggestions. A successful PM program will need the cooperation of everyone, and the best way to get that support is to start out with the same people. They should help to put the plan together. Ask for specific ideas about the PM intervals.
- Tracking internal performance measures. These measures can include oil sampling (if oil samples tested following oil changes are indicating oil breakdown, shortening the interval may be necessary), part failure analysis, unscheduled repairs, on-the-road repairs, on-the-road breakdowns, and out-of-service violations. It does not make any difference how well your maintenance schedule matches up with the OEM's recommendations, if the vehicles are constantly breaking down or are constantly in need of major repairs (such as engine replacements).

One issue that will need to be considered when establishing the maintenance interval is the need to service the emissions system. In vehicles built to the 2007 and 2010 emissions standards there are parts in the emissions system that require regular service. Diesel particulate filters (DPF), selective catalytic reduction (SCR) systems, and exhaust gas recirculation (EGR) components all require routine service.

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Determining PM checklists

As was mentioned earlier, PM involves scheduled inspection and maintenance of the vehicle. One key to making sure the necessary items are being inspected and maintained is the development of maintenance checklists. At the end of this chapter there are examples of PM checklists that are commercially available. If you want to develop your own, there are many factors that must be considered. Some of these factors are:

- OEM recommendations. All OEMs provide recommended inspection and maintenance items and procedures. These should serve as the basis for any program you develop.
- Regulations. Certain inspections are mandated in the Federal Motor Carrier Safety Administration regulations. An example of a mandated inspection is the periodic (annual) inspection. The items found in Part 393 and Appendix G can serve as the basis for any checklist covering a required inspection.
- Your history. By data-mining maintenance records and determining ECLS and MTBF for various parts and components, you can predict when parts and components become unreliable. Also, testing samples of fluids can determine the length of time fluids should be left in the various components, and therefore, the timing on fluid changes.
- Your people. If your technicians are reporting that they are constantly having to repair a part or component on vehicles, and the part or component is not on the PM checklist, you should consider adding it.

In the above discussion we hit on some terms and concepts that we need to further explore.

ECLS and MTBF

ECLS, or Expected Component Life System (sometimes referred to as Expected Component Life Cycle System), is a method of studying vehicle maintenance trends and replacing parts and components before they fail.

The first step to effectively using ECLS to determine PM checklists is having accurate maintenance data. By digging through the maintenance records and mining data out of the records, the Maintenance Pro can determine the Mean Time Between Failures (MTBF) for all parts and components on the vehicle. The MTBF is nothing more than the average miles or hours that a component fails

Once the MTBF has been determined, the next step is to determine the ECLS replacement schedule for the component. If the ECLS is set at the MTBF, roughly half of the vehicles will suffer a failure of the component or part before it is replaced. If the ECLS is set at the earliest known failure point, then many times the part or component will be removed from the vehicle well before replacement is necessary.

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The basic question becomes, what are you willing to accept for an on-the-road failure rate? If you do not want any on-the-road failure of the component in question, then you will want to set the ECLS at the earliest known failure point. However, if the item is not a critical component, or an item whose failure can be easily dealt with when the vehicle is on the road, then using the MTBF point as the replacement point may be acceptable.

Wear limits

Some components, such as tires and brakes, can be tracked through the MTBF and ECLS programs, but their replacement will be directly tied to the vehicle inspections. The MTBF and ECLS data can be used to compare tire and brake performance, but the decision to replace the parts will be based on the findings of inspections. This is done through determining “wear limits” on parts and components.

Wear limits are the minimum acceptable depths or thicknesses you are willing to allow on a component, regardless of the MTBF or ECLS data. An example would be tires. The legal minimums for a tire are $\frac{4}{32}$ ” on the steer axle, and $\frac{2}{32}$ ” on all other positions. As a company you have decided that you are not going to allow the tires to wear down to that point. You will replace steer tires at $\frac{8}{32}$ ” and all other tires at $\frac{4}{32}$ ” (this is then considered your failure point for MTBF purposes).

The MTBF and ECLS can give you a general idea of when the wear limit should be reached, but how many hours or miles it takes to reach the failure point is irrelevant. Once the tire has worn to the predetermined point (either $\frac{8}{32}$ ” or $\frac{4}{32}$ ”), the tire is replaced.

Fluid sampling

Another method of determining maintenance needs that does not involve MTBF and ECLS is fluid sampling.

Fluid sampling and testing can provide the Maintenance Pro with a “wear limit” method of analyzing the internal condition of a component. A prime example is the engine.

By simply looking at an engine the Maintenance Pro cannot tell the condition of the internal parts. A MTBF study can determine when most of the engines will fail. But with engine rebuilds being an expensive repair, doing a rebuild simply based on MTBF and ECLS data could lead to unnecessary and costly maintenance.

Taking an oil sample, and having it tested, can give the Maintenance Pro a look inside the engine. If antifreeze is appearing in the oil, that can indicate a head gasket is leaking. Iron, steel, chromium, or aluminum particles in the oil sample can indicate that the one of the internal components of the engine is beginning to fail. The presence of excessive copper (or similar metals) in the oil can indicate that there are bushings or bearings that are beginning to wear.

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Sampling and testing other components can also locate problems. Transmissions, differentials, and auxiliary hydraulic systems (wet kits) are all examples of components where sampling and testing can indicate problems in advance of failure.

Testing the fluids in every vehicle component at every service could get costly (\$7 to \$15 dollars per test). Many carriers are willing to pay this and consider it part of the PM cost of the vehicle. As well as providing early warning of problems, a regular sampling program can help with any warranty claims associated with the component (sampling will show the failure was a sudden failure, not due to neglect over time).

What many carriers that use sampling do is combine sampling with MTBF and ECLS data. When the vehicle first enters service, samples are only taken at benchmark intervals, such as during quarterly or the annual inspection. Once a vehicle reaches a predetermined threshold, the sampling and testing then become part of all regular inspections. Here is an example of a combination approach:

- **Engine:** Due to MTBF and ECLS data we will sample and test engine oil as part of the annual inspection for the first two years. After the second annual inspection engine oil sampling and testing will be performed as part of each oil change.
- **Transmission:** Due to MTBF and ECLS data we will sample and test transmission oil as part of the annual inspection for the first five years. After the fifth annual inspection transmission oil sampling and testing will be performed as part of each oil change.
- **Differentials (including interaxle):** Due to MTBF and ECLS data we will sample and test differential oil as part of the annual inspection for the first five years. After the fifth annual inspection differential oil sampling and testing will be performed as part of each oil change.

Documenting preventive maintenance

The FMCSA regulations require that the company have a record system that shows the vehicle's maintenance schedule, and last and next scheduled service (both due date and nature of the service). The regulations do not spell out how a company is to accomplish any of this. The regulations do not provide a "required schedule" or "required form and format" for documentation. The regulations only require that a company have a systematic maintenance program and document it. One reason the FMCSA does not "spell out" a preventive maintenance schedule that carriers must follow is because of the wide variety of commercial vehicles that are in operation and covered by these regulations. Everything from pickup trucks to motorcoaches to tractor-trailers are covered by these regulations.

To develop and document the preventive maintenance program a Maintenance Pro will need to use the information we have mentioned so far, and then develop and document the maintenance program for each vehicle (or group of vehicles). This is not as complicated as it sounds.

First, for preventive maintenance purposes and later tracking divide the vehicles in the fleet into "dynamic groups." Each group should be made

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up of similar vehicles (based on similar traits and maintenance requirements, not necessarily make and model).

Next, review the existing information for each group and write a preventive maintenance schedule (including intervals, checklists, and wears points for important and high-wear components).

Once you have established the schedule for each of the dynamic groups, copy them and place a copy into the corresponding vehicle files. As well as containing the preventive maintenance information, the vehicle files must also contain identifying information (vehicle number, make, VIN, year, tire size, and the entity providing the vehicle if it is not owned by the company), and records of all inspections, maintenance, and repairs. This is required by the FMCSA regulations under §396.3. For more information on these regulations see the DOT tab in the Compliance section of this manual.

Finally, either on a form in the file or physically on the file, keep track of each scheduled preventive maintenance, and record when the next scheduled maintenance is due.

Some companies go one step further to make the process easier. In addition to the files they use a wall board that displays the individual vehicles and last/next service. This way, technicians and supervisors can tell at a glance when a vehicle received scheduled preventive maintenance last, and if it coming due for its next service.

One key point to remember: The FMCSA is letting you develop your own preventive maintenance program and schedule. However, the FMCSA is going to expect you to adhere to your program and schedule, just as if they were regulations. This really is a case where you “get to write your own regulations.” As long as you have a documented preventive maintenance program that includes a maintenance schedule, records that show past and future maintenance, your vehicles are being serviced in accordance with your schedule, and your vehicles are passing roadside inspections, the FMCSA will be satisfied with your preventive maintenance program and schedule.

Example of a PM schedule

The actual maintenance portion of PM is composed of scheduled and standardized inspections and maintenance. This is sometimes referred to as the vehicles’ “scheduled service,” or simply “service.” PM services are commonly designated as A, B, C, D, etc. Under the normal system, every letter you move up into the alphabet represents an increase in the complexity of the PM service (and time required).

PM A services are also known as a “maintenance check-out” or “safety inspection” and generally consists of a safety check and lubrication as well as checks of key components such as brakes, lights, tire condition and inflation, and fluids. It also includes checking and adjusting high wear components. Typically, these PM As are scheduled at half of the oil change interval of the vehicle. The normal interval for A service is between 1,500 and 2,500 miles on light vehicles, and between 5,000 and 10,000 miles on medium and heavy duty vehicles.

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Note: Some companies use an “inspection lane” and perform an A service every time the vehicle returns to the maintenance facility.

PM Bs normally include all PM A items, and also include an oil and filter change, as well as more in-depth checks of the engine and driveline. The normal interval for B service is 3,000 to 5,000 for light duty vehicles and 10,000 to 20,000 for medium and heavy duty vehicles. A PM B should also include a download of the ECM and action on any troublecodes or problems reported by the ECM (if applicable).

One consideration with passenger-carrying vehicles is that the pushout windows, emergency doors, and emergency door marking lights must be inspected once every 90 days. If the vehicles will not be undergoing PM Bs within 90 days, then this inspection item will need to be included in the PM A inspections for these vehicles.

PM C service calls for both A and B service and more extensive service (i.e. alignment, scheduled component replacement, the DOT annual inspection required by §396.17, and other scheduled engine and driveline component inspection or replacement). Normally, C services are scheduled annually. To make sure they are done in a timely manner, it is not unusual for carriers to actually schedule them on an eleven-month schedule.

PM D service is either a scheduled rebuild or replacement of a major component (i.e. engine, transmission, axle) or a “special” service. Examples of “special service” are seasonal service (winterization or summerization) and scheduled upgrade services. Scheduling of D services varies by company. The D designation may or may not be used, depending on the company.

Companies continue the lettering system based on their needs. Some companies go as far as PM L.

Don’t forget the trailers! Trailers are subject to the same regulations as the vehicles that pull them and should be subject to the same type of PM program. Typical preventive maintenance scheduling for a trailer is:

- **T1 or TA** services are scheduled every 3 months. This PM service includes an inspection and lubrication, including a check of (at a minimum) the lights, tires, brakes, coupling devices, safety equipment, and any other “systems” (refrigeration unit, sliding axles, etc.).
- **T2 or TB** PMs are scheduled every six months. This PM service includes all the items of a T1, and a more in-depth inspection, as well as additional maintenance (pulling off hubcaps to check grease condition, retorquing lugs, etc.).
- **T3 or TC** services are normally scheduled annually. These include all the inspection and maintenance included in a T1 and T2 service, along with more extensive maintenance such as an alignment or complete brake overhaul. Some carriers will also perform the periodic (annual) inspection required under §396.17 as part of the Type T3 service.

Don’t forget the auxiliaries! Auxiliary power units (APUs), refrigeration units, wet kits, hydraulic pony engines, lavatory systems (in motorcoaches), and idle reduction equipment all need to undergo the

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same scheduling process as the vehicles and trailers. The maintenance scheduling for these units can be rolled into the vehicle they are associated with. Examples would be servicing the wet kit on a vehicle each time the vehicle is serviced and servicing an APU as part of an annual inspection.

Inspection lane — An inspection lane is a designated lane or shop bay where vehicles entering or exiting (or both) the facility must check in or out. When in the inspection lane a technician will do an inspection on the vehicle. An inspection lane can be used to serve as a location to perform A inspections, if the vehicle is due for one, or it can be used strictly as a screening location.

In the “screening location” function the technician can check items such as driver complaints, body damage, fluid leaks and levels, lights, wipers, springs, brakes, tire pressures, and time or mileage since the last PM.

The vehicle might also be washed quickly. If a problem is discovered, the technician can then communicate the problem to the maintenance supervisor. The vehicle can then be scheduled for repairs or service in the regular maintenance/repair area.

Also, if the vehicle is being checked into the yard, the driver can submit his or her DVIR to the technician doing the inspection, beginning the DVIR process while in the inspection lane.

The inspection lane can be located within the shop, but it is more often located in the yard next to the shop because it's more convenient for the driver to drive through an open area rather than back into or drive into a building. Also, having space available in the yard is more predictable.

Timing is the critical element for this kind of inspection. Usually a vehicle gets inspected every time it enters or exits the yard, so the inspection must be done quickly. Some fleets are very strict about this requirement; a vehicle has to run through the lane even though it may have been gone for only a half-hour. If the inspections take too long, it may be difficult to maintain operational support for the inspection lane.

Fleets who use inspection lanes often run time-critical movements, i.e. passengers or food service delivery, and management wants to be absolutely sure that vehicles are in top condition every time they are in the terminal.

Maintenance people who use inspection lanes emphasize that if you are considering adding this kind of inspection, you should resist the temptation to make even minor repairs in the lane. All repairs must be done in the shop and accompanied by the appropriate request paper work, repair order, etc. However, some regular servicing may be scheduled for the lane.

One fleet, for example, greases their trucks during every inspection lane visit. It should also be mentioned that the inspection lane supplements driver inspection and the regular PM inspections; it does not replace them.

The inspection lane routine may prove to be too expensive or cumbersome for every fleet. In place of it, some companies use a process of “yard checks.” At specified times throughout the day, technicians will “cruise

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the yard” and check the equipment that is newly arrived into the yard. These checks involve simple items, such as brakes, tires, lights, body damage, and upcoming maintenance requirements. The technician will then record all units in the yard, and what work was done on which vehicles. If a vehicle is found to be in need of major repair or PM during the yard check, the technician will tag the unit as due for maintenance or repair, and then report it to the maintenance supervisor. The vehicle will then be worked into the shop for the needed work (similar to what happens in an inspection lane).

Other carriers do not use inspection lanes or yard checks at all, and rely entirely upon schedules and the drivers reporting to the shop when a vehicle is due for PM or in need of repair.

The bottom line is only you can decide how much PM to give your vehicles, and how to schedule it.

Pre-service inspection.

The concept of a pre-service inspection should be applied to all equipment new to the fleet, whether new or used.

With used vehicles, beginning with a C level PM inspection (and service) is preferred and recommended. Additionally, all accessible nuts, bolts, and adjustments (lug nuts, hub nuts, axle nuts, bell housing bolts, motor mounts, dash screws, front-end alignment, etc.) not normally checked as part of a level C inspection should be checked, retorqued, and/or adjusted. Developing a pre-service checklist of what you consider key components is critical.

New vehicles can benefit from this process as well. Since everything is new, you may be less concerned with the overall condition of the unit, but you will still want to make sure everything has been properly located and torqued. Many maintenance pros have “horror stories” concerning problems with brand new vehicles.

Also, you will want to be sure that everything you specified is on the line-setting sheet and actually on the vehicle. You will also want to check the model and serial numbers, sizes, etc. of all components, and log them into your recordkeeping system.

You should also consider doing pre-service inspections on vehicles that have been inactive for a significant amount of time (due to extended maintenance, driver unavailability, accident repairs, drop in demand, etc.). It would create another set of problems if a vehicle fresh off major repairs broke down for an unrelated reason that could have been found in a pre-service inspection.

How much time should you spend on a pre-service inspection? The time spent on a pre-service check depends on fleet policy. Some fleets put in a day and a half on a new semi-tractor; others add a road test and extensive component testing which can push the time to over a week, depending on the detail. The objective is to make sure that every part is tight and in good working condition.

Fleets that consider the pre-service check to be an important part of PM assign the mechanics who will be in charge of the vehicle to the task.

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Managers who feel a superficial check is good enough assign a less-expensive employee. Either way, it is probably to your advantage to use a detail-oriented employee.

You will have to create your pre-service standard according to the equipment. The line-setting sheet gives the frame of reference; you determine what checks will need to be made and develop the list from there. That checklist is, in a sense, the first service document of the new vehicle. As such, it becomes a standard quality control reference. On it you may want to include the quantities and grades of fluids added, belt tensions, tire pressures, etc.

Deciding how soon you wish to bring a new vehicle back into the shop for a follow-up inspection after its pre-service inspection is your next decision. This may seem like an unnecessary procedure, but again, the idea is to catch things before they happen. The follow-up inspection is actually part of the shakedown, and the vehicle should not be considered as fully in service until this step is completed. This is because the maintenance department cannot simulate the operational environment the vehicle will be operating in no matter how hard they try. Allowing the vehicle to operate in the environment during a short shakedown period will allow any potential problems to be dealt with early.

Sometimes a representative from the dealership is present during different phases of the pre-service inspection process. This can be an advantage if something has to be changed by the manufacturer, especially if you want immediate action.

You might also use the pre-service inspection process to familiarize drivers with the new vehicle.

Trailers should be looked at carefully too. A new trailer should be put through the same paces. Too often a trailer is neglected, especially the pre-service check, which may seem unimportant. Remember, federal regulations require that trailers have a regular maintenance schedule.

If you are going to add any special equipment to a vehicle during the pre-service period (lift gate, autogreaser, wheelchair lift, etc.) or at any other time, you will want to add a couple of steps to the process. First, verify that the alterations are legal by checking Part 393, Part 571, and Appendix G (included in the Compliance Management and Regulations sections of this manual). Next, be sure to add the work to your pre-service and inspection checklists.

At the end of this unit are examples of maintenance and pre-service checklists. While they are primarily aimed at large property-carrying vehicles, they can be modified for smaller vehicles and passenger-carrying vehicles by adding or removing specific items.

Shop Operations

Driver's role in PM

Driver inspections

A driver is required to perform a pre-trip inspection (§392.7 and §396.13) and determine, to the best of his or her ability, that the vehicle is in safe operating condition. The driver also completes a written post-trip inspection report on vehicle condition at the completion of each day's work (see §396.11). This report is then submitted to the carrier.

The driver is primarily concerned with reporting safety problems; each time the driver operates the vehicle, the driver's pretrip inspection certifies that the vehicle is in safe condition. Driver inspections are different than PM inspections.

PM inspections are performed by maintenance personnel and involve in-depth inspection of vehicle components, possibly requiring the removal of access covers and other components to conduct the inspection, and involve specific measurements of parts and components.

The maintenance team approach sees the driver as a partner in maintenance. When the driver goes a step beyond the specific driver inspection report, looking and listening for potential problems that may be developing and reporting them to the maintenance department, he or she is contributing to the PM program. Problems unrelated to safety are reported so that the vehicle can be checked during the next scheduled maintenance inspection. Body damage, a hose starting to show wear, etc. are important clues that need further investigation and attention.

To sum it up, driver inspections are concerned with what condition the vehicle is presently in, while a PM is concerned with keeping the vehicle in good condition. By working as partners and allowing their responsibilities to overlap, the mechanics and drivers can keep the fleet in excellent condition.

Driver training: driving habits and PM

The driver's commitment to PM begins where the inspection report leaves off. He or she must inspect for safety, but we've also seen how important accurate, consistent driver observation can be in alerting mechanics to potential problems. Here's where attitude comes in. The driver must believe that taking care of the vehicle is important and that it can really extend vehicle and component life, contribute to a safe vehicle, and save money for the fleet.

Drivers make a more tangible contribution to PM through their driving habits. If the fleet has developed specific cost-cutting maintenance policies, it is fleet management's responsibility to train drivers to accomplish these goals. As the Maintenance Pro you may be asked to assist in that training in an effort to reduce maintenance costs, extend equipment life, and promote fuel economy, all areas directly affected by driving habits. Let's use four subjects as examples: tires, brakes, clutch, and fuel economy.

Tires: Your drivers know the inspection procedures for tires. They need to be sure that the tire is properly inflated and clean, that the lug nuts are tight, that the tire is free from cuts or punctures, and that it has

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adequate tread. These inspection items are covered in basic CDL training. To make the driver more active in the PM program and more proactive, train the drivers to also check for:

- strange wear patterns,
- mechanical faults,
- mismatched duals,
- wrong tubes or flaps,
- unsuitable rims and wheels,
- incorrect mounting,
- objects lodged between duals,
- missing valve caps, and
- valve stem pull-through or shear.

Drivers also need to understand that fast stops and starts will wear out tires before their time. Bouncing over chuck holes and curbs, and running over debris in the road can also spell early death for a tire. Are drivers aware that bouncing over a chuck hole or curb can cause sudden tire failure, break or bend the rim, throw the wheels out of balance, misalign the wheels and the front end, and/or knock off hub caps?

Most importantly, encourage frequent inflation checks by drivers using an accurate tire gauge. Tires should be checked with a gauge when cold, before operation. Under-inflation, and the heat it generates, is the major cause of tire problems. Under-inflation leads to excessive wear, damage to the sidewalls due to extra flexing, and eventually complete failure if not corrected.

Over-inflation can negatively affect tire life also. An over-inflated tire is not distributing the weight it is carrying across its whole "footprint." Only the center of the tire is bearing the weight, so this part of the tire will suffer from excessive wear. Warn drivers that when gauging "hot" tires they will appear to be over-inflated. This is normal as tires will increase their pressure between 10 and 20 percent when hot. Because of this, instruct drivers to never let air out of a hot tire.

"Thumping" tires with a hammer or tire club can tell the driver if the tire has air in it, but not how much. Thumping should be done during an enroute inspection when the tires are warm from running down the road and a gauge would not be accurate. Thumping can locate tires that are severely under-inflated, and in need of immediate repair. Drivers that get in the habit of gauging tires as part of their pre-trip and thumping tires at every stop can significantly reduce blowouts, the most expensive and time-consuming type of tire failure.

An important PM training point to share with drivers is refilling tires safely. Due to the hazards involved in filling tires, you must ensure that your drivers (and technicians) are familiar with, and follow, the safety rules involved in filling tires. Here are basic rules for drivers:

- Use a locking chuck,

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- Do not be in line with the sidewall when filling, and
- Never refill a tire that has been run down the road at 20 percent or more below normal cold pressure.

Tires that have been run down the road 20 percent or more below normal pressure could easily have sustained sidewall damage because of the extra flexing the tire may have done. This damage may not be evident until someone tries to bring the tire back up to normal pressure. The damaged sidewall can fail with little or no warning. There could be a second or two of “popping” just before failure, but you cannot count on that. This is known as a “zipper failure.” Tires that have been run down the road 20 percent or more below normal pressure must be removed from the rim, repaired, inspected, and refilled in a safety cage if deemed serviceable by a tire technician.

Drivers that understand how to take care of their tires will be performing a valuable PM function while on the road. The more problems drivers can deal with proactively, the less the chances of breakdowns or major time spent performing repairs in your shop!

Brakes: Out-of-adjustment brakes continue to be a major out-of-service violation for heavy trucks (as well as other vehicles). In addition to a potential downtime, there is a safety concern that brakes which need adjustment provide the vehicle with only 50 percent of their normal braking ability.

Out-of-adjustment brakes can also create a brake imbalance that could potentially cause the vehicle to enter a side-skid during a panic stop.

As well as creating a safety hazard, brakes that are out-of-adjustment lead to abnormal wear. The brakes that are in adjustment have to do extra work when the vehicle is slowed, leading to excessive wear on these brakes. On downgrades, the brakes that are in-adjustment may over-heat, damaging them.

Are drivers aware how dangerous fanning the brakes is? Do they know that this habit can gradually reduce available air in the reservoirs and cause excessive wear? Gearing down on descents and in traffic is the better way. Good braking technique really boils down to good driving. Drivers should be trained to anticipate the moves of other drivers and proceed at the speed most appropriate for existing road conditions to minimize harsh brake use.

Good driver brake maintenance starts with a daily pre-trip inspection. Carriers should consider training drivers to perform the equivalent of a Level 2 CVSA inspection, which includes looking for signs of oil leakage (hub seal indicator reading low or oil/grease on the brake shoes), wear or cracks in the brake linings, and cracks in the brake drums. Drivers should also check the push rods to see if the slack adjusters are in adjustment. All of this can be taught to a driver within a very short time.

Just like the tires, if drivers are finding potential brake problems before they become major problems, the maintenance task becomes much easier.

Clutch: A clutch can't last forever, but its life can be extended by good driving technique and a driver that knows when it needs to be adjusted. The skills most important to master in clutch operations are starting in

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the right gear, engaging the clutch properly, and recognizing clutch malfunctions and the need for re-adjustment. Riding and slipping the clutch, disengaging and engaging the clutch while coasting, and coasting with the clutch released and the transmission in gear will shorten clutch life.

The driver can also be helpful in diagnosing clutch problems. Clutch noise out-of-the-ordinary may mean that there is looseness or wear in the clutch or one of the associated parts (throw-out bearing, linkage, etc.). It could also be a sign of poor lubrication. Clutch slippage could be a sign of worn clutch facings or a lack of clutch pedal free play. Can you driver tell that the clutch is slipping and why? Clutch drag might be poor adjustment or something as serious as a warped drive disc. Help your drivers to be specific about complaints. When does the problem occur? Is it only present at certain speeds or in certain gears? Does the problem disappear when power is increased or decreased?

If the driver is trained on what to expect out of the clutch, how to treat it, and how to answer clutch-related questions, the driver can become an active member of the PM program with regards to the clutch. The clutch is a prime example of a component where the driver's knowledge can keep maintenance costs down by catching problems early.

Fuel economy: Many factors play a part in determining how economically a vehicle consumes fuel. The size of the engine, the transmission gearing, the differential gearing, the aerodynamics of the vehicle, the speed the vehicle operates at, the terrain the vehicle operates on, and the ambient temperature the vehicle must deal with are all examples of factors that will ultimately determine fuel mileage.

Fleets can take different approaches to a fuel-economy program. They may place their emphasis on equipment specifications or fuel quality. They may look toward routing efficiency and make an effort to maximize loads.

The driver is the end-user of fuel-efficient equipment, quality fuel, and a well-maintained vehicle, so whether these measures work depends on him. Convince the drivers that the easiest and cheapest way to save fuel is to slow down and adopt a less aggressive driving style. Other practices that should be encouraged by the fleet to improve fuel economy may be avoiding excessive shifting, high RPM driving, and idle time.

A curious thing bears mentioning here, drivers that driver have the habit of driving with fuel mileage as a goal (they try to practice smooth steady acceleration and deceleration, low RPM and progressive shifting, and keep idle time to a minimum) will operate the equipment in a manner that will reduce maintenance problems. This is because the same driving habits that increase fuel mileage reduce wear and tear on the vehicle. The less wear and tear the vehicle is undergoing, the more effective the PM program can be.

Finally, encourage drivers to keep the vehicle clean. Keeping the vehicle clean will make spotting minor mechanical problems easier.

Examples of various maintenance and inspection checklists are included at the end of this unit.

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Case study

What follows is a case study on how vehicle maintenance scheduling and practices (including recordkeeping and training) can all be combined to create a dangerous (in this case a fatal) situation.

The NTSB investigated a crash involving an air brake equipped dump truck that was unable to stop while descending a grade in Glen Rock, PA, striking four vehicles that were stopped at an intersection at the bottom of the grade. One of the four other vehicles also struck three pedestrians after being hit by the dump truck.

The brake failure was so complete that even after striking the vehicles the dump truck continued through a gas station, over a set of railroad tracks, coming to rest 300 feet past the intersection. The truck at this point was 407 feet from where it had first impacted another vehicle.

As a result of the accident the driver, owner, and a manager from the company involved were convicted of various criminal violations involving negligence.

The rear brakes on the dump truck were "Type 30" (30 square inches of diaphragm area) and the steer axle was equipped with "Type 16" brakes (16 square inches of diaphragm area). All brake units were equipped with automatic slack adjusters.

The post accident investigation determined that the larger rear brakes had not provided any braking force due to being severely out of adjustment. Because the larger rear brakes were not providing any brake force the smaller front brakes were trying to slow the vehicle and load (the vehicle was found to be overweight at the time of the accident). These brakes quickly overheated during the downhill braking. As a result of the overheating the front brakes "faded" and failed. At this point the vehicle had no braking power.

The fact that the rear brakes were out of adjustment was the cause of the accident, therefore the automatic slack adjusters caused the accident, right? Wrong! The brake units from the vehicle were tested by the NTSB after the accident. During the testing it was discovered that the clevises and pins that attached the brake chamber push rod to the slack adjuster were so badly worn that the automatic slack adjusters could not achieve correct adjustment. As part of the testing the clevises and pins were replaced and the automatic slack adjusters immediately brought the units into adjustment.

In short, the automatic slack adjusters had not failed. The other brake components on the truck were in such poor condition that the automatic slack adjusters could not function correctly.

The NTSB investigated the truck further and discovered that the truck had the automatic slack adjusters manually readjusted multiple times. The driver that had driven the truck the previous summer had been placed out of service due to the brakes being out of adjustment. To clear the out-of-service violation he manually readjusted the automatic slack adjusters. During that summer the driver stated he had manually readjusted the automatic slack adjusters "at least three or four more times."

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In January, during an annual inspection, the brakes were found to be out of adjustment again. At that time the mechanic performing the inspection readjusted the automatic slack adjusters.

In April, three days before the Glen Rock accident the truck had rolled into a car. According to the driver the brakes had not “held.” It is not known if the brakes were readjusted after the incident (there is no documentation of a repair).

To sum it up, the automatic slack adjusters on the truck had been adjusted at least five times, and possibly many more times in the previous 12 months. Due to the incomplete records, it is not known exactly how many times the brakes had been adjusted. Also, the company did not include brake components (other than checking adjustment) in their preventive maintenance.

Here is the key point. No one checked the actual brake components or investigated why the automatic slack adjusters required readjusting. The manufacturer’s material warns that readjusting the automatic slack adjusters is only intended to be a “temporary fix.” The underlying cause must be corrected or the out-of-adjustment situation will return.

How could this case have ended differently?

Better records. If the carrier had been keeping better records of repairs and maintenance, and was able to see that the brakes on the truck were continually being readjusted but no other repairs were being performed, it could have triggered a more complete check of the vehicle’s brakes.

More frequent maintenance. If the carrier would have been using a more aggressive maintenance schedule (seeing the truck more often than they were) the accident could have been avoided. The carrier was faulted for not having a regular inspection and maintenance program in this case.

Accident follow up. Had the carrier followed up after the accident three days prior when the brakes did not hold, the brake problems could have easily been detected. It is a policy at many companies that any vehicle involved in an accident must undergo a maintenance inspection ASAP. This is done to check for hidden damage and to locate vehicle problems that could lead to future accidents of the same type (as happened in this case).

More complete inspections. If the carrier had used a more complete inspection checklist and better procedures, the worn clevises and pins could have been located. Locating and replacing the worn clevises and pins would have brought the brakes back into complete operation.

Violation reporting. If the carrier would have had a policy that drivers must report all roadside violations to the maintenance department, who then verified that everything had been corrected, the maintenance department might have been able to locate the defective parts.

Driver and technician training. If the technicians involved had been better trained on the basics of air brakes, in particular the basics of automatic slack adjusters, they could have detected and corrected the problem with the pins and clevises well before any accidents occurred. If the driver had been correctly trained on vehicle inspections, the driver

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would have spotted the worn clevises and pins, or noticed poor brake performance, and reported the problem to the maintenance department for repair.

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Sample maintenance and inspection forms

INSIDE THE CAB

Cab

Although appearance counts a lot in publicizing your fleet's professional image, cleanliness is also the first maintenance rule for the cab. Corrosion can ruin a truck and the easiest way to fight this enemy is to keep trucks and trailers clean. Vehicles should be washed and waxed on a regular schedule to remove road dirt and salt that collects on metal surfaces and on exposed components. Accumulation of dirt not only adds weight to the vehicle, but it also increases aerodynamic drag. (A dirty vehicle doesn't do much for the company image, either.)

A drive-through washing system is adequate, but a high pressure wand-type system does a much better job of reaching undercarriage areas. The kind of washing equipment required depends on how many trucks you have and how often they are to be washed. There are many systems on the market today that use hot water, cold water, steam, or chemicals. In making a choice, you must consider water and energy costs as well as whether local regulations permit dumping wash-rack water into the sewer.

Do you have available personnel to do the washing? It takes a minimum of at least 30 minutes to wash a truck well. A wash should be the first step in a PM inspection; however, it is a good idea to inspect for vehicle leaks before the washing. Then check the area again afterward.

The inspection list should include watching for scratches on the exterior; immediate attention is required. The interior shouldn't be neglected. Drivers should be instructed to clean out the cab before they leave it after the run. (One fleet provides a vacuum cleaner for the interior and drivers are expected to use it at the terminal before they turn over the vehicle.) Interior cab cleanliness promotes respect for the driver and his or her workplace. The mechanic, too, should leave it spotless after the inspection.

Body exterior 

Clean vehicle

Check cab steps/mounting/tightness

Check grab handles/condition

Check door/door hinges/stops/locks/condition/operation

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		Notes
	Body interior 	
Check seat mounts/attachment/condition		
Check seats/condition/operation		
Check seat belts/condition/operation		
Check seat belt mounting bolts/condition (tightness)		
Check cab floor/doghouse/ashtray/glovebox/condition		
Check general interior/condition		
Check cab safety equipment/condition		
Fire extinguisher charge/seals/mounting		
Triangles/flares/condition/mounting		
Check windows/condition/operation		
Check mirrors/visibility/condition		
	Lube points/body  Lube door hinges/stops/latches  Lube seat rails  Lube windshield wiper shafts  Lube lock button/key holes  Lube striker plate/lock snubs  Lube steering U-joints (cab)  Lube pedals/pivot pins (brake/accelerator) 	
Check clutch free play		
Specification: 1-1/2" to 2" maximum; adjust any time free play falls below 3/4"		
Check pedal brackets/pads/condition		
	Lube clutch pedal linkage 	
Check ignition switch/push button/operation		
Check starter engagement/disengagement/operation		
Check warning indicator lights/instruments/switches/operation		
Oil pressure warning light		
Cooling system warning light		
Low air light/alarm		

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Oil pressure gauge
Ammeter/voltmeter
Temperature gauge
Fuel gauge
Transmission/differential temperature gauges
Pyrometer
Differential lock indicator
Directionals/indicators
Hazard warning
Low beam/high beam/high beam indicator
Air application pressure gauge

Check controls/switches/operation
Windshield wipers/washers/condition/operation
Horn (air and electric)
Air vent
Defroster
Temperature control
Heater

Engine tachometer
Engine hand throttle

Check shift lever/condition/operation

Brake system and compressor

Check compressor for normal buildup pressure in braking system
Test for air pressure drop/lb per minute:
Apply foot brake; continue to hold for one minute after pressure has stabilized
Check pressure drop (3 psi per minute; if tractor hooked to trailer, 4 psi)



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	Notes
Check low air pressure warning device  Test: Brake repeatedly to lower pressure; alarm should go on any time air falls below 60-70 psi Cut-out pressure: 100-120 psi Cut-in pressure: 20 psi less than cut-out pressure	
Check air compressor governor  Test: Run engine fast idle; continue air buildup until governor cuts out Gauge pressure: 105 psi to 125 psi	
Check air dryer operation: should cycle for 2 to 15 seconds every time compressor reaches cut-out pressure Check parking brake/operation (manual and automatic)	
Check tractor protection valve/operation (manual and automatic)	
Check treadle valve/operation Check hand brake/operation	
Check steering response  Test: Turn steering wheel in both directions from center and note looseness Specification: maximum amount of play 15° either side of center	
Check speedometer/operation  Check engine stop/operation Check emergency shutdown/operation	
AROUND THE VEHICLE	
Check cab/hood/condition 	
Check cab/hood locks/condition/operation Check mounting/condition	
Lube hood latches/hinges 	
Check windows/mirrors/condition (cracks, chips) 	

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Notes

Check external lights/condition/operation
Headlights/headlight aim/intensity (candlepower)
Turn signals
Brake lights
Backup lights
Marker/clearance lights

Check front bumper/condition (damage)
Check mounting/condition (damage)
Check body/fender/condition (damage)
Check mounting/condition
Check mud flaps/condition
Check mounting/condition
Check frame rails/crossmembers/condition (cracks)
Check mounting/condition (wear)
Check air deflectors/shields/side panels/condition (damage)
Check mountings/condition

Batteries

A thorough battery inspection includes visual and electrical checks. Battery connections and terminals should be cleaned; wiping off salt, dirt, and corrosion maintains the flow of power. A mild solution of baking soda and water is recommended; terminal brushes speed up the cleaning. Make sure that terminal connections are clean before installation. After connecting, coat the terminal with mineral grease or petroleum jelly. Vibration damage can be avoided by inspecting the holdowns; after battery replacement, be sure holdowns are properly torqued; overtightening these can crack the battery case.

Conventional antimony batteries require electrolyte checking; maintenance-free batteries are tested with a voltmeter. After charging, the battery ideally should be allowed to set for 5-7 days and then checked for terminal shorting. If it then reads less than the recommended minimum, it should not be used.

Shop Operations

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Batteries, Continued

If the battery was charged just before the testing, it may have developed a surface charge that can affect the reading; turn on the headlights for a minute; turn them off, wait 30 seconds and then test the battery.

If the load-testing option is used, be sure mechanics are familiar with the manufacturer's instructions, because models may differ.

All routine PM inspections should include the alternator and regulator to avoid overcharged or undercharged batteries. With everything in place, run engine at fast idle for ten minutes; check alternator and regulator outputs at this time.

Since stored batteries self-discharge, they should be checked every month or so, and recharged when capacity falls below 75%. Be sure "older" batteries are checked out of inventory first; watch the warranty period.

Clean batteries/box area

Check battery box mounting/latches/condition

Lube hinges

Check battery cover/mounting/condition

Check battery holddown/condition

Check battery terminals/cables/connections/condition

Check battery case/caps/condition (cracks, warping)

Check battery fluid level/specific gravity

Specifications: Water level should be at bottom of split ring; never add electrolyte to battery already in service — water only.

Hydrometer reading should be 1.260 at 80 °F for new batteries, 1.220-1.260 at 80 °F for used. No more than .050 points between high and low readings.

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Wheels/tires

Most wheel problems are caused by two conditions: overloading and improper maintenance. The "rules" for PM include keeping the wheels clean and tight, and making regular inspections to spot developing problems.

Encourage mechanics to inspect tires with an eye toward analyzing wear, i.e. what kind of wear indicates a balance problem? loose wheel bearings? Check for feather edges on tires resulting from incorrect toe-in or excess wear on the outside tread face which can point to a camber problem. Good tire inspection training for drivers and mechanics pays off in longer tire life.

Set a standard tread depth for removal and rotation of steer, drive, and dead axle tires, depending on type of tire and fleet operations. If you use tire pressure decals, be sure that the inspecting mechanic checks that they're present and current.

Check tires/wheels

Check rims/rings/flanges/studs/nuts/condition (rust streaks, disc)

Check wheel nuts/torque

Check tires/condition (tears, cuts, bulges, depressions, cracks, separations)

Check size/matching

Specification: 1/4" difference/duals

Check wear pattern/front/rear and record:

Check axle flange nuts/condition

Check valve caps/condition (bent, leaks, missing)

Check tread and record:

Check pressure and record:

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Notes

Fifth-wheel assembly

Decide on an interval for fifth-wheel inspections and adjustments—every 30,000 miles or three months, advises one manufacturer. Steam-clean first for a better inspection. Be sure mechanics know correct lubrication procedures and that they clean off all the old grease before applying new. Lubrication should be done at least once a week.

If your fleet includes sliding fifth wheel and trailer tandems, be sure drivers are aware of the dangers of indiscriminate use. While sliders are a perfectly legal means of changing weight distribution without going in and reloading the cargo, drivers have been known to move them in order to get a better ride and to make steering easier (the weight is taken off the steering axle). The risk lies in overloading the rear drive axle of the tandem, especially if the unit is equipped with a four-spring suspension system (other suspension systems do a better job of equalizing the load on the tandem). The consequences of overloading are premature tire wear, and more importantly, shorter brake lining life and loss of brake balance.

Clean fifth wheel



Check mounting bolts/condition (cracks, wear)

Check slider rails/condition (cracks)

Check mounting/condition

Check bushings/pins/condition

Check release mechanism/condition pivot points/wear; bent/operation

Check jaws/condition/operation ("C" or when necessary)

Adjust jaws

Check automatic slider mechanism/condition/operation

Lube fifth wheel plate

Lube pickup ramps, pivot pins, jaws



Check fuel tank/condition



Check mounting/condition

Check fuel crossover lines/shutoff valves/condition/operation

Drain air tanks/check for water/oil

Check automatic drains on tanks/condition/operation



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Shop Operations

UNDER THE VEHICLE

The braking system

Like many PM goals, extending brake component life is a shared responsibility between driver and mechanic. The supervisor also does his part by making sure that the component specs in the braking system are compatible: air chamber size, slack adjuster length or wedge angle, push-rod stroke, lining friction, rolling radius and drum type, weight and size should be identical across the braking system of each axle. Once the maintenance department provides the identical components and a secure air-line system, it's the driver's job to daily check the condition of the brakes and air lines, and balance across the system, including trailer. (Straight trucks are not as likely to have balance problems.)

Does your fleet have a procedure policy for checking brakes during the pre-trip inspection? Have drivers been instructed to drain air tanks on tractor and trailer daily to release moisture? Do they regularly examine the air lines for cracks, loose rubber, or worn parts? Have they been trained to make manual brake adjustments on tractor and trailer? Do they check trailer brake operation as part of the pre-trip inspection?

A brake has no governor or limiting device, so it will work as hard as the driver pushes it. Are drivers aware of how important good braking technique is in extending brake system life? The defensive driver plans his stops and applies the brakes gradually, coming to a safe stop. The cowboy jumps on the brakes at the last moment, pouring heat into the drum faster than it can be transferred out into the air. The heat on the drum surface will eventually cause drum cracks and failure. Drivers can check brake temperatures by feeling the drums at rest stops. (Temperatures that vary are an indication of brake imbalance.) Training a driver to carry and use a hand pyrometer to check temperature is a good idea. Drivers also need to know that brakes really don't cool all that quickly. Gearing down on hills instead of using intermittent braking to slow down the vehicle spares the service brakes.

Brake PM includes scheduled cleaning, adjusting, relining, drum reconditioning, and lubrication. And accurate recordkeeping. Any defective parts should be replaced during a PM brake inspection. You should treat each axle as a unit and make the same repairs on both brakes. Slack adjusters should also be replaced in pairs. And don't just reline; do a complete overhaul at that time.

Check air lines/condition

Check mounting/condition (tightness)



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Check relays/quick release/control valving/condition/operation
 Check mounting/condition
 Check air tanks/condition
 Check mounting/condition
 Check emergency braking system/operation
 Check parking brake system/operation

Check brake assemblies



Lining wear/thickness

Record:

Drum condition (scoring, heat cracks, cracks)

Backing plates/mounting/condition

Wheel seals/leaks

Pull drums/calipers for complete brake inspection/wheel bearing inspection/seal replacement



Cam brakes



Check push rod angle measurement

Maximum 90° at 100 psi

Check brake chamber/mounting/condition/operation

Check clevis pin/condition

Check push rod alignment

Check slack adjuster/condition/operation

Check push rod travel

Maximum 1½" at 100 psi

Check cam shaft/bushings/condition/operation

Check mounting brackets/condition

Lube camshaft bearings

Lube slack adjusters



Adjust brakes (slack adjusters) (NOTE: Always adjust brakes when vehicle is cold.)

Wedge brakes



Check brake chamber/condition/operation

Check mounting/condition

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		Notes
Adjust brakes (star wheels)		
Disc brakes		
Check pads/condition (wear)		
Check rotors/condition (cracks, warping)		
Check floating caliper/operation (seizure)		
Check actuating arm/condition		
Check operation (angle)		
Lube wear points		
Adjust brakes (actuating arm)		
Hydraulic braking system		
Check master cylinder fluid level		
Check brake lines/connections/condition/routing		
Check backing plates/leaks		
Check hydrovac/condition (lines)/operation		
Adjust brakes		
Pull wheels/check foundation brakes/condition (leaks)/operation		
Driveline Axle alignment is essential for good tire wear. Whenever alignment is conducted, align the drive axles as well as the front. Worn torque arm bushings can lead to drive axle misalignment; check these before trying to align the axles, and retorque all U-bolts and fasteners according to suspension manufacturers' recommendations. Lubrication is the critical PM procedure for driveline maintenance. The first oil change for new or reconditioned axle carriers should be at 1,000 miles; change filter too, if equipped. Drain oil when warm. Change axle oil (and filters) regularly — 25,000 to 30,000 miles. Axle manufacturers' instructions for type of oil, capacity, and fill procedures should be followed to the letter. They can differ. A low level may point to leaks, caused by worn or damaged seals or simply improper filling. Damage can occur during seal installation; if it's not straight in the bore, it will leak. If the bore is scratched, it will leak from the outside. Purchasing a seal driver set for this purpose discourages using the wrong tools during installation (i.e. hammer), which can ruin a new seal.		

Vehicle Maintenance Pro

Notes

Driveline, Continued

Insufficient lube, the wrong type of lube, contaminated lube, or lube with worn out additives can cause lube failure, resulting in burned lube and parts. The increased wear leads to contaminated gear oil which causes bearing failure. Dirt and moisture can enter through the breather. A magnetic drain plug capable of lifting two pounds of steel can slow down wear and is worth specifying; in fact, use them in any drain, fill, or level hole. Consider using oil analysis to help establish good change intervals. Installing axle temperature gauges is also a good idea. (Some axles have a small, tapped, plugged hole near or under the oil level hole. This is for the oil temperature sender, not to be confused with the oil level plug.)

Vibration, noise, and looseness are early signs of U-joint problems. Mechanics should look for discoloration on bearing surfaces, leaking seals, and end-play across the bearings. Lubrication intervals for U-joints and slip splines vary according to the operating environment of the truck (6000 - 8000 miles or 150 - 200 hours; 2000 - 3000 miles or 50 - 75 hours for heavy operations). When lubricating a U-joint, all four bearing seals should be flushed to get rid of abrasives (examine the purged grease to see if it's rusty or gritty) and to make sure that the bearings are completely filled.

Differentials

Check differential housing/condition
Check mounting/condition (cracks, loose bolts)
Check differential vent (should spin free)

Check differential fluid level
Check pinion/wheel seals/leaks
Check axle shift devices/condition/operation

Check mounting/condition
Change differential fluid/filters

Check propeller shaft/condition (in phase, warp, damage)
Check (shake) each U-joint/condition (wear, rusty spots, looseness)
Lube U-joints (make sure all U-joint seals pop)
Check bearing lock bolts/condition (tightness, rusty spots)
Check yokes/condition (looseness)
Check slip joint spline/condition (wear)

Lube slip joint spline



Shop Operations

After greasing slip joints in winter, operate vehicle before parking outside
(damage to slip joint can result)

Check pinion bearing/condition (looseness)
Check carrier bearings/condition
Check mounting/condition



Check axle lubricant level
Check axle breather vent
Check 2-speed axle shift oil level
Clean magnetic drain plugs
Change axle oil filter
Check wheel bearings
Repair, adjust



Suspension

Suspension parts need periodic adjustment and lubrication. U-bolts should always be clamped to manufacturers' specs. For springs with eyes, make sure the pins are lubricated. (Failure to do so can lead to seizing, then breaking, thus impairing axle alignment.)

Inspection for cracks should be done regularly; cracks usually appear just outside the U-bolts that clamp the spring to the axle. The main leaf, usually the longest, is generally the first to go. There are some guidelines for spring rebuild vs. replacement.

If breakage occurred between the U-bolts, it was probably caused by the loose U-bolts and the spring can possibly be rebuilt. If breakage occurred between a U-bolt and the end of the spring, it was probably caused by fatigue and the spring should probably be replaced. Replace medium-duty multileaf and heavy-duty long taper front springs; rear springs are often rebuilt. Three-leaf trailer springs are commonly replaced and all broken single-leaf trailer springs are usually replaced. A spring rebuilt once should not be rebuilt again. If a spring breaks and the suspension is nearing the end of a normal service life, replace all the springs to avoid downtime later. Know what kind of service life to expect from springs installed on your trucks.

Notes

Vehicle Maintenance Pro

Notes

Rear suspensions

Check rear springs/condition (wear, cracks, broken leaves)



Check U-bolts/condition (looseness)

Check spring shackles/hangers/condition

Check pins

Check bushings

Check center pins

Check torque rods/bushings/condition

Check equalizers/bushings/condition

Check stabilizers/condition

Check shock absorbers/condition

Lube all points



Trucks with Kenworth torsion bar suspension must be greased off the ground

Check air ride suspension/operation



Check air lines (condition)

Check bolts, U-bolts/condition (looseness)

Perform axle alignment



Transmission

Drivers should monitor changes in transmission operation, such as noise, jumping out of gear, sticking, hard shifting and watch closely for any sign of leaks. Correct operation is essential to long transmission life.

Lubrication is the primary concern of PM; transmission lubricant must be kept at the proper level (overfilling must be avoided); types and brands of oil shouldn't be combined. Operating temperatures can affect certain oils, so external coolers or more frequent oil changes should be used when the truck:

- operates consistently at lower speeds on grades;
- operates in high ambient temperatures;
- has the transmission located too close to the exhaust system or with restricted air flow around it.

Shop Operations

Notes

Transmission, Continued

Magnetic devices or drain plugs help keep lubricant free from metal debris (mechanics should take care when removing them because the oil is hot at that time). Analysis of the particles found on magnetic drain plugs can be useful in monitoring component wear.

Check transmission shift mechanism/operation



Check bushings/linkage/U-joints

Check mounting bolts/condition (tightness)

Lube points



Check transmission mounts/bolts/condition (cracks, looseness)



Check breather/condition (open)

Check air controls/leaks/condition/operation

Check seal/leaks

Check PTO linkage/condition/operation

Check shaft/condition

Check U-joints/wear

Check for leaks

Lube points



Check transmission fluid

Change transmission fluid/filters/air filter

Check transmission air pressure



Automatic transmissions

Check fluid level/fluid condition (burnt) Check warm

Check cooler/leaks/condition (plugged)

Change transmission filter and fluid



Clutch

Drivers should report changes in clutch operation immediately so that mechanics can make the necessary inspection, adjustments, and lubrication. Drivers should also be aware that type of clutch facing makes in difference in operation; a ceramic-type clutch has a shorter slip period and engages more firmly than the organic-type facings. They should also check the amount of travel in the pedal on a daily basis because this is a key to the condition of the clutch and release mechanism. High-temperature lubricants, not a chassis lubricant, should always be used with the clutch.

Vehicle Maintenance Pro

Notes

Check clutch operation



Adjust as necessary

Check clutch brake/condition/operation/adjust

Check clutch linkage/condition

Lube clutch pedal shaft and linkage (pivot points, cross-shaft bushings)



Check linkage/condition (wear)

Check relays/ball joints/condition

Check cross-shaft/bushings/condition

Check return spring tension/cables/condition

Check forks/clevis pins/condition

Check release bearing/condition (wear)

Specifications: Free play 1½" to 2"

Cross-shaft to release bearing 1/8"

Release bearing to clutch brake ½"

Lube clutch release bearing (sparingly)



Front Suspension

Check front springs/condition (wear, cracks, broken leaves)

Check U-bolts/condition (tightness)

Check center bolts

Check spring hangers

Check shackles/kingpins

Check bushings

Check shock absorbers

Lube all points



The steering system

The steering system starts at the steering wheel and ends with the wheels on the road. Your steering maintenance problems are probably at either end of the system, too. Your ally in correcting steering problems is the driver at the wheel. One steering system manufacturer estimates that 99% of driver steering complaints are legitimate and deserve to be checked out immediately. Is there a communication problem

The steering system, Continued

sometimes on the DVIR? Because a driver is often less than specific about a steering problem, Air-O-Matic Power Steering Company has published a pamphlet that defines some terms that a driver can use to describe symptoms correctly:

Hard steering	Excessive effort required to turn steering wheel;
Darting	Sudden change in direction without obvious cause;
Oversteering	Turning farther than desired;
Wandering	Random straying from a straight course;
Free play	Movement of steering wheel without resistance;
Wheel recovery	Normal tendency of front wheels to straighten out after a turn;
Leading	Constant veering in the same direction;
Shimmy	Abnormal vibration felt in the front wheels;
Knotty feel	Uneven resistance to turning of steering wheel.

At the other end of the system are the wheels and tires. Alignment is crucial to correct steering — and especially good tire life—so it should be checked often.

Drivers and mechanics should know how to “read” tire wear patterns as clues to alignment problems. And alignment specs must be maintained; changing the toe specs to correct wander is not a solution. (Although giving more steering stability, it increases tire wear.) PM should include checking alignment specs (especially toe, which decreases normally as parts wear) as often as 3-4 months for a linehaul unit and every time steer axle tires are replaced.

PM for the linkages between “wheels” amounts to lots of lubrication and periodic adjustments. PM inspections should check for wear in ball joints, tie-rod ends, and drag link ends, although by that time you will probably have heard from the driver. Steering system experts recommend checking steer axle specs (watch for overloading), lubricating U-joints more often if they are particularly accessible to road spray, and greasing kingpins twice—with vehicle jacked up and on the floor.

Check for condition (looseness and wear):

- Tie-rods/ball joints
- Drag link/ball joints
- Link rod ends/ball joints
- Pitman arm
- Steering shaft U-joints/pinch bolts (proper torque: 40-45 lb/ft)
- Steering shaft slip joints



Vehicle Maintenance Pro

Notes

Steering column/bushings
Steering arms
Ball joints

Lube points 

Check steering gear box/mounting bolts/condition

Check area for leaks/seals/connections



Check hoses/condition

Check for excessive tire wear

Check steering response



Lift front axle off ground, rest on jack stands for the following checks.

Kingpins and bushings maximum .065 end play with dial indicator or $\frac{1}{2}^\circ$ with camber gauge

Wheel bearings/looseness

Wheel run-out ($\frac{1}{8}$ " maximum)

Check power steering pump/fluid level/condition/leaks



Check power assist ram/condition/operation

Check mounting/condition



Check front alignment

Specifications: toe-in $0-\frac{1}{4}$ "; preferably $\frac{1}{8}$ "



Lube all points 

Check wheel bearings/clean/repack/adjust

Check hub oil levels



Tag axles



Check axle mounting/condition/operation

Check brake assembly/condition/operation

Check axle control mechanism/condition/operation

Check hub oil level



Engine

The engine manufacturer is the best source for maintenance information and intervals. Regular diagnostic tests of the different engine components should be scheduled at PM service intervals. A daily check of the engine by the driver for loose or worn parts pays off in prevention of premature engine failure. Such a check includes:

- checking for excessive use or leak of oil/air/water/fuel;
- checking the cooling system for coolant level, cleanliness of radiator core, and radiator cap seal condition and tightness;
- listening to the engine for any unusual noise;
- checking the fuel pressure gauge with the engine running;
- checking air cleaner indicator with engine running;
- spending a few minutes cleaning the engine compartment to make inspection easier and to improve appearance.

Engine lubricating system

Oil changes are basic to PM (most camshaft and crankshaft failures can be traced to some kind of oil problems). Be sure that drivers are trained to check oil level daily and in the proper manner. Only good grade oil of the proper viscosity should be used. Timing of changes can be scheduled according to mileage, hours of engine use, months of service, or even on gallons of fuel used. The longest but still safest oil change interval occurs just before contamination. Oil analysis can help to determine that point by monitoring how much contamination is present in the oil, i.e. how well it is holding up. Oil analysis can test for:

- viscosity; if it increases too much, the oil is oxidized and must be changed. Too-thin oil points to fuel dilution, which is usually caused by a mechanical problem or excessive idling.
- water; most water from the combustion gases go out in the exhaust, but some gets into the oil. Too much can mean a leak in the coolant system, poor combustion, etc.
- antifreeze; if present, the oil must be changed immediately and tested again. If the presence continues, there's bigger trouble (probably blown head gaskets).
- solids; fuel soot, carbon, etc. are normal products of engine operation, but if solids show up consistently in your oil analysis, the oil-change interval should be decreased.
- metals; normal engine wear results in metal particles wearing away; oil keeps these particles in suspension until they can be removed by an oil filter. But identification of the particles can also give clues as to

Notes

Engine lubricating system, Continued

where the wear is taking place; i.e. iron wear from cylinders, pistons, valve train, and crank; copper-wear from piston bushings, etc.

- silica; dirt may be entering the air intake system, so checking hoses, seals, and filters would be in order.

Laboratories differ as to the detail of analysis offered; a variety of do-it-yourself kits are also coming on the market. Using manufacturer's data to establish oil and filter changes and then waiting until oil analysis indicates a change can help determine an interval that's right for your vehicle. In fact, oil analysis is particularly critical for the small fleet; a single vehicle downtime can represent a greater percentage of loss of business.

A good PM inspection and service program can be even more helpful if combined with oil analysis. (Fuel, lubricant, etc. analyses are also available.) Such substance reports help you in making decisions about component replacement or engine overhaul, for example.

Some fleets use oil analysis to eliminate the "A" service and instead perform a more thorough "B." The oil change interval can be extended because changes in the oil (solids accumulation, coolant leaks, percentage of water present, etc.) are immediately revealed. And the hour spent on the oil and filter changes can be used in other ways, say the maintenance people. Check out the manufacturers; they may offer free analysis if you use their products.

Change engine oil and filters

Check oil lines/condition (tightness)

Check area for oil leaks

Check oil level/condition



The fuel system

Some fleets swear by fuel analysis to ensure that no contaminants are present in the fuel supply. Samples are taken from the bottom of storage tanks and tested for water, sediment, and microbial contamination. Testing of storage tanks for signs of leaks and ground seepage and inspection of storage tank pump filters help keep fuel pure. Some fleets also take samples from each fuel delivery (from the first two minutes of pouring). The filler neck area and delivery truck's hose should be clean. In short, all fuel-related hardware should be kept clean and in good condition.

Shop Operations

Notes

The fuel system, Continued

Fuel filters. Gasoline is a clean fuel and easier to filter than diesel, so unless the gas picks up water from a storage tank, the filter handling the fuel can go a long time without a change. Diesel, on the other hand, absorbs water easily and contains certain chemical constituents which tend to precipitate out of the fuel at different temperatures. Since water is particularly harmful, a fuel/water separator can keep fuel "clean."

A change interval for fuel filters is more difficult to determine. Engine manufacturers' recommendations are naturally to be observed; gauges can indicate a time for change as can fleet experience. Fuel additives can be very helpful especially in warm or humid climates. Fuel pumps should be tested for delivery rates, vacuum pressure, and volume. To help eliminate pump and injection problems, keep injectors adjusted (every 50,000 miles) and filter fuel well. And all hoses, lines, and connections should be regularly inspected for leaks.

Change fuel filters

Drain fuel/water separator (especially during winter)

Check fuel lines/condition (tightness, cracks, leaks, routing)

Check fuel heater/operation



The air-intake system

Unlike oil and fuel filters, air filters suffer from over-servicing; in a sense, they work better with age. They are changed when the level of air restriction has caused an increase in fuel consumption to the point where the cost of a new element is offset by improvement in fuel economy. So the restriction gauge plus the fleet's fuel and mileage records give clues to the change interval. The filter element should be inspected at every oil change and replaced at 50,000 to 70,000 miles. (Filter life is probably 100,000 miles, but at this point there's a sufficient decline in fuel economy to merit the new filter investment.)

Check air cleaner restriction gauge

Check element (if no restriction gauge present)



Vehicle Maintenance Pro

Notes

Check air cleaner/housing/condition
 Check gaskets/seals
 Check housing mounting/seal/bolts
 Check connecting hoses/seals/condition
 Check air intake pipes/condition
 Check dust collector valve
 Check air compressor/lines/hoses/condition



Change oil in oil bath cleaner



Check turbocharger compressor/lines/drains/seals
 Check blower/condition
 Check drains/lines/drives/seals



Exhaust system

Check exhaust piping/condition (tightness)
 Check exhaust pipe mounting/condition
 Check insulation protection/condition
 Check pyrometer condition/operation
 Check mounting/condition
 Check exhaust system/leaks/carbon deposits
 Check muffler/condition
 Check mounting/condition



The engine cooling system

Cooling system maintenance prevents premature engine wear by removing tremendous amounts of engine heat. The principal parts of the system include the coolant hoses, the drive belts, the thermostat, the water pump, the radiator, the engine water jacket and cooling passages, and the liquid coolant. Each of these items deserves a word.

The engine cooling system, Continued

Hoses: PM is the best way to avoid hose breakdown; all coolant hoses should be replaced during a major overhaul. Their condition must be checked regularly. Train drivers to watch for following conditions during inspection.

Tears or splits in hoses result from internal or external hose failure caused either by deterioration of the coolant (anti-freeze), or by too much fluid pressure.

Soft hose with swelling happens when the interior fabric reinforcement starts to separate and the outside rubber material stretches and eventually ruptures.

Hardened hose comes from heat—either from hot summer weather or, more likely, from excessive engine heat. The hose becomes brittle and breaks as a result of vibration.

Soft, spongy hose has been exposed to leaking engine oil or power-steering fluid.

Drive belts: Failure to maintain proper belt tension (too low, too tight) is the major service problem with belts (as is failure to include a readjustment after a new installation). Mismatched belts in multiple belt drive sets can cause problems; matched sets should be replaced that way. Check manufacturer's specs to be sure that a new belt is the right type; improper installation procedures can also shorten belt life. Many fleets replace belts every 100,000 miles regardless of condition.

High temperatures inside smaller engine compartments can still lead to hard and cracked belts, despite new rubber compounds. And if a belt becomes soaked with oil or fuel, it cannot grip the pulley correctly. Contamination of the belt by coolant solutions will also make it slip.

Thermostat: Industry experts remind us that a thermostat is not designed to control the maximum engine temperature; rather, it controls the minimum temperature so that the engine doesn't run too cool (leading to poor engine performance and lube oil contamination). So when a thermostat fails, the engine may already have experienced overheating.

Thermostats can be checked by submerging in water, gradually heating the water, and checking when the thermostat opens. Normal life is about two years for medium-duty vehicles and one to two years or about 200,000 miles for heavy-duty trucks; however, particles circulating in the coolant system can affect this life. Why take a chance. If the driver or mechanic suspects that an engine is running too hot or too cold and that the thermostat is not operating correctly, replace it to be sure.

Water pump: You can usually spot a leaking water pump seal. However, sometimes a pump seal will leak air into the coolant, which can reduce cooling capacity, promote oxidation, and lead to pitting of the cylinders. Checking for air bubbles rising to the surface of the coolant in the top of

Vehicle Maintenance Pro

Notes

The engine cooling system, Continued

the radiator when the engine is running is the first step. If the bubbles stop when the fan belt is removed and the engine operated for a minute (the water pump is stopped), that's a good clue to water-pump air leak.

Radiator: Good air flow through the radiator is essential to proper cooling, so thorough inspection of the fins is essential. Bent or damaged fins should be straightened for maximum air flow. Drivers should assist in this task, especially in summer when more insects are trapped in the radiator. Cooling systems must be air-tight as well as fluid-tight at all times, so piping and caps must be secure and tight. Pressure-testing the system checks for leaks.

Water jacket/passages: Rust or scale can be deposited on the walls of the engine jacket, the cylinder head cooling passages, and the radiator core. It can be seen by looking inside the radiator cap or into the water jacket (when the thermostat housing or water pump is removed). Cleaning products can be added to the coolant (not all antifreeze products contain a conditioner to prevent corrosion and pitting), or a filter can be used.

The coolant: Chemical analysis of coolant samples can help identify cooling-system problems just like oil analysis shows internal engine wear. The programs offered vary from routine PM to failure analysis of the cooling system.

Use of permanent type anti-freeze for too long a period of time can result in a high acid content in the coolant or rust formation because the coolant additives are finally depleted. Anti-freeze called "permanent" should not be used indefinitely; its life is only one full winter unless new protective additives or a chemically treated water filter is used (the chemical is slowly released as the coolant passes through the filter).

Check radiator mounting/bolts/condition (tightness)



Check radiator exterior/condition

Check radiator shutter/operation



Check coolant level

Check coolant protection level/condition (corrosion)/use analysis



Pressure-test coolant system

Check lines/clamps/condition (tightness)

Check radiator cap pop-off pressure

Check fan shroud/condition

Check bolts/condition (tightness)

Check fan clutch/condition/operation



Check hoses/leaks/mounting/condition

Lube idler pulley/water pump



Shop Operations

		Notes
Check all drive belts/condition/tension	☐	
Check spring for automatic belt tensioner/condition/operation	☐	
Check alternator/mounting/condition	☐	
Check alternator bracket		
Check mounting bolts/condition (tightness)		
Check wiring/condition		
Check wiring mounting/condition		
Check output. Record:		
Check starter/mounting/condition	☐	
Check cable/condition (tightness)		
Check mounting/condition		
Check engine throttle linkage/controls	☐	
Check relays/ball joints/condition (wear)		
Check return springs/condition		
Check throttle lever/travel		
Lube pivot points	☐	
Check governor housing/seals (leaks)/condition	☐	
Check fuel pump/seals (leaks)/condition		
Check engine stops/condition/operation		
Check air lines/condition/leaks		
Check mounting/condition/routing		
Check engine mounts/condition (tightness)	☐	
Check valve cover/condition (tightness)		
Check oil pan/bolts/condition (tightness)		
Check oil seals/leaks		

Gasoline engines

Diesel engines are moving into applications that have typically been gas-powered in the past. However the gasoline engine is still around; it, too, must be spec'ed and maintained.

Among the new spec'ing options are fuel injection, turbocharging, and electronic ignition, of which the latter is a very popular choice today. Spec'ing this system does away with the normal 15,000-mile tune-up replacement of points, spark plugs, etc.

Vehicle Maintenance Pro

Notes

Gasoline engines, Continued

Maintenance, specifically PM, revolves around oil changes and tune-ups. The most common tune-up interval is still 10,000 to 15,000 miles, although some maintenance supervisors claim to be able to extend that time to 20,000 miles. Check manufacturers' recommendation for proper mileage and time intervals. The carburetor and electrical system pose the greatest maintenance problems. And the exhaust system continues to give trouble to managers who wrestle with balancing emissions control requirements with engine performance.

Visual inspection

Check engine operation (noises, missing, vibration, hesitation, rough or erratic idle)

Test cylinder balance

Adjust tappets; check cam lobes and bearing surfaces/condition

Emissions control system

Check exhaust control valve

Check exhaust gas recirculation valve

Check crankcase emission system/condition

Check/clean/hoses

Check PCV valve/condition

Ignition

Check spark plugs/condition

Check wiring (primary and secondary)/condition (cracks, worn insulation, high resistance)

Check coil/condition

Check distributor cap/condition (cracks, corrosion)

Check rotor/condition (cracks, corrosion, high resistance)

Check distributor/condition/operation (advance mechanisms)

Check timing

Standard ignition

Check dwell setting

Check cam lobes/condition (wear)

Lube

Check breaker plate/condition/operation

Carburetion

Check choke/operation

Check idle speed/mixture/adjust

Shop Operations

Notes

Check governor seals/operation

Record engine rpm:

Check governor lines/linkage/condition

Cranking/charging system

Check starter/condition/operation/starter draw

Check alternator output

Check voltage regulator

Load-test battery/check fluid level

TRAILER

Trailer

Trailers are usually seen less often by the shop, but they should have their own PM inspection and service schedule. The frequency depends on the type of trailer and where they operate. Manufacturer's recommendations are the first source of information, supplemented by your own records. Like the tractor, the trailer is subject to inspection and maintenance regulations, so your trailer records provide documentation and an equipment history.

Fleets differ as to the PM inspection interval. One fleet tried inspecting every 30 days, but found that some trailers were being serviced too often. A 10,000-mile interval works best for them. Another example is based on operating a trailer for 30,000 miles per year: a PM appointment every two or three months works well.

Chassis lubrication, a very important part of trailer PM, varies too. One fleet lubes before every trip; another at 5,000-mile intervals. You will have to determine the schedule that is best for your equipment. Lubrication, axle fluid level, and brake adjustment are items that require particular attention — even between normal inspection intervals. Prior to the PM inspection, the trailer should be cleaned, including undercarriage and suspension.

Body/Exterior

Check surface/roof/condition (damage, dents, scratches)/loose rivets

Check mud flaps/mounting/condition

Check doors/sills/condition/operation

Check latches/hinges/seals/condition

Lube hinges/side rollers

Check door holdback hooks/condition

Check overhead door/condition

Check cables/condition

Vehicle Maintenance Pro

Notes

Body/Interior

Check surface/scuff plates/cracks/condition

Check/loose rivets

Check for holes in interior and around doors with doors closed

Body, dump

Check cab shield/wear bars/side boards/ extensions/bottom and side panels

Check tailgate lock/pins/condition/operation

Check tailgate/chains/condition

Check hoist packing/lines/leaks

Check hinge pins/lube

Body, tank

Check outer shell/damage/leaks

Check discharge line/piping/valves/overflow drains/condition

Check manifolds/vents/condition

Check pressure relief valves/condition/operation

Check master safety shut down/operation

Check cover gaskets/condition

Check locks/operation

Check pumps/hoses/condition

Check ladders/condition

Suspension/springs

Drivers should watch for any conditions that would cause axle to shift, i.e. broken spring leaves, loose U-bolts. Uneven wear on spring pads can point to twisted springs or hangers. Springs should be centered in hangers and have space to move in. Equalizers should be checked for obstruction; rocker beam should be checked for clearance between beam hub and spring ends.

Check spring hangers/wear

Check springs/condition

Check leaves/condition

Check center bolts/tightness

Check hangers/pads/condition

Check equalizers/condition

Shop Operations

Check bushings/condition
Check torque arms/tightness
Check U-bolts/tightness
Check air suspension/bolts/tightness

Axle/alignment

Axle alignment is one of the most critical adjustments made on a trailer and it should be checked at least once a year and any time a problem arises. When abnormal tire wear is observed or an axle or suspension component is replaced or modified, the alignment must also be checked. Drivers should be sensitive to trailer action and report any abnormal movement, i.e. dog tracking.

Ensure that axle lubrication is maintained by checking wheels, hubcaps, and axles regularly for oil leaks. Regular PM also includes greasing the axle camshaft.

Check axle/condition
Check axle fluid level
Check axle/alignment/front axle/kingpin
Check axle/alignment/rear axle (tandem) to front axle
Record measurement:
Check sliding tandem mechanism/condition

Wheels/tires

Rims and wheels should be inspected for cracks, damage, or rust streaks around fasteners. Any rust around lugs indicate improper torque, worn bolt holes, or damaged studs. Watch for corrosion buildup on wheels, cracks, bent flanges, damaged or missing parts.

Check tires/wear
Measure/record tread:
Check dual mating
Check air pressure
Record:

Notes

Vehicle Maintenance Pro

Notes

Check valve caps
Check wheels/cracks/condition
Check wheel seals/leaks
Check nuts/tightness
Check hubodometer/operation

Brakes

Brake balance between tractor and trailer is a problem for all fleets today; it's minimized a bit if "foreign" trailers aren't run with your fleet's tractors and you thus have control over both parts of the unit.

A trailer PM shop inspection or service always includes a brake inspection and adjustment. Do you change brakes by mileage? Although brake lining should never be less than 1/4" thickness, some fleets change linings when 3/8" is reached. And usually shoes on all four brakes are changed at the same time (at a minimum, both brakes on the axle).

Trailer air tanks should be drained daily to remove water and other contaminants. The driver should always check gladhands to make sure that the seal, housing, and air lines are in good condition.

Drain air tanks
Check air lines/condition (leaks, kinks, routing)
Check gladhand seals
Check spring emergency brake/operation
Measure brake lining
Record:
Check brake drums/condition (ridges, cracks)
Check position of brake shoe roller on cam shaft (S-cams)/lube cams/rollers
Check brake linkage/shoes/condition
Check bushings/slack adjusters
Check self-adjusting brakes
Check chamber push rod travel/adjust
Check torque arms/condition (wear)
Check electrical/skid control/operation
Check secondary/parking brake system/operation

Lube every 6000-8000 miles

Shop Operations

	Notes
Check frame/undercarriage	
Check upper fifth wheel plate/kingpin/locking surface/ wear/cracks	
Check bolts/tightness	
Check frame rails/crossmembers/condition	
Check bumpers/spare tire carrier/condition	
Check landing gear/condition/lube	
Lighting	
Check lights/reflectors/condition	
Check wiring/connections/condition/clearance	
Check trailer socket/pins/wear/corrosion	
REFRIGERATION UNIT	
Drivers should conduct a pre-trip inspection on the refrigeration unit before unit startup:	
● drain water from bottom of fuel tank; ● check fuel supply; ● check engine oil level; ● check engine coolant level/anti-freeze protection; ● check that battery terminals are clean; ● check battery fluid level; ● check belts/condition/adjustment; ● check condenser fan/condition; ● check evaporator fan/condition; - check all bearings/fan drive; ● check for any leaks, broken parts, etc. The exhaust rain cap should operate freely. All condenser and evaporator coils should be clean; the damper in the evaporator outlet must move freely. ● check that doors are firmly latched.	
After unit startup:	
● check engine oil pressure;	
Record:	
● check ammeter charging rate; ● check compressor oil level;	

Vehicle Maintenance Pro

Notes

- check lines/filters/leaks;
- check hoses/leaks;
- check condenser/evaporator fan/operation;
- check thermostat to see if the cycle sequence is functioning properly;
- check ducts/drains;
- precool/defrost as indicated.

An on-the-road checklist includes:

- check engine water temperature gauge;
- check refrigerant level;
- check thermometer calibration;
- check manual defrost/operation/light/defrost termination thermostat.

A PM inspection/service checklist should be developed for refrigeration units whether they are serviced in the shop or sent out for repair. Look to manufacturer's recommendations for guidelines.

Shop Operations

Notes

TANKER TEST AND INSPECTION REPORT

Information as required by Sec. 180.407(h)(4), and 180.417(b) & (c) of the D.O.T. Hazardous Materials Regulations

INSPECTION TEST DATE				REPORT NUMBER	
OWNER				CARRIER (if other than owner)	
PRINCIPAL PLACE OF BUSINESS ADDRESS				PRINCIPAL PLACE OF BUSINESS ADDRESS	
CITY, STATE, ZIP CODE		TELEPHONE		CITY, STATE, ZIP CODE	
OWNER'S SERIAL NO.		MFG. DATE		ORIG. TEST DATE	
CARGO TANK MOTOR VEHICLE MFG.		CARGO TANK MOTOR VEHICLE CERT. DATE		TANK MANUFACTURER	
MAX. WEIGHT OF LADING		LADING MATERIALS		DOT SPECIFICATION NO.	
HEATING SYSTEM		DESIGN PRESSURE		DESIGN TEMPERATURE	
SHELL		HEAD		ORIGINAL TEST DATE	
EXPOSED SURFACE AREA IN SQ. FT.		MAX. DESIGN DENSITY OF LADING (LBS. PER GAL.)		MAXIMUM ALLOWABLE WORKING PRESSURE	
TYPE OF TEST(S)		MATERIAL		DESIGN TEMPERATURE	
☐ EXTERNAL VISUAL (V)		☐ LEAKAGE TEST (K)		☐ PRESSURE RETEST (P)	
☐ INTERNAL VISUAL (I)		☐ HYDROSTATIC		☐ PNEUMATIC	
☐ LINING INSPECTION (L)		☐ DELIVERY HOSE/PIPING		☐ PNEUMATIC	
☐ THICKNESS TEST (T)		☐ K-EPA27		☐ OTHER	
☐ LINED		☐ SPECIAL SERVICE		☐ INSULATED	
☐ MATERIAL CORROSIVE TO TANK		☐ DEDICATED SERVICE		☐ WATER CAPACITY IN LBS.	
☐ OTHER					

CHECKLIST OF ITEMS INSPECTED OR TESTED														
YES	NO	ITEM	YES	NO	ITEM	TYPE				K-EPA27				
						TEST	START	END	MEASURE	START	END	AVERAGE	RESULTS	
☐	☐	Tank Shell	☐	☐	Frangible (Rupture) Disk	PRESSURE RELIEF DEVICES								
☐	☐	Tank Heads	☐	☐	Major Apertures									
☐	☐	Head-to-Shell Seam	☐	☐	- upper coupler assembly									
☐	☐	Valves	☐	☐	- suspension system attachments									
☐	☐	Gaskets	☐	☐	- connecting structures		Device Number	1	2	3	4	5		
☐	☐	Manhole Covers	☐	☐	Lining Material		Tested							
☐	☐	Manhole Gaskets	☐	☐	Pressure Bearing Portions of Heating System		Removed							
☐	☐	Devices for Tightening Manhole Gaskets on Full Opening Rear Head	☐	☐	Flues for Heating System		Inspected							
☐	☐	Self-closing Stop-valves	☐	☐	Corroded or Abraded Areas		Replaced							
☐	☐	Excess Flow Valves	☐	☐	Distortions		Reinstalled							
☐	☐	Remote Closure Devices	☐	☐	Dents	Pressure - set to discharge								
☐	☐	Reclosing Pressure Relief Valves	☐	☐	Welds	Pressure - when open								
☐	☐	Nuts and Bolts	☐	☐		Pressure - when resealed								
DELIVERY HOSE/PIPING						THICKNESS (INCHES)	MFG.		MIN.		UPPER COUPLER ASSEMBLY			
HOSE I.D. NO.						HEAD					☐ EXAMINED IN PLACE			
DATE OF ORIG. HOSE ASSEMBLY TEST						SHELL TOP					☐ REMOVED FOR EXAMINATION			
CONDITION OF HOSE ASSEMBLY & PIPING SYSTEM						SHELL SIDE					I.D. OF FLUID USED FOR TEST			
						SHELL BOTTOM					TEST PRESSURE			
											HOLDING TIME OF TEST			

(CHECK ONE) ☐ NO DEFECT OR DAMAGE DISCOVERED ☐ DEFECTS OR DAMAGE DISCOVERED			
LOCATION OF DEFECTS OR DAMAGE: ☐ weld ☐ heat-affected zone ☐ liquid phase ☐ vapor phase ☐ head-to-shell seam ☐ delivery hose/pipe ☐ apertures			
Explain:			
NATURE AND SEVERITY:			
METHOD OF REPAIRS:			
IS REPAIR CERTIFICATION REQUIRED? ☐ YES ☐ NO DESIGN CERTIFYING ENGINEER REGISTRATION NO.			
THIS UNIT HAS HAULED ☐ ANHYDROUS AMMONIA ☐ ANY OTHER MATERIAL THAT MAY CAUSE STRESS CORROSION CRACKING			
DOT REGISTRATION NUMBER OF THE TESTING FACILITY/PERSON			
TEST DATE			
STRESS RELIEVED AFTER REPAIR ☐ YES ☐ NO			
TESTED BY (Person's Name)			
REPAIRED BY			
ADDRESS			
CITY, STATE, ZIP			

CARGO TANK: ☐ MEETS ☐ FAILS TO MEET THE REQUIREMENTS OF THE DOT SPECIFICATIONS IDENTIFIED ON THIS REPORT			
DISPOSITION OF CARGO TANK: ☐ WITHDRAWN FROM SERVICE ☐ RETURNED TO SERVICE MARKINGS APPLIED: ☐ YES ☐ NO			
SIGNATURE OF INSPECTOR		DOT REGISTRATION NUMBER	
DATE		SIGNATURE OF OWNER	
DATE		DATE	

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165-FS-D2 (Rev. 4/05) 8897

ORIGINAL

Vehicle Maintenance Pro

Notes

COMPLIANCE DATES – INSPECTIONS AND TEST UNDER §180.407(c)

Test or inspection (cargo tank specification, configuration, and service)	Date by which first test must be completed (see note 1)	Interval period after first test
External Visual Inspection: All cargo tanks designed to be loaded by vacuum with full opening rear heads	September 1, 1991	6 months.
All other cargo tanks	September 1, 1991	1 year.
Internal Visual Inspection: All insulated cargo tanks, except MC 330, MC 331, MC 338 (See Note 4)	September 1, 1991	1 year.
All cargo tanks transporting lading corrosive to the tank	September 1, 1991	1 year.
All other cargo tanks except MC 338	September 1, 1995	5 years.
Lining Inspection: All lined cargo tanks transporting lading corrosive to the tank	September 1, 1991	1 year.
Leakage Test: MC 330 and MC 331 cargo tanks in chlorine service	September 1, 1991	2 years.
All other cargo tanks except MC 338	September 1, 1991	1 year.
Pressure Test: (Hydrostatic or pneumatic) (See Notes 2 and 3) All cargo tanks which are insulated with no manhole or insulated and lined, except MC 338	September 1, 1991	1 year.
All cargo tanks designed to be loaded by vacuum with full opening rear heads	September 1, 1992	2 years.
MC 330 and MC 331 cargo tanks in chlorine service	September 1, 1992	2 years.
All other cargo tanks	September 1, 1995	5 years.
Thickness Test: All uninsulated cargo tanks transporting material corrosive to the tank, except MC 338	September 1, 1992	2 years.

Note 1: If a cargo tank is subject to an applicable inspection or test requirement under the regulation in effect on December 30, 1990, and the due date (as specified by a requirement in effect on December 30, 1990) for completing the required inspection or test occurs before the compliance date in this table, the earlier date applies.

Note 2: Pressure testing is not required for MC 330 and MC 331 cargo tanks in dedicated chlorine service.

Note 3: Pressure testing is not required for uninsulated lined cargo tanks with design pressure or MAWP of 15 psig or less, which receive an external visual inspection and lining inspection at least once each year.

Note 4: Insulated cargo tanks equipped with manholes or inspection openings must conform either an internal visual inspection in conjunction with the external visual inspection, or a hydrostatic or pneumatic pressure-test of the cargo tank.

§180.407(h)(4)

(4) After July 1, 2000, Registered Inspectors of specification MC 330 and MC 331 cargo tanks, and nonspecification cargo tanks authorized under §173.315(k) of this subchapter must visually inspect the delivery hose assembly and piping system while the assembly is under leakage test pressure utilizing the rejection criteria listed in §180.416(g). Delivery hose assemblies not permanently attached to the cargo tank motor vehicle may be inspected separately from the cargo tank motor vehicle. In addition to a written record of the inspection prepared in accordance with §180.417(b), the Registered Inspector conducting the test must note the hose identification number, the date of the test, and the condition of the hose assembly and piping system tested.

§180.415 Test and inspection markings.

(a) Each cargo tank successfully completing the test and inspection requirements contained in §180.407 must be marked as specified in this section.

(b) Each cargo tank must be durably and legibly marked, in English, with the date (month and year) and the type of test or inspection performed, subject to the following provisions:

(1) The date must be readily identifiable with the applicable test or inspection.

(2) The markings must be in letters and numbers at least 32 mm (1.25 inches) high, near the specification plate or anywhere on the front head.

(3) The type of test or inspection may be abbreviated as follows:

- V for external visual inspection and test;
- I for internal visual inspection;
- P for pressure test;
- L for lining inspection;
- T for thickness test; and
- K for leakage test for a cargo tank tested under §180.407, except §180.407(h)(2); and
- (vii) K-EPA27 for a cargo tank tested under §180.407(h)(2) after October 1, 2004.

Examples to paragraph (b). The markings "10-99 P, V, L" represent that in October 1999, a cargo tank passed the prescribed pressure test, external visual inspection and test, and the lining inspection. The markings "2-00 K-EPA27" represent that in February 2000, a cargo tank passed the leakage test under §180.407(h)(2). The markings "2-00 K, K-EPA27" represent that in February 2000, a cargo tank passed the leakage test under both §180.407(h)(1) and under EPA Method 27 under §180.407(h)(2).

§180.416 Discharge system inspection and maintenance program for cargo tanks transporting liquefied compressed gases.

(a) *Applicability.* This section is applicable to an operator using specification MC 330, MC 331, and nonspecification cargo tanks authorized under §173.315(k) of this subchapter for transportation of liquefied compressed gases other than carbon dioxide. Paragraphs (b), (c), (d)(1), (d)(5), (e), (f), and (g)(1) of this section, applicable to delivery hose assemblies, apply only to hose assemblies installed or carried on the cargo tank.

(b) *Hose identification.* By July 1, 2000, the operator must assure that each delivery hose assembly is permanently marked with a unique identification number and maximum working pressure.

(c) *Post-delivery hose check.* After each unloading, the operator must visually check that portion of the delivery hose assembly deployed during the unloading.

(d) *Monthly inspections and tests.* (1) The operator must visually inspect each delivery hose assembly at least once each calendar month the delivery hose assembly is in service.

(2) The operator must visually inspect the piping system at least once each calendar month the cargo tank is in service. The inspection must include fusible elements and all components of the piping system, including bolts, connections, and seals.

(3) At least once each calendar month a cargo tank is in service, the operator must actuate all

emergency discharge control devices designed to close the internal self-closing stop valve to assure that all linkages operate as designed. Appendix A to this part outlines acceptable procedures that may be used for this test.

(4) The operator of a cargo tank must check the internal self-closing stop valve in the liquid discharge opening for leakage through the valve at least once each calendar month the cargo tank is in service. On cargo tanks equipped with a meter, the meter creep test as outlined in Appendix B to this part or a test providing equivalent accuracy is acceptable. For cargo tanks that are not equipped with a meter, Appendix B to this part outlines one acceptable method that may be used to check internal self-closing stop valves for closure.

(5) After July 1, 2000, the operator must note each inspection in a record. That record must include the inspection date, the name of the person performing the inspection, the hose assembly identification number, the company name, the date the hose was assembled and tested, and an indication that the delivery hose assembly and piping system passed or failed the tests and inspections. A copy of each test and inspection record must be retained by the operator at its principal place of business or where the vehicle is housed or maintained until the next test of the same type is successfully completed.

(e) *Annual hose leakage test.* The owner of a delivery hose assembly that is not permanently attached to a cargo tank motor vehicle must ensure that the hose assembly is annually tested in accordance with §180.407(h)(4).

(f) *New or repaired delivery hose assemblies.* Each operator of a cargo tank must ensure each new and repaired delivery hose assembly is tested at a minimum to 120 percent of the hose maximum working pressure.

(1) The operator must visually examine the delivery hose assembly while it is under pressure.

(2) Upon successful completion of the pressure test and inspection, the operator must assure that the delivery hose assembly is permanently marked with the month and year of the test.

After July 1, 2000, the operator must complete a record documenting the test and inspection, including the date, the signature of the inspector, the hose owner, the hose identification number, the date of original delivery hose assembly and test, notes of any defects observed and repairs made, and an indication that the delivery hose assembly passed or failed the tests and inspections. A copy of each test and inspection record must be retained by the operator at its principal place of business or where the vehicle is housed or maintained until the next test of the same type is successfully completed.

(g) *Rejection criteria.* (1) No operator may use a delivery hose assembly determined to have any condition identified below for unloading liquefied compressed gases. An operator may remove and replace damaged sections or correct defects discovered. Repaired hose assemblies may be placed back in service if retested successfully in accordance with paragraph (f) of this section.

(i) Damage to the hose cover that exposes the reinforcement.

(ii) Wire braid reinforcement that has been kinked or flattened so as to permanently deform the wire braid.

(iii) Soft spots when not under pressure, bulging under pressure, or loose outer covering.

(iv) Damaged, slipping, or excessively worn hose couplings.

(v) Loose or missing bolts or fastenings on bolted hose coupling assemblies.

(2) No operator may use a cargo tank with a piping system found to have any condition identified in this paragraph (g)(2) for unloading liquefied compressed gases.

(i) Any external leak identifiable without the use of instruments.

(ii) Bolts that are loose, missing, or severely corroded.

(iii) Manual stop valves that will not actuate.

(iv) Rubber hose flexible connectors with any condition outlined in paragraph (g)(1) of this section.

(v) Stainless steel flexible connectors with damaged reinforcement braid.

(vi) Internal self-closing stop valves that fail to close or that permit leakage through the valve detectable without the use of instruments.

(vii) Pipes or joints that are severely corroded.

Shop Operations

TANK CLEANING AND INSPECTION REPORT

CARRIER, NAME AND ADDRESS

P.O. NO.

TRAILER NO.

LOAD NO.

DATE:

EQUIPMENT CONTROL

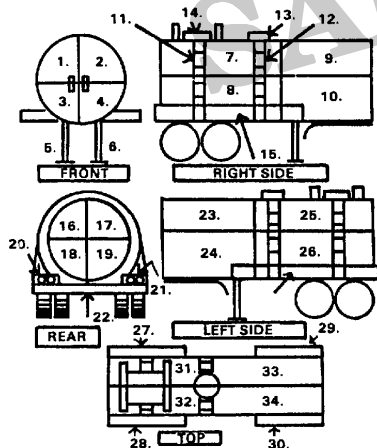
NAME	DRIVER NO.	DESCRIPTION	OUT	IN	DESCRIPTION	OUT	IN
1.		NUMBER OF 2" HOSES			TANK CLEANLINESS RATING		
2.		NUMBER OF 3" HOSES			3 X 2 PRODUCER		
3.		NUMBER & TYPE SPECIAL HOSES			GASKETS TEFLON OTHER		
4.		FUSIBLE CAPS			CHRISTMAS TREE		

NOTIFY DISPATCH OF ANY DISCREPANCIES

REMARKS:

COMP.	LAST PRODUCT	#GL'S HEEL
1.		
2.		
3.		
4.		
5.		

TRAILER DAMAGE CONTROL



List all damages using numbers in diagram to identify location. Give brief description of all damage using the code on the back of this form.

DRIVER:

SIGNATURE

DATE

SIGNATURE

DATE

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CARRIER COPY

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Notes

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Notes

Truck _____ Tractor _____ Company power unit number _____

Make _____ Model _____ Date delivered _____

Date of Inspection _____

Procedure	OK	Action
CAB Air conditioning, heating, ventilation Check fans at all speeds Check bunk heater fans Check drive belts Check sight glass for level of refrigerant Check hoses Check nuts and bolts Check compressor/oil level/mounts 		
Exterior Check general cab condition; delivery damage Check cab tilt mechanism Check fifth wheel mounting/grease Check mounting aerodynamic device Check horn covers Check mirrors Check bugscreen/winterfront Check door latches/hinges Check adjustment and door stops Check bumpers Check license plate holders Check mud flaps Check tank brackets Check hood latches. Adjust Check cab holddown equipment. Adjust Check hoses, trailer springs, gladhand holders/rubbers 		

Shop Operations

PRE-SERVICE CHECKLIST — POWER UNITS, Continued

Procedure	OK	Action
Interior Check dashboard lights, overhead lights, bunk lights, light plug Check horns Check door handles, window handles/operation Check locks/keys Check radio, speakers, antenna/all connections Check seat adjustment Check seat belts Check wiper speeds/operation Check windshield washers, wiper blades Check interior cab gauges/operation Check all lights high/low beams/indicator Check for aim/adjust parking/marker lights stop/taillights turn signals four-way flasher Check air, oil, temperature pressure warning devices Check speedometer when truck comes into shop 		
CHASSIS Check frame and cross members Tighten loose bolts Jack up wheels. Spin wheels, check for bearing noise Check wheels Tighten lug nuts Fill wheel bearing reservoirs Check axle flanges/loose, missing nuts Align tandem axles Check tire alignment Lube front end Check for excessive play in steering Drain and fill steering box. Specifications: Set caster, toe-in, center steering. Specifications: Check for loose U-bolts		

Notes

Vehicle Maintenance Pro

Notes

PRE-SERVICE CHECKLIST -- POWER UNITS, Continued

Procedure	OK	Action
CHASSIS, Continued Lube all points. Do all take grease. Specifications: Lube entire unit. Replace missing or defective fittings Check all lines, fittings, mountings, and bolts for tightness Check U-joints and yokes for play/bolts/locks Check rear springs U-bolts center bolts equalizers torque arms/brackets for loose bolts 		
Brakes Check brake valve for air leaks Check brake operation for holding/releasing Build up air pressure. Check governor kick-out Pump down air. Check governor kick-in Check air valves for operation/leaks Apply foot brake, hold. Specifications: Check engine brake/operation Adjust front brakes Check rear brakes, drums, linings/adjust Check wheel seals 		
Tires Check tires. Pressure: Install steel valve caps 		

Shop Operations

PRE-SERVICE CHECKLIST — POWER UNITS, Continued			Notes
Procedure	OK	Action	
POWERTRAIN Clutch Check clutch pedal for free play Check clutch brake adjustment/linkage _____ _____			
Transmission Check transmission for hard shifting Check transmission through the gears Check transmission/bell housing bolts Drain/fill with transmission oil. Specifications: _____ _____			
Engine Drain crankcase Replace oil filters Refill crankcase Check pan capacity/dipstick markings Drain fuel/water separator Check coolant levels. Specifications: _____ _____ Pressure-test cooling system Tighten hose clamps Check fan hub bearings/brackets Lube Check compressor/leaks Check mounting bolts/brackets Check alternator wiring Check all belts/adjust Check fuel lines for leaks/tightness Check fuel pump for leaks/mounting bolts Check and tighten all engine bolts Check intake ducting for holes, bent pipes/clearance Check/loose clamps Tighten battery cables, connections Check battery holddowns/box Check/lube all linkage			

Vehicle Maintenance Pro

Notes

PRE-SERVICE CHECKLIST — POWER UNITS, Continued

Procedure	OK	Action
Engine operating: Check engine/unusual noise Check engine for surge/rough idle/miss at high rpm Check oil pressure: high idle/maximum rpm. Record: Check fuel pump rail pressure, rpm. Record: Check air cleaner restriction Check all mufflers, exhaust pipes/clamps, mounting brackets Check all filters and lines for leaks Lube tachometer/speedometer cables		
Check for presence in vehicle: Fire extinguisher Permit holder Green card holder Reflector kit Case oil Air shield Decals Tags/permits Cab maintenance card _____ _____		

Shop Operations

Company trailer number _____	Make _____	
Description _____	Date delivered _____	
Date of inspection _____		

Procedure	OK	Action
TRAILER Check all marker lights Check taillights, stop, directionals, license plate lights Check lighting wiring harness/tightness Check emergency brakes/operation Check brake air pressure drop Check service brake/hand valve operation Check all brake line fittings Check air lines/clearances/tightness Check all brake adjustments Check/torque suspension U-bolts Check all wheel bearings Fill wheel reservoirs Grease all zerk fittings Check/torque inside wheel studs Check/torque outside wheel nuts Check all tire pressure Install steel valve caps Check landing gear and leg extension Check bolts/tightness Check cotter pins		
Drop trailer Check kingpin/plate/bolts/lubricate Check tandem alignment		
Doors Check cable tension/operation _____ _____ _____ Check hinges/latches/lubricate Check door seals/tightness Check locks/security		

Vehicle Maintenance Pro

Notes

PRE-SERVICE CHECKLIST — TRAILERS, Continued

Procedure	OK	Action
Interior Check interior walls/floor/condition Check top rails/roof/condition Check/install vehicle numbers Check for presence in trailer permits license plates _____ _____ _____ _____		
Refrigeration Check fuel tank/mounting Drain engine oil Replace oil/fuel filters Fill crankcase Check battery/tighten Check all drive belts Check coolant level _____ _____ _____ _____ Crank engine Record oil pressure: _____ idle: _____ Check charging system output Cut engine Check hoses/clamps/fittings Check electrical connections Drain water from fuel tank Run master refrigeration/manufacture's instructions Check safety circuit/operation Calibrate thermostat/temperature gauges Check heat/cool/defrost cycles Grease damper/idler bearings		

Shop Operations

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DRIVER'S VEHICLE INSPECTION REPORT

Date: _____

Carrier's
Name: _____

Address: _____

CHECK ANY DEFECTIVE ITEM WITH AN X AND GIVE DETAILS

TRACTOR/TRUCK NO. _____ Odometer _____

☐ Air Compressor	☐ Horn	☐ Suspension System
☐ Air Lines	☐ Lights	☐ Starter
☐ Battery	Head - Stop	☐ Steering
☐ Body	Tail - Dash	☐ Tachograph
☐ Brake Accessories	Turn Indicators	☐ Tires
☐ Brakes, Parking	☐ Mirrors	☐ Tire Chains
☐ Brakes, Service	☐ Muffler	☐ Transmission
☐ Clutch	☐ Oil Pressure	☐ Wheels and Rims
☐ Coupling Devices	☐ Radiator	☐ Windows
☐ Defroster/Heater	☐ Rear End	☐ Windshield
☐ Drive Line	☐ Reflectors	☐ Wipers
☐ Engine	☐ Safety Equipment	☐ Other
☐ Exhaust	Fire Extinguisher	
☐ Fifth Wheel	Reflective Triangles	
☐ Frame and Assembly	Flags - Flares - Fusees	
☐ Front Axle	Spare Bulbs & Fuses	
☐ Fuel Tanks	Spare Seal Beam	

TRAILER(S) NO.(S) _____

☐ Brake Connections	☐ Hitch	☐ Tarpaulin
☐ Brakes	☐ Landing Gear	☐ Tires
☐ Coupling Devices	☐ Lights - All	☐ Wheels and Rims
☐ Coupling (King) Pin	☐ Roof	☐ Other
☐ Doors	☐ Suspension System	

REMARKS: _____

- ☐
- Condition of the above vehicles is satisfactory

Driver's Signature: _____

- ☐ Above defects corrected
☐ Above defects need not be corrected for safe operation of vehicle

Mechanic's Signature: _____ Date: _____

Driver Reviewing Repairs: Signature: _____ Date: _____

131-FS-E3 Rev. (5/03)

ORIGINAL

Notes

Determining Maintenance Schedules

Vehicle Maintenance Pro

Notes

To Reorder: 1-800-327-6868



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LIGHTWEIGHT VEHICLE SAFETY REPORT

(For Routine Vehicle Safety Check or Inspection)
✓ Applicable column if item is "OK" or "Needs Repair"

COMPANY NAME		VEHICLE NO.	MILEAGE	DATE
YEAR	MAKE	MODEL	INSPECTED BY:	
OK	NEEDS REPAIR	ITEM	CAB INSPECTION	
		DASHBOARD WARNING LIGHTS	All dashboard warning lights should light up when engine is cranking and parking brake is on.	
		HORN	Gives adequate and reliable warning signal.	
		WINDSHIELD WASHERS AND WIPERS	Do washers work? Do wipers clean the windshield? A clear clean windshield is a must for safe driving.	
		WINDSHIELD AND WINDOWS	No cracks in windshield over ¼" wide, no intersecting cracks, no objects or stickers on windshield or windows which impair vision.	
		SEAT BELTS	Available & buckles work easily. Driver note: USE THEM!	
		REAR VIEW MIRRORS	Firmly attached and reflect view behind vehicle.	
		BRAKES	① Push pedal down, if it goes down more than ½ way to the floor, brakes need adjustment. ② Push pedal down hard and hold down and count to 10, if the pedal keeps going down, have it repaired immediately. (For vehicles with power brakes, engine must be running for this test.) ③ Drive vehicle and step on brakes, if vehicle swerves to the side or anything feels suspicious, have checked.	
		PARKING BRAKE	Stop vehicle, set parking brake firmly and attempt to move vehicle in "drive" or "first". If vehicle moves forward easily, the brakes need adjustment or repair.	
		SPEEDOMETER	Check while vehicle is moving - must register M.P.H.	
		CAB-GENERAL	Objects in cab must not obstruct drivers vision or prevent free movement or exit from vehicle. NOTE: Remove any object from the dash, visors or seat which could fly around the cab and injure the driver, if vehicle stops suddenly or an accident occurs.	
OK	NEEDS REPAIR	ITEM	OUTSIDE VEHICLE INSPECTION	
		LIGHTS	Get helper to check headlights (high and low beam), emergency flashers, side markers, parking lights, license plate lights, tail lights, brake lights, back-up lights (shift to reverse) turn signals (front and back) and interior dash lights.	
		TIRES	① Check tire pressure with gauge for correct pressure. ② Check tread wear. (Tread wear indicators will show up when tread gets down to last ⅛ inch, indicators showing across two or more grooves means tire should be replaced.) ③ Check both sides of tire for bulges or large cracks on sidewall.	
		SHOCK ABSORBERS	Bounce vehicle up and down at each wheel. If vehicle continues to bounce two or more times after you let go, shocks are weak and will cause unnecessary tire wear and handling problems.	
OK	NEEDS REPAIR	ITEM	UNDER VEHICLE INSPECTION	
		BRAKE LINES	Check for apparent fluid leaks on brake lines and cylinders.	
		GAS TANK	Check for leaks and must have securely attached gas cap.	
		OIL LEAKS	Look for oil leaks under transmission, engine and differential.	
		WATER LEAKS	Look for water leaks under radiator – NOTE: clear, condensed drops from air conditioner is O.K.	
		EXHAUST SYSTEM	Check complete exhaust system, muffler, tail pipes, exhaust pipe for any exhaust leaks.	
Deficiencies Corrected Signed:			Vehicle OK To Operate Signed:	

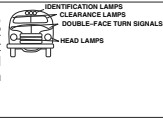
ORIGINAL

Form No. 126-FS-C2
(Rev. 5/96)

Shop Operations

VEHICLE SAFETY REPORT

(For Routine Vehicle Safety Check or Inspection)
✓ Applicable column if item is "OK" or "Needs Repair"

COMPANY NAME		VEHICLE NO.	MILEAGE	DATE
YEAR	MAKE	MODEL	INSPECTED BY:	
OK	NEEDS REPAIR	ITEM	CAB INSPECTION	
		PARKING BRAKE	Must be adequate to hold vehicle on any grade operated free from ice or snow.	
		AIR PRESSURE READING PSI (fully charged)	Air pressure gauge reading in PSI required.	
		LEAKAGE TESTS	Serious air losses are imminently hazardous and are likely to cause accident or breakdown. Procedure: with engine stopped and no brakes applied, observe gauge reading - loss should not exceed 3 lbs. per minute; apply full brakes for 2 minutes - loss should not exceed 4 lbs. per minute (if loss exceeds limits, check out further before leaving terminal).	
		WARNING DEVICE	Must be visible or audible and operate at all pressures at and below 50% of cut out pressure. Pressure Build Up Test: run engine at fast idle; time to raise pressure to cut out should not exceed 5 minutes.	
		SPEEDOMETER	Must register mph.	
		HORN(s)	Required to give adequate and reliable warning signal and be in proper working order.	
		WINDSHIELD WIPERS	Two required, unless one clears all but one inch at right and left sides.	
		WINDSHIELD & WINDOWS	No cracks in windshield over 1/4 inch wide; no intersecting cracks; damage to windshield must be small enough to cover with a penny. No vision reducing objects or stickers on windows, either side of driver's compartment; stickers required by law permitted on windshield, but must be within 4 1/2 inches from bottom of windshield.	
		REAR VISION MIRRORS	Two required, one on each side, firmly attached and must reflect a view of highway along both sides of vehicle.	
		TRAILER EMERGENCY BRAKING DEVICE	Clear indication of emergency position or method or operation is required; manual control device must be operable from driver's seat.	
		CAB - GENERAL	Objects in the cab must not obscure driver's vision, prevent driver's ready access to emergency items or interfere with driver's free movement or exit from cab. Sleeper berth restraints required on vehicles built after July 1, 1971. Driver's seat belts required in 1965 and newer units (DRIVER NOTE: USE THEM!)	
		EMERGENCY EQUIPMENT	Emergency equipment is required as follows: fire extinguisher must be properly filled, securely mounted and manufactured in a manner for visual inspection - power units not transporting hazardous materials must carry either one extinguisher with a UL Rating of 5 B:C, or two extinguishers with UL Rating of 4 B:C or more - power units transporting hazardous materials of substance and quantity to require placarding must carry one fire extinguisher with a UL Rating of 10 B:C or more. At least one spare fuse must be carried if not equipped with circuit breakers. Warning devices: three bidirectional emergency reflective triangles are required for vehicles equipped with warning devices after January 1, 1974; however, vehicles equipped with warning devices before January 1, 1974 may continue to use one of the following combinations until they need replacement, at which time they may continue to be carried only as a supplement to three bidirectional reflective triangles: 3 flares, 3 fuses, 2 red flags (at least 12" square); 3 red electric lanterns, 2 red flags; 3 red reflective triangles.	
OK	NEEDS REPAIR	ITEM	FRONT END INSPECTION	
		HEADLAMPS	At least two headlamps are required; in any event, there must be an equal number on each side with upper and lower beam selectable at driver's will.	
		CLEARANCE LAMPS	 Truck-tractors (over 80 inches in width): 2 clearance lamps, amber in color; 3 identification lamps, amber in color; 2 turn signals, amber in color and one on each side (must have switch to flash simultaneously as a traffic hazard warning system, must be capable of operating with ignition on or off). Semitrailers & trailers: 2 clearance lamps, amber in color.	
		TIRES	No tire shall have fabric exposed thru thread or sidewall or have less than 2/32nd inch tread depth; front tire on power unit must not be regrooved and must have at least 4/32nd inch of tire depth.	
		WHEELS	Check for cracks, loose lug nuts or missing studs - these are imminently hazardous conditions which are likely to cause an accident or breakdown.	
		BRAKE TUBING & HOSE	Check for chafing, kinking or other mechanical damage - connections must be free from leaks.	
		BRAKES	Brakes are required on all wheels (1980 and newer), except that 3-axle power units need not have brakes on front axle (1979 and older). All required brakes must be operative. Check brake drums, chambers & component parts - cracked or broken drums, blown diaphragms, other chamber leaks, missing or broken or disconnected parts are all imminently hazardous conditions and should be checked and corrected before leaving terminal.	
		STEERING	Check for loose or missing nuts and bolts or positioning parts for steering column or gear box; excessive play; steering should turn full right and left - correct hazardous condition before leaving terminal.	

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Notes

Vehicle Maintenance Pro

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OK	NEEDS REPAIR	ITEM	LEFT SIDE INSPECTION
		FUEL TANK	Check for leaks; must have securely attached tank cap.
		SIDEMARKER LAMPS & REFLECTORS	Truck-tractors, no requirements. Semitrailers and trailers: side-marker lamps, one amber in front, one red at rear: reflectors all mounted not more than 60 inches high, one amber in front, one red at rear (one additional amber side-marker and one additional amber reflector required at intermediate position on semitrailers & trailers over 30 ft. long). Lamps & reflectors must not be obscured by other parts of the vehicle or load or dirt, etc.
		BATTERY	Must be covered, unless located in engine compartment or covered by a fixed part of the vehicle.
OK	NEEDS REPAIR	ITEM	REAR OF POWER UNIT INSPECTION
		LAMPS & REFLECTORS	Truck-tractors: one tail lamp, one stop lamp, two reflectors-one at each side, all red in color; if front turn signals are not double-faced and visible to passing drivers, two turn signals one at each side are required. License plate lamp - white.
		TIRES, WHEELS, BRAKE TUBING & HOSE, BRAKES, including drums, chambers & component parts	Check thoroughly as required for front end inspection.
		WIRING	Check for bare, loose, dangling, chafing or poorly connected wires and correct if necessary.
		SUSPENSION SYSTEM	Check for broken leaves, missing or loose U-bolts or other defective conditions likely to cause an axle shift - these can be hazardous conditions which may cause an accident or breakdown.
		FIFTH WHEEL	Lower half should be securely affixed by U-bolts or other secure means - lower half must not shift on frame; check for cracks, loose or missing mounting brackets, missing or inoperative locking devices - each of these could cause an accident or breakdown.
OK	NEEDS REPAIR	ITEM	REAR OF TOWED UNIT INSPECTION
		LAMPS & REFLECTORS	Semitrailers & Trailers: 2 tail lamps-one at each side, 2 stop lamps-one at each side, 2 turn signals-one at each side, 2 clearance lamps-one at each side, 2 reflectors-one at each side, 3 identification lamps on vertical centerline (all red in color). License plate lamp - white.
		TIRES, WHEELS, BRAKE TUBING & HOSE, BRAKES, including drums, chambers & component parts	Check thoroughly as required for front end inspection.
		WIRING & SUSPENSION SYSTEM	Check thoroughly as required for rear of power unit inspection.
OK	NEEDS REPAIR	ITEM	RIGHT SIDE INSPECTION
		SIDEMARKER LAMPS & REFLECTORS	Check for same requirements as left side inspection
		FUEL TANK	Check for same requirements as left side inspection
		EXHAUST SYSTEM	Must not cause burning, charring, or damage to electrical wiring, the fuel supply or any combustible part of the vehicle. Exhaust system not securely fastened or leaking forward of or under cab constitutes a hazardous condition.
		CONTROL (Service) & SUPPLY (Emergency) HOSES & CONNECTIONS	Must be secured against chaffing, kinking or other mechanical damage - must not drag on frame, fuel tank, deck plate, etc. Connections should be checked for leaks: there should be suitable provision to prevent accidental disconnection.
		BREAKAWAY & EMERGENCY BRAKING (Disconnect lines)	Trailer brakes must apply immediately upon disconnecting - no back flow of air from trailer or air flow from the tractor should exist.
		DETACHABLE ELECTRICAL CONNECTIONS	Detachable connections made by twisting together wires from towing and towed units are prohibited; wiring must be contained in a cable or cables or entirely within a substantially constructed protective device; check for incorrect connection or accidental disconnection. Check for bare, loose, dangling, chafing or poorly connected wires.
Deficiencies Corrected Signed:			Vehicle OK To Operate Signed:

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3003 W. Brezewood Lane - Neenah, WI 54957-0368

Shop Operations

DRIVER'S VEHICLE CONDITION REPORT

Company _____ Vehicle Number _____
 Date _____ Mileage _____

Check items needing attention

	Driver	Mechanic		Driver	Mechanic		Driver	Mechanic
SAFETY			STEERING			FUEL		
Fire extinguisher			Hard steering			Fuel Lines		
Accident report kit			Shimmy			Fuel pump		
Flares			Wander			Fuel tank		
Flags/standards			Free play			Other		
Fuses			Other					
Spare light fuses						EXHAUST		
Other (Explain below)			CLUTCH			Exhaust pipe		
CAB			Poor release			Muffler		
Mirrors			Grabs			Other		
Windshield wipers			Chatters					
Horn			Slips			WHEELS/SPRINGS		
Glass			Other			Condition		
Doors						Lugs/nuts		
Exterior condition			TRANSMISSION			Brake drums		
Interior condition			Hard shifting			Fifth wheel		
Other			Jumps out of gear			Trailer axle alignment		
			Noisy			Other		
			Oil leak					
INSTRUMENTS			Other			TIRES		
Speedometer/odometer						Condition		
Oil pressure			FRONT AXLE			Matching		
Air pressure			Tire wear			Tread wear		
Temperature			Wheel balance			Other		
Switches			Alignment					
Other			Other			ELECTRICAL		
						Headlight		
ENGINE			REAR AXLE			Taillight		
Oil consumption			Pulling			Stop		
Oil leak			Coasting			Marker		
Oil pressure loss			Noisy (at _____ mph)			Directional		
Overheating			Oil leak			Reflectors		
Hard starting			Other			Interior		
No power						Switches		
Knocks			BRAKES			Wiring		
Lopes			Brake action, front			Battery		
Misses			Brake action, rear			Trailer connections		
Noisy			Balance			Other		
Other			Parking brake					
			Hoses			BODY		
COOLING SYSTEM			Air leak			Condition		
Radiator leak			Tractor/trailer connection					
Water pump leak			Tractor protection valve					
Hoses			Trailer relay valve					
Overheating			Other					
Runs cold								
Other								

Explanation _____

Driver _____ Date _____ Mechanic _____ Date _____

Notes

Notes

237-FS-E3 (Rev. 7/97)

ANNUAL VEHICLE INSPECTION REPORT

DATE _____	INSPECTOR'S NAME (PRINT) _____
MOTOR CARRIER OPERATOR	THIS INSPECTOR MEETS THE QUALIFICATION REQUIREMENTS IN SECTION 396.19 ☐ YES ☐ NO
ADDRESS _____	VEHICLE IDENTIFICATION (CHECK AND COMPLETE ONE) ☐ Lic. Plate No./State ☐ Fleet Unit Number ☐ Veh. ID No. ☐ Other _____
CITY, STATE, ZIP CODE _____	_____

VEHICLE COMPONENTS INSPECTED		mark X	Yes, ok; X	No, not ok; X	Does not apply
OKAY		OKAY			
YES	NO	YES	NO		
	1. BRAKE SYSTEM			7. STEERING MECHANISM	
	a. Service brakes			a. Steering wheel free play	
	b. Parking brake system			b. Steering column	
	c. Brake drums or rotors			c. Front axle beam and all steering components other than steering column	
	d. Brake hose			d. Steering gear box	
	e. Brake tubing			e. Pitman arm	
	f. Low pressure warning device			f. Power steering	
	g. Tractor protection valve			g. Ball and socket joints	
	h. Air compressor			h. Tie rods and drag links	
	i. Electric brakes			i. Nuts	
	j. Hydraulic brakes			j. Steering system	
	k. Vacuum systems				
	2. COUPLING DEVICES			8. SUSPENSION	
	a. Fifth wheels			a. Any U-bolt(s), spring hanger(s), or other axle positioning part(s) cracked, broken, loose or missing resulting in shifting of an axle from its normal position.	
	b. Pintle hooks			b. Spring assembly	
	c. Drawbar/towbar eye			c. Torque, radius or tracking components	
	d. Drawbar/towbar tongue				
	e. Safety devices				
	f. Saddle-mounts				
	3. EXHAUST SYSTEM			9. FRAME	
	a. Any exhaust system determined to be leaking at a point forward of or directly below the driver/sleeper compartment.			a. Frame members	
	b. A bus exhaust system leaking or discharging to the atmosphere in violation of standards (1), (2) or (3).			b. Tire and wheel clearance	
	c. No part of the exhaust system of any motor vehicle shall be so located as would be likely to result in burning, charring, or damaging the electrical wiring, the fuel supply, or any combustible part of the motor vehicle.			c. Adjustable axle assemblies (Sliding subframes)	
				10. TIRES	
				a. Tires on any steering axle of a power unit	
				b. All other tires	
	4. FUEL SYSTEM			11. WHEELS AND RIMS	
	a. Visible leak			a. Lock or side ring	
	b. Fuel tank filler cap missing			b. Wheels and rims	
	c. Fuel tank securely attached			c. Fasteners	
				d. Welds	
	5. LIGHTING DEVICES			12. WINDSHIELD GLAZING	
	All lighting devices and reflectors required by Section 393 shall be operable			Requirements and exceptions as stated pertaining to any crack, discoloration or vision reducing matter (reference 393.60 for exceptions)	
	6. SAFE LOADING			13. WINDSHIELD WIPERS	
	a. Part(s) of vehicle or condition of loading such that the spare tire or any part of the load or dunnage can fall onto the roadway			Any power unit that has an inoperative wiper, or missing or damaged parts that render it ineffective.	
	b. Protection against shifting cargo				

APPLY TO VEHICLE

237-FS-E3 (Rev. 7/97)

LABEL APPLICATION INSTRUCTIONS		Notes
1. Fold ply 1, the mylar film, over the top of stub.	5. Remove the liner from ply 1.	
2. Write firmly to enter data onto plies 2 and 3. Use a permanent ink marker or permanent pencil with an ink image that is fade resistant and will not deteriorate in direct sunlight for the effective annual inspection period.	6. Carefully, beginning at the top, press the clear mylar down over the top of the label until completely covered.	
3. Remove ply 3 at the stub perforation from the set. This copy is for the vehicle file.	7. Properly dispose the label liner.	
4. To apply the label to the vehicle	WHEN PROPERLY INSTALLED, THIS SURFACE PROTECTED, PERMANENT ADHESIVE VINYL LABEL IS WEATHER RESISTANT AND DURABLE FOR REFERENCE BASED ON THE 12 MONTH ANNUAL VEHICLE INSPECTION REQUIREMENT.	
a. provide a clean-grease, dust and dirt free surface.	REMEMBER: USE A PERMANENT IMAGE MARKER OR PENCIL.	
b. remove the liner from the label		
c. apply the label to the clean location		
ADDITIONAL INSPECTION COMMENTS:		
SAMPLE		
		© Copyright 1997 J. J. KELLER & ASSOCIATES, INC. Neenah, WI • USA • (800) 327-6868 • Printed in the United States

Vehicle Maintenance Pro

Notes

TO WRITE ON THIS LABEL USE AN INDELIBLE, PERMANENT INK MARKER,
PEN OR PENCIL THAT WILL NOT FADE IN DIRECT SUNLIGHT

ANNUAL VEHICLE INSPECTION LABEL NO. 123456

COMPLETED: MONTH _____ YEAR _____

A RECORD OF THIS VEHICLE'S ANNUAL VEHICLE INSPECTION REPORT IS
MAINTAINED AT: ☐ MOTOR CARRIER ☐ OTHER ENTITY

COMPANY / NAME

STREET

CITY, STATE, ZIP CODE

TELEPHONE

MOTOR CARRIER IDENTIFICATION NUMBER

CERTIFICATION: THIS VEHICLE HAS PASSED AN INSPECTION IN ACCORDANCE
WITH 49CFR 396.17 THROUGH 396.23.

VEHICLE IDENTIFICATION: IF THE VEHICLE IS NOT READILY, CLEARLY, AND
PERMANENTLY MARKED, CHECK ONE AND COMPLETE.

☐ FLEET UNIT NUMBER ☐ LICENSE / REGISTRATION NUMBER

☐ VEHICLE IDENTIFICATION NUMBER ☐ OTHER _____

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PREVENTIVE MAINTENANCE										
DATE	MILEAGE	✓ APPLICABLE SQUARE							TOTAL COST	
		OIL CHANGE	OIL FILTER CHG.	LUBRICATION	AIR FLTR. CHG.	COOLING SYSTEM	TUNE-UP	ROTATE TIRES		

FILE ALL RECEIPTS IN ENVELOPE IN BACK OF BOOK

Notes

UNIT MAINTENANCE EXPENSE SUMMARY REPORT

ORIGINAL

Vehicle Service Due Status Report

VEHICLE IDENTIFICATION

MAKESERIAL NUMBER

YEARTIRE SIZE

COMPANY NUMBER/OTHER I.D.OWNER, IF LEASED

DATE OF INSPECTION	TYPE OF INSPECTION	MILEAGE AT TIME OF INSPECTION	DATE NEXT INSPECTION DUE	MILEAGE TYPE OF INSPECTION DUE	INSPECTION DUE
SAMPLE					

Notes

Vehicle Maintenance Pro

Notes

Lubrication Record

VEHICLE IDENTIFICATION

MAKE	SERIAL NUMBER
YEAR	TIRE SIZE
COMPANY NUMBER/OTHER I.D.	OWNER, IF LEASED

DATE	LUBRICATE CHASSIS AND ACCESSORIES	CAB HARDWARE AND DOOR LATCHES	UNIVERSAL JOINTS	CHECK: STEERING GEAR BOX	TRANSMISSION MAIN	TRANSMISSION AUXILIARY	DIFFERENTIAL	OIL CHANGE	OIL FILTER CHANGE	SERVICE AIR CLEANER AND BREATHERS	DRAIN TRANSMISSION* DIFFERENTIAL*

*According to operational requirements.

Notes _____

Inspection, Repair & Maintenance Record

VEHICLE IDENTIFICATION

MAKE

SERIAL NUMBER

YEAR

TIRE SIZE

COMPANY NUMBER/OTHER I.D.

OWNER, IF LEASED

DATE

OPERATION PERFORMED, INSPECTION AND/OR REPAIR

SAMPLE

Vehicle Maintenance Pro

Notes

Inspection Lane Checklist

Check mark or "OK" indicates pass

N indicates repair needed

Vehicle must be moved into shop if PM or repair is necessary

(No repairs allowed in the inspection lane)

ALL repairs and adjustments (including brake adjustments and tire inflations) must be listed on a work order

Unit number _____

Plate number _____

Assigned driver _____

Date _____

Mileage _____

Inbound/Outbound (circle one)

Technician _____

Before starting

___ Ask driver for any know problems
(Have driver assist if possible to speed the inspection)

___ Check recall, technical bulletin, outstanding PM, and outstanding repair boards

___ Check mileage since last PM A and B

___ Check months and mileage since last PM C

___ Check for outstanding PM D

If vehicle is due for PM or in need of repair, stop inspection and report vehicle to supervisor

___ Check for new permits or plates

___ Fresh damage Y/N

___ Place LOTO sign in/on vehicle

Report any cleanliness issues or fresh damage to supervisor immediately

All lights

___ Headlights: Low ___ High ___

___ ID Marker lights

___ Clearance lights

___ Midline signal and marker (if equipped)

___ Worklight(s)

___ Fog/road lights (if equipped)

___ All signals: Left ___ Right ___ Hazard ___

___ Brake lights

In cab

Report any cleanliness issues to supervisor

___ Windshield

___ Mirror condition and mounting

___ Wiper controls

___ Brake controls

___ Air brake check

___ Leaks

___ Air warning

___ Button pop-out

Under hood

___ General condition and leaks

___ Electrical connections

___ Air connections and leaks

___ Oil level: Added ___

___ Coolant level: Added ___

___ Power steering fluid: Added ___

___ Transmission fluid: Added ___

___ Belt condition and tension: Adjusted Y/N

___ Air compressor

___ Radiator screen

___ Turbo charger

___ Exhaust leaks

Steering assembly

___ Steering column

___ Steering gear box

___ Pitman arm and ball joint

___ Drag link and ball joint

___ Upper steering arm and joint

Steer axle (both sides)

___ Spring hangers, shackles, and U-Bolts

___ Springs

___ Shock absorbers

___ Brake chamber air lines

___ Brake chambers

___ Brake push rods and clevis/clevis pins

___ Brake adjustment: Free-play before adjustment L ___ R ___

If adjustment was necessary, reason was determined

Shop Operations

- ☐ Slack adjusters
- ☐ S-Cams and S-cam bearings
- ☐ Brake drums
- ☐ Brake shoes/pads
- ☐ Brake linings: Thickness L ___ R ___
- ☐ Hub oil leakage
- ☐ Hub oil level: Added L ___ R ___
- ☐ Lower steering arms and associated ball joints
- ☐ Kingpins
- ☐ Tire tread depth: L ___ R ___
- ☐ Tire inflation: L ___ R ___
L ___ R ___
- ☐ Tire condition
- ☐ Rims
- ☐ Lugs

Cab/body/frame

- ☐ Doors, door seals, and windows
- ☐ Mirrors
- ☐ Emergency equipment
 - ☐ Triangles
 - ☐ Extinguisher
 - ☐ Spare fuses
- ☐ Fuel tank
- ☐ Wipers
- ☐ Windshield
- ☐ Mirror mounts

Drive wheel assembly

- ☐ Drive shaft
- ☐ Axles
- ☐ Spring/arm hangers
- ☐ U-Bolts
- ☐ Springs/arms
- ☐ Air bags
- ☐ Shock absorbers
- ☐ Brake chamber air lines
- ☐ Brake chambers
- ☐ Brake push rods and clevis/clevis pins
- ☐ Brake adjustment: Free-play before adjustment LF ___ LR ___ RF ___ RR ___
- ☐ *If adjustment was necessary, reason was determined*

- ☐ Slack adjusters
- ☐ S-Cams and S-cam bearings
- ☐ Brake drums
- ☐ Brake shoes/pads
- ☐ Brake linings: Thickness LF ___ LR ___
RF ___ RR ___
- ☐ Hub leakage
- ☐ Tire tread depth: LFI ___ O ___ LRI ___ O ___
RFI ___ O ___ RRI ___ O ___
- ☐ Tire inflation: LFI ___ O ___ LRI ___ O ___
RFI ___ O ___ RRI ___ O ___
- ☐ Tire condition
- ☐ Rims
- ☐ Lugs

Upon completion

- ☐ Report vehicle as available to driver or report need for repair/PM to supervisor
- ☐ Turn in all paperwork

Report any non-driver reported defects discovered during inspection to supervisor

Notes

Vehicle Maintenance Pro

Notes

PM A Checklist

Check mark or "OK" indicates pass
N indicates needed repair
(repairs must be listed separately on work order)
X indicates repair completed

Unit number _____
Plate number _____
Assigned driver _____
Date _____
Mileage _____
Start time _____
End time _____
Technician _____

Before starting PM

___ Pull any outstanding work orders or driver inspection reports and review
___ Check recall, technical bulletin, and outstanding repair boards
___ Check mileage since last PM A and B
___ Check months and mileage since last PM C
___ Check for outstanding PM D
___ Check for new permits or plates
___ Fresh damage Y/N
___ Place LOTO sign in/on vehicle

Report any cleanliness issues or fresh damage to supervisor immediately

All lights

___ Headlights: Low ___ High ___
___ ID Marker lights
___ Clearance lights
___ Midline signal and marker (if equipped)
___ Worklight(s)
___ Fog/road lights (if equipped)
___ All signals: Left ___ Right ___ Hazard ___
___ Brake lights

In cab

Report any cleanliness issues to supervisor

___ Windshield
___ Mirror condition and mounting
___ Clutch freeplay ___

___ Steering freeplay/lash ___
___ Wiper controls
___ Brake controls
___ Air brake check
___ Leaks
___ Air warning
___ Button pop-out

Under hood

___ General condition and leaks
___ Electrical connections
___ Air connections and leaks
___ Oil level: Added ___
___ Coolant level: Added ___
___ Power steering fluid: Added ___
___ Transmission fluid: Added ___
___ Belt condition and tension: Adjusted Y/N
___ Air compressor
___ Radiator screen
___ Turbo charger
___ Exhaust leaks

Steering assembly

___ Steering column: Lubricated Y/N
___ Steering gear box
___ Pitman arm and ball joint: Lubricated Y/N
___ Drag link and ball joint: Lubricated Y/N
___ Upper steering arm and joint: Lubricated Y/N

Steer axle (both sides)

___ Spring hangers and shackles: Lubricated Y/N
___ U-Bolts: Tightened Y/N
___ Springs
___ Shock absorbers
___ Brake chamber air lines
___ Brake chambers
___ Brake push rods and clevis/clevis pins
___ Brake adjustment: Free-play before adjustment L ___ R ___
___ **If adjustment was necessary, reason was determined**
___ Slack adjusters: Lubricated Y/N
___ S-Cams and S-cam bearings: Lubricated Y/N
___ Brake drums

Shop Operations

- __ Brake shoes/pads
- __ Brake linings: Thickness L __ R __
- __ Hub oil leakage
- __ Hub oil level: Added L __ R __
- __ Lower steering arms and associated ball joints: Lubricated Y/N
- __ Kingpins: Lubricated Y/N
- __ Tire tread depth: L __/32 R __/32
- __ Tire inflation: Before filling L __ psi R __ psi
After filling L __ psi R __ psi
- __ Tire condition
- __ Rims
- __ Lugs: Torque check Y/N
Tightened Y/N

Cab/body/frame

- __ Frame, crossmembers, body mounts
- __ Doors, door seals, and windows
- __ Mirrors
- __ Emergency equipment
 - __ Triangles
 - __ Extinguisher
 - __ Spare fuses
- __ Fuel tank
- __ Fuel lines
- __ Wipers
- __ Windshield
- __ Mirror mounts

Drive wheel assembly

- __ Drive shaft: Lubricated Y/N
- __ Interaxle differential
- __ Front differential: Added ____
- __ Rear differential: Added ____
- __ Spring/arm hangers: Tightened Y/N
Lubricated Y/N
- __ U-Bolts: Tightened Y/N
- __ Springs/arms
- __ Air bags
- __ Shock absorbers
- __ Brake chamber air lines
- __ Brake chambers
- __ Brake push rods and clevis/clevis pins

- __ Brake adjustment: Free-play before adjustment LF __ LR __ RF __ RR __
If adjustment was necessary, reason was determined
- __ Slack adjusters: Lubricated Y/N
- __ S-Cams and S-cam bearings: Lubricated Y/N
- __ Brake drums
- __ Brake shoes/pads
- __ Brake linings: Thickness LF __ LR __
RF __ RR __
- __ Hub leakage
- __ Tire tread depth: LF __/32 LR __/32
RF __/32 RR __/32
- __ Tire inflation: Before filling LFI __ LFO __
LRI __ LRO __
RFI __ RFO __
RRI __ RRO __
After filling LFI __ LFO __
LRI __ LRO __
RFI __ RFO __
RRI __ RRO __
- __ Tire condition
- __ Rims
- __ Lugs: Torque check Y/N
Tightened Y/N

Upon completion

- __ Update recall, technical bulletin, repair, and PM board
- __ Place new sticker on door/windshield/seat
- __ Report vehicle as available
- __ Turn in all paperwork

Report any non-driver reported defects discovered during PM to supervisor

Notes

Vehicle Maintenance Pro

Notes

PM B Checklist

Check mark or "OK" indicates pass

N indicates needed repair

(repairs must be listed separately on work order)

⌘ indicates repair completed

Unit number _____

Plate number _____

Assigned driver _____

Date _____

Mileage _____

Start time _____

End time _____

Technician _____

Before starting PM

- ___ Pull any outstanding work orders or driver inspection reports and review
- ___ Check recall, technical bulletin, and outstanding repair boards
- ___ Check mileage since last PM A and B
- ___ Check mos. and mileage since last PM C
- ___ Check for outstanding PM D
- ___ Check for new permits or plates
- ___ Get necessary parts
- ___ Fresh damage Y/N
- ___ Place LOTO sign in/on vehicle

Report any cleanliness issues or fresh damage to supervisor immediately

All lights

- ___ Headlights: Low ___ High ___
- ___ ID Marker lights
- ___ Clearance lights
- ___ Midline signal and marker (if equipped)
- ___ Worklight(s)
- ___ Fog/road lights (if equipped)
- ___ All signals: Left ___ Right ___ Hazard ___
- ___ Brake lights

In cab

Report any cleanliness issues to supervisor

- ___ Windshield
- ___ Mirror condition and mounting
- ___ Gauges
- ___ Interaxle differential control
- ___ Air suspension control
- ___ Shifter play
- ___ Pedal action
- ___ Clutch freeplay ___
- ___ Steering freeplay/lash ___
- ___ Light indicators (L, R, HB)
- ___ Dash lights
- ___ Dome lights
- ___ Wiper controls
- ___ Brake controls
- ___ Seat adjustment
- ___ Air brake check
 - ___ Leaks
 - ___ Air warning
 - ___ Button pop-out

Electrical

- ___ Check battery/terminal condition
- ___ Load check batteries
- ___ Test 120 plug in
- ___ Check system with ammeter/voltmeter
- ___ Check ammeter/voltmeter on dash
- ___ Download ECM/EDR
- ___ Check for fault codes

Report any issues to supervisor

Under hood

- ___ General condition and leaks
- ___ Electrical connections
- ___ Air connections and leaks
- ___ Oil level before oil and filter change
- ___ Oil level after change: Added ___
- ___ Coolant level: Added ___
- ___ Coolant strength

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___ Coolant filter: Last changed _____
Replaced Y/N
___ Power steering fluid: Added _____
Transmission fluid: Added _____
Belt condition and tension: Adjusted Y/N
Air compressor
Fuel pump
Fan clutch engagement and fan condition
Air filter: Last changed _____
Replaced Y/N
Fuel filter: Last changed _____
Replaced Y/N
Fuel/water separator
Air dryer cartridge/function:
Last changed _____
Replaced Y/N
Radiator screen
Turbo charger
Exhaust leaks

Steering assembly

___ Steering column: Lubricated Y/N
___ Steering gear box
___ Pitman arm/ball joint: Lubricated Y/N
___ Drag link/ball joint: Lubricated Y/N
___ Upper steering arm/joint: Lubricated Y/N

Steer axle (both sides)

___ Spring hangers/shackles: Tightened Y/N
Lubricated Y/N
___ U-Bolts: Tightened Y/N
___ Springs
___ Shock absorbers
___ Brake chamber air lines
___ Brake chambers
___ Brake push rods and clevis/clevis pins
___ Brake adjustment: Free-play before
adjustment L ___ R ___
If adjustment was necessary, reason was determined

___ Slack adjusters: Lubricated Y/N
___ S-Cams/S-cam bearings: Lubricated Y/N
___ Brake drums
___ Brake shoes/pads
___ Brake linings: Thickness L ___ R ___
___ Hub oil leakage
___ Hub oil level: Added L ___ R ___
___ Lower steering arms and associated ball joints: Lubricated Y/N
___ Tie rod
___ Kingpins: Lubricated Y/N
___ Alignment checked Y/N
___ Tire tread depth: L ___/32 R ___/32
___ Tire inflation: Before filling L ___ R ___
After filling L ___ R ___
___ Tire condition
___ Rims
___ Lugs: Torque check Y/N
Tightened Y/N

Cab/body/frame

___ Frame, crossmembers, body mounts
___ Doors, door seals, and windows
___ Mirrors
___ Emergency equipment
___ Triangles
___ Extinguisher
___ Spare fuses
___ Fuel tank
___ Fuel lines
___ Wipers
___ Windshield
___ Mirror mounts

Vehicle Maintenance Pro

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Drive wheel assembly

- ___ Drive shaft: Lubricated Y/N
- ___ Interaxle differential
- ___ Front differential: Added ___
- ___ Rear differential: Added ___
- ___ Spring/arm hangers: Tightened Y/N
Lubricated Y/N
- ___ U-Bolts: Tightened Y/N
- ___ Springs/arms
- ___ Air bags
- ___ Shock absorbers
- ___ Brake chamber air lines
- ___ Brake chambers
- ___ Brake push rods and clevis/clevis pins
- ___ Brake adjustment: Free-play before
adjustment LF ___ LR ___ RF ___ RR ___

If adjustment was necessary, reason was determined

- ___ Slack adjusters: Lubricated Y/N
- ___ S-Cams/S-cam bearings: Lubricated Y/N
- ___ Brake drums
- ___ Brake shoes/pads
- ___ Brake linings: Thickness LF ___ LR ___
RF ___ RR ___

- ___ Hub leakage
- ___ Tire tread depth: LFI ___/32 LFO ___/32
LRI ___/32 LRO ___/32
RFI ___/32 RFO ___/32
RRI ___/32 RRO ___/32

- ___ Tire inflation:
 - Before filling LFI ___ LFO ___
LRI ___ LRO ___
RFI ___ RFO ___
RRI ___ RRO ___
 - After filling LFI ___ LFO ___
LRI ___ LRO ___
RFI ___ RFO ___
RRI ___ RRO ___

- ___ Tire condition
- ___ Rims
- ___ Lugs: Torque check Y/N
Tightened Y/N

Upon completion

- ___ QC by supervisor
- ___ Update recall, technical bulletin, repair,
and PM board
- ___ Place new sticker on
door/windshield/seat
- ___ Report vehicle as available
- ___ Sign off on DVIR (if driver submitted
one)
- ___ Place DVIR in door pouch for driver
- ___ Complete work order(s) for PM and
Repairs
- ___ Attach PM checklist to work order
- ___ Turn in all paperwork

Report any non-driver reported defects discovered during PM to supervisor

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Shop Operations

Parts Management

Sourcing Parts

Parts

That expensive brand-new truck, so clean and beautiful on delivery day, begins to deteriorate the day it starts its service life. From then on it's a constant battle to stay one step ahead of the wear-and-tear process. Every Maintenance Pro must plan a strategy for making sure the shop can get a disabled truck back on the road as quickly as possible, and that planning includes parts. We'll briefly look at sources, warranty, and inventory: getting, tracking and stocking parts.

Sources for parts

Aftermarket (selling products/parts/equipment for installation or replacement after the vehicle is purchased) is big business. In the past, the original equipment manufacturers (OEMs) had a lock on the aftermarket parts market. In many cases, the non-OEM parts were viewed as inferior. However, the appearance of better and different products in the aftermarket area (some even viewed as superior to the OEM parts) has changed the climate, making the parts market fairly competitive. Because of this, the truck parts buyer has several sources for parts and services today.

Whether purchasing parts through the OEM or an aftermarket parts dealer, the Maintenance Pro has one important question to answer first. Do you want to insist on new parts, or explore other options?

OEMs still do hold sway over some parts purchasing decisions. If the vehicle is under warranty, the OEM may require that their parts be used to continue the warranty. In some cases the use of a non-OEM part could void the warranty on component or system.

New: The most reliable part is, of course, the brand-new part. It is assembled and packaged by the Original Equipment Manufacturer (OEM) or an aftermarket parts dealer, and it is exactly like its counterpart on a new vehicle. The best reason for buying “new” is the long warranty that is offered and the security of knowing that it should last as long as the original component installed at the factory.

The disadvantages may be the price and availability. All parts for all vehicles of all ages can't be stocked at all OEM and parts dealers. This can lead to vehicle downtime while you wait for parts.

No matter where you deal for new parts, you should get:

- A well-equipped parts center with state-of-the-art testing equipment and trained personnel.

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Vehicle Maintenance Pro

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- A full range of parts services.
- Night and weekend availability.
- An extensive inventory of parts.
- Product support that goes back to the part manufacturer; everyone should stand behind the product from the parts dealer to the manufacturer.
- Seasonal specials, discounts, etc. on a timely basis.
- The willingness to stock parts for you. If you discover that all your water pumps need changed, but you do not have room to stock that many water pumps, will you parts dealer stock them for you?
- A liberal return policy, possibly including an annual “buy-back program” that allows for the return of overstocked items from your inventory (restocking fees are normal in this arrangement).
- Honest communication and responsiveness to your needs, questions, problems.

The fleet that is struggling to meet the higher prices required to purchase parts must remember the labor costs that it takes to temporarily repair a defective part is time that is wasted. This is due to the fact that the labor costs will be duplicated in a short time when a part fails and must be replaced. To sum it up, purchasing new parts helps keep labor costs down.

Used: These are parts that still have service life left in them, possibly after some minor repair or reconditioning. They may be taken from an idle vehicle, from a stock of used parts which are kept on hand for this purpose, or purchased from a used parts dealer. Often the repair or reconditioning can be done in-house to get a vehicle back on the road quickly. Once again, the Maintenance Pro must consider the labor time; a used part is a temporary measure unless the part is completely reconditioned.

A better alternative to a used part might be a “used” vehicle to fill in for emergency service. An older, but well-maintained and still reasonably reliable vehicle (which has been fully depreciated) can perhaps do the job. A spare vehicle’s costs would be primarily licenses, insurance, etc. Its main advantage is the ability to reduce downtime, the scourge of every small fleet. One can also maintain a slim inventory by keeping a spare vehicle on hand because it’s there to take over the run, and you have time to order the parts needed for the disabled unit.

Rebuilt: This booming business entails more than minor repairs. A rebuild job means disassembly, complete cleaning, inspection, replacement of any worn components if necessary, and reassembly. You can do some rebuilding in-house or go outside to specialty rebuilders. The quality of the rebuild depends a great deal on the technician performing the operation and the materials used in the rebuilding. Many fleets have developed a close relationship with rebuild shops for certain components. They have full confidence in the products and are also realizing significant cost savings when comparing the rebuilt parts cost to the cost of new parts.

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Since rebuilding does not involve any component testing, it is more like repair; however, rebuilders don't have access to the manufacturer's specs as a rule. Warranties are available, although they may be a bit on the short side, or strictly limited to purchased parts used to complete the rebuild. Some specialty shops can offer very competitive warranties because of the high-quality work they do.

Remanufactured: A product of an assembly-line process, the remanufactured component is really a combination of new (usually about 15%) and totally reconditioned components (85%). It is tested like a new part to meet the OEM specifications. Design changes that have occurred since original manufacture may also be incorporated into the reman product.

Many OEMs offer reman "exchange programs" where the customer trades in the core component and receives an adjustable trade-in credit, depending on its condition. Exchanging a component before failure saves you money. High-quality remanufacturers:

- Conduct an extensive testing process under realistic operating conditions.
- Offer a warranty written in clear, specific language. Often these warranties are equal to, or even better than, the warranties offered on the corresponding new parts.
- Enjoy a good reputation in the industry.
- Insist on a high-quality finish for the reman component so it also looks as good as new.
- Are often authorized to use OEM company identification or logo.
- Employ a highly trained quality-control staff.
- Have engineering staff that stays current on changes which improve the reman product.
- Maintain membership in a national trade association.
- Have the financial backing to invest in new equipment and attract top-quality people.

No matter where the part was sourced and what type of part it was (new, used, rebuilt, or remanufactured) watch out for cheap imitation parts. This kind of part can run the gamut of legitimacy and quality from doesn't quite fit, to a part that simply fails more quickly, to a part that is downright dangerous.

Key parts terms

We should make some distinctions between all the terms that are currently floating around. "*Genuine replacement parts*" may be packaged under a private label owned by an OEM and handled by an independent distributor. Similarly, *foreign parts* aren't necessarily bogus parts. The medium- and heavy-duty trucking industry operates in a world market today. Many OEMs buy components abroad. Information is your best

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protection here. Check out specifically what the words on the package mean.

“*Will-fit*” parts are supposed to replace a particular manufacturer’s component. In some cases this term has a negative meaning today. While they may indeed do the job, will-fit parts are seen as copies of a product. The manufacturers in this market do not offer any kind of technical support or customer service. Needless to say, they don’t have large research and development departments either. The uninformed customer **thinks** he’s getting an equivalent product at a bargain price.

OEMs would like to see regulations passed to require will-fit manufacturers to meet OEM specs and provide proof of sufficient testing. The OEMs also believe that either the will-fit manufacturer or the distributor who chooses to handle their products should be required to carry product liability insurance. Usually it’s the vehicle manufacturer who is the first to get a claim before it’s discovered that the part in question was manufactured by someone else.

Moving one step beyond “will-fit” is the *look-alike*. The difference is that we are now in the shadow of intentional deception. Even though the look-alike may not at present be judged illegal, it is packaged in a box that is exactly like that of the factory part. Or it may be an identical product in appearance but packaged in a radically different box. A brand name or description may resemble the factory name with some cunning variations. Often the only sign of trouble to an uninformed purchaser is the premature fail date. These manufacturers are depending on the thought that it’s the rare buyer who is suspicious when inspecting parts.

The problem of counterfeit parts

Counterfeit parts are the worst of the cheap imitations. Manufacturers of bogus parts usually choose to copy the high-volume part that moves quickly. Any successful manufacturer is a potential target for the counterfeiter and the practice is widespread throughout the transportation industry: cars, buses, trucks, airplanes, and even NASA equipment for the space shuttle program have been found with counterfeit parts. Counterfeit parts are substandard in quality. A price that’s simply too good to be true may be a clue, however, some brazen counterfeiters charge full price to avoid this suspicion.

The first legislative efforts to protect brand-name labels in the early 1980s did not create much national support on the part of Americans. When the extent of bogus parts-importing and the great dangers to public safety that can result from using inferior parts (safety features were rarely built in) became known, the anti-counterfeiting legislation of 1984 had considerably more support. This legislation dealt primarily with copyright infringement, however, and much more needs to be done.

Remember that it takes a willing buyer to keep counterfeiters in business. If you are a regular customer of your suppliers, they are less likely to cheat you. If you look at more than just the price tag, you’ll protect your fleet from bogus parts and help put the counterfeiters out of business.

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Your best weapon is information. Here are some pointers to keep in mind:

- Deal with suppliers that you trust and know to be reputable. If a supplier is new to you, check it out thoroughly.
- Check on the support services that come along with the products carried by the supplier.
- Ask whether the product meets manufacturer's specifications and has a manufacturer's warranty.
- Ask for customer references and the supplier's product sources.
- The more you standardize, the better you'll get to know the part, packaging, identification system, etc. You and your technicians will know what to watch for — the right amount of filtering material in an air cleaner, for example.
- Don't buy anything on the phone, always examine the part personally, and don't accept anything COD. In fact, 30-day payment terms will give you some time to examine the part and check out how the part is working before you have to pay for it.
- Ask your regular suppliers about new brands from other sources that appear suddenly as a special deal.
- Watch prices, and don't be too quick to switch to a brand-new supplier only on the basis of price. If the prices a new supplier is offering seem too good to be true, they probably are!

It's better to develop some competition between your regular suppliers on price, so deal with several. Get to know them and develop a good working relationship with all of them.

Tracking parts

It's important to know where your parts come from, but you must also track where and when they are used, right to the end of their service life. Recordkeeping on repair orders (ROs) can do this, so try to include the necessary information. Parts yield great information when they lie on the scrap heap also.

Parts/cost tracking

Whenever a part is taken from the parts inventory and used, it must be accounted for. The *cost* of the part must also be assigned to the correct vehicle. If this is not done, studies done to determine the operating cost of a vehicle will not be valid. A Maintenance Pro should be able to open a maintenance file on a vehicle and be able to determine the total cost and cost per mile of maintaining the vehicle. If parts costs are not being correctly assigned to the vehicles, it will be impossible to be accurate.

Also remember to credit back parts costs for warranty reimbursements. If you assign the cost of a part to the vehicle, then a warranty program reimburses some or all of the cost of the new part, there must be an accounting of this or you will not have an accurate maintenance cost for the vehicle. In most cases this will involve going back to the original invoice and work order and adjusting the costs accordingly.

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This includes even small parts such as nuts and bolts. A vehicle requiring an unusual number of nuts and bolts will have additional costs (not only the nuts and bolts, but the manhours to install the nuts and bolts) and may be having problems.

One concept that is in use is “bundling” parts into kits for normal maintenance or repairs. This makes requesting and tracking parts easier for the technician doing the repairs, and places the recordkeeping back onto the parts personnel. Here is an example of assigning a part number to the parts needed to complete a normal PM B (remember, this is just an example, you will need to determine your own parts requirements for a PM B):

Part number 1234567 includes:

- 2 — Main oil filters part number 23456
- 1 — Auxiliary oil filter part number 24680
- 1 — Fuel filter part number 34546
- 8 gallons 15w-40 oil
- 1 quart 5th wheel lubricant

The technician or parts personnel would record the one overall part number on the RO or service checklist when doing the PM, and parts personnel would record the actual parts used later. If the technician needs additional parts (antifreeze, slack adjuster, tire, light bulb, air filter, etc.) the extra parts are recorded on the RO or service checklist.

Who records the parts when they are used?

One internal function you will need to iron out is who will track parts as they are removed from parts storage. There are several different ways this can be accomplished. Here are the most common:

- Designate one technician to be the parts manager. Anyone taking parts out of the parts inventory would need to notify this individual. This individual would then be responsible for documenting the use of the part on the appropriate paperwork (RO, checklist, or parts use ticket). Part of this technician’s responsibilities would also include doing an inventory and ordering parts as necessary. This is used in carriers that are too small to designate a dedicated parts manager.
- Each technician can be made responsible for recording the parts used on the RO, checklist, or parts use ticket. Whoever is responsible for parts (parts person, parts manager, or a specified technician) would then need to review the ROs, checklists, and parts use tickets (and possibly do computer entry) to track the parts inventory and assign parts to the correct vehicles.
- Designate a dedicated parts person or parts manager. In small to medium sized operations this individual could be assigned all parts responsibilities including documenting parts use, warranty verification and claim filing, parts failure analysis, and reordering.

Shop Operations

Failure analysis

All maintenance people recognize that parts do eventually wear out. And if you've been tracking the cost per mile and service life of components, you'll have a pretty good idea of when it's time to finally stop repairing and just replace. You'll keep testing different manufacturers' components to see how they compare with your life-cycle standards. But instead of just tossing aside the part, try to sharpen everybody's observations by asking why the part failed? What kind of wear was observed? Technicians should be trained to tell whether parts are worn by normal wear and tear or abnormal conditions.

Parts should never be thrown away without looking them over. Some fleets store failed parts in a specific location, and trained supervisors and technicians then look through the parts at least once a month. Drive axle failures, for example, need to be analyzed to see if the component failed because of shock, fatigue, overloading, or improper lubrication. Parts that have been repaired in the shop are always checked over. You need to know whether any part failure was a result of:

- Poor PM procedures or inspections that were too infrequent.
- The design of the part.
- Improper use of the part.
- Driver abuse.

Recordkeeping on components, particularly if it's computerized, can track which brands have the longest life, the fewest technician hours, and the best overall cpm. You need to know why they failed, how they failed, how many hours/miles were on the parts, not just when they failed.

Warranty program

A warranty is a guarantee by the manufacturer that you will be reimbursed for early failures resulting from a poor manufacturing process or some fault. To collect on a manufacturer warranty you must have accurate records, starting with hard data that is consistently gathered and maintained.

Naturally you look at vehicle and product warranties before purchase. Any vehicle or parts warranties should be set forth in writing and in detail before purchase. You should ask:

- What exactly is covered, all parts and labor?
- Who is authorized to grant warranty claims (dealer, supplier, manufacturer, etc.) and what is the filing procedure (online, in-person)?
- What is required to substantiate a claim?
- Are any related costs covered?
- When are claims settled (once filed, 30 days)?
- Is there a grace period?

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- Is there a choice of cash or credit once the warranty claim is determined to be valid?
- May any shop (including your own) perform the warranty work or only an authorized dealer shop?
- What is required to get (and keep) your shop authorized as a warranty shop?

New vehicle warranties are the easiest to track. New vehicles come with a warranty package. Simply keep track of the component warranties and compare them to the vehicle mileage or hours whenever a component fails.

Where warranty tracking becomes difficult is when trying to track warranties on replacement parts. Many carriers lose money regularly by tossing damaged parts that were still under warranty.

To avoid this, carriers have developed various strategies. All of these strategies depend on knowing (and recording) the parts warranty, tracking the date and mileage or hours of the installation of the part, and entering the information in the vehicle records (whether paper or computerized). Here are a few of the strategies that are in use to try to catch the fact that a warranted part has failed:

- Whenever a part is removed it is tagged with the vehicle number and mileage or hours. It is then placed in the failure analysis area. As part of the failure analysis an assigned individual does a records search and determines when the part was installed and if there is still any warranty that may apply.
- The addition of a warranty module to the maintenance computer system that warns the technician or supervisor whenever a warranty part is being removed.
- Placing warranty dates on vehicle components so that they can't be overlooked by technicians.
- The designation of a warranty supervisor who is assigned the responsibility of establishing and supervising a custom warranty program.

While computerized records are ideal because they can be accessed faster and can be programmed to remind you when a component carrying a warranty is being serviced, any records system can help you recover more claims. In most cases you must remove, retain, and tag components to demonstrate your claims to the manufacturer or supplier.

Finally, you must remain alert for changes in manufacturers' warranty policies so that you'll be able to purchase intelligently in the future. Submit every claim that you think you're entitled to (even if you are not sure you qualify). Don't say you're too busy to be bothered. You can't afford that attitude. Keep track, too, of all warranty claims, payments, settlements, and denials in a separate book, and review these periodically.

Shop Operations

Stocking parts: The inventory

If it didn't cost so much, all fleet shops would have a big parts department so the right part would always be in stock. Inventory can be a sizeable investment; first of all, the parts themselves, then storage costs, insurance and property taxes, and the cost of obsolescence if the part isn't used. So it's evident that better inventory control can save the fleet some money.

All fleet shops must have some parts on hand for a single, important reason: to reduce vehicle downtime. And that's the only reason for stocking parts. You need them to be available immediately for use when they're needed for service or repair. So you must balance the cost of carrying the item in stock against the certainty of its availability.

All inventory systems must decide:

- What to stock.
- How many to stock.
- When to order more stock.

What to stock — A simple thought process should go into this decision. You will need to study parts use over a specific period. What you are looking for are parts that move quickly off the shelves and parts that left vehicles sitting. If vehicles were sitting waiting for parts, examine what parts were involved and how often this happened. It may be beneficial to stock one or two of the parts, even if they are expensive, to avoid downtime.

How many to stock — This is also an area that simply requires some study. Keep track of the volume used to determine what the parts inventory should be. The window that many experts use is 30 days. At any given time you should never have more than a 30-day supply of any part, no matter how frequently it is used. If it sits on the shelf for over 30 days you are in a situation where you have paid for a part you are not using.

The only variable that may change this is bulk discounting or bulk buying to avoid a known price increase. If buying larger quantities of a part will reduce costs, it may be worth the purchase (however, remember to consider your cost of paying for and then carrying the parts on your shelves). However, bulk buying seldom-used parts can never be a winning proposition (extended carrying times/costs and the possibility of obsolescence). This applies even if your parts dealer offers an annual overstock buy-back. This program can help reduce the impact of overstocking, but the parts dealer will charge a restocking fee.

To assist in managing this, some carriers date incoming parts. This can be done using a manual system or dating the part in the computerized inventory and setting a flag to pop up for parts that have been shelved for too long. The ordering situation around any parts that stay on the shelf for more than 30 days is then investigated.

When to order more stock — When to reorder is closely tied to how many to stock. The frequency of the use of the part will determine this. If the part is one that moves slowly (one or two per month) you may be

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able to reorder when the last one is used. Parts that move through the parts department in a hurry may require reordering while there are still several on the shelf.

One industry expert believes that most fleet shop inventories are too high and that in terms of dollar amounts, about a month's turnover should be on hand at any one time. This amount would vary with the amount of work performed by the shop or if the parts supplier were close by. We have already mentioned that standardization of equipment would also require a lower level of parts inventory.

You can also look to your supplier. Many truck manufacturers and parts dealers offer extra services to attract and keep customers, such as assistance with inventory control. Inventory stock can be reduced by having close communication with a well-stocked supplier that ships just-in-time (JIT). This is an ideal situation, but success depends on a guaranteed delivery time if the supplier is some distance away.

The other consideration is how well-stocked your local suppliers are, and their delivery speed and your ability to send someone for parts. It may not be necessary to stock seldom-used parts if your local suppliers are well stocked on the part. Also, if your parts dealers are willing to stock for you, especially in the case of additional needs (having to replace all of the water pumps in the fleet), you have less need to stock the parts on your shelves.

What to stock, how many of the items to stock, and when to reorder requires forecasting what the future needs. This requires studying previous use patterns and trying to forecast future use. If all things remain constant, past performance should be a reliable indicator of future requirements. However, if the fleet is allowed to age or is turned over at an accelerated rate, adjustments may be needed.

An important task of any parts control system is reducing inventory by getting rid of obsolete items and parts that are overstocked to the point that you will never use all of them. It is important that the parts inventory system helps to identify these white elephants. Once identified they need to be moved on. Possible solutions include selling them back to the supplier (either as an independent item or as part of an annual buy-back program) or selling them outright. Either way, get rid of these white elephants and get at least some of your money back before you are stuck with them permanently.

Inventory control

Manual control

While many fleets have computerized their parts control, a manual system can be just as efficient if the system is organized and the parts people are trained. Most manual systems are based on organization by bins, or parts boxes stacked on shelves. Each bin lists the part number, price, and minimum and maximum quantities permitted. Designating a fleet part number classifies identical parts which could have different manufacturers' numbers. And of course the parts room is organized with heavier things on the floor; small, high-volume items in the front, etc.

Shop Operations

Regular physical inventories conducted by the parts people must be made so the inventory can be kept stocked and parts don't walk away.

One small fleet that has plenty of storage space and an organized technician in charge, has lots of extra salvaged and rebuilt parts to back up the regular parts department. When there are no vehicles in for service, the technicians clean, check, and rebuild the parts that were removed from vehicles.

A manual system would also need some kind of master record of what's in stock. As parts come in they could be logged on a master parts card (identified and indexed by part name and number) together with quantity and price. Parts are charged out on the technician's RO; when the repair is over, the parts are deleted from the master card inventory. It's detailed work and time-consuming, but that's a necessary part of control.

An accounting system can then be developed that pulls parts use off ROs, adds in restocks, and generates a parts count. This is then compared to the parts inventory as determined by the parts cards.

Finally, if you're located in a state with high taxes that consider property or stock on hand, you'll want to deliberately reduce the inventory at fiscal year-end. This way the inventory will be reduced when the assets of the company are calculated. Once the tax inventory is completed you can slowly build the inventory back up to a more comfortable level.

Computer control

A computerized inventory system keeps track of parts automatically and effortlessly. Some software systems can print out a list of needed parts when the number of items gets down to a predetermined level. These systems will assign company control numbers, keep track of bin locations, and even print bin labels.

The system can use manual entry, bar code reading, RFID chips, or a combination of all of these (RFID on large items, bar code and/or manual entry for smaller items) to track items entering and leaving the inventory. Once established, the inventory system can have flags installed at predetermined inventory levels. If too many or too few parts are on hand, based on the control numbers, the system will notify someone.

These systems can also make cost tracking easier. The actual cost of the part at time of purchase can be tracked and stored in the system. Once the part is removed from storage and placed on a vehicle, the vehicle can be charged the actual value of the part. Manual systems can have trouble with this if the part has been in the inventory for any length of time. Also, if there is a warranty reimbursement later, this can simply be updated in the computer system. Manual systems may require retrieving and updating two or three paper records to accurately reflect the reimbursement.

Large fleets with several terminals may have a central parts warehouse to serve them. The computer can carry the total inventory, displaying on the screen the parts availability of any item. Almost any kind of report can be generated: shipping lists to a single terminal, quantities adjustment, inventory on hand by terminal, etc.

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How often to order is the final inventory decision; it should be based on past demands, not simply replacing parts used. Establish a lead time — the time between arrival of a new order until the reorder point is reached — for parts so that the ordering process can run smoothly. Good service from a supplier can help. A fast telephone ordering arrangement with vendors can be useful if storage limitations force the shop to stock fewer parts. But established lead times can help you get better prices and fewer emergency situations.

Vehicle Maintenance Pro

Shop Operations

Recordkeeping

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Maintenance and repair recordkeeping

There are two reasons to maintain records of all maintenance and repairs.

One is operational in nature. By saving data on all maintenance and repairs, you will have an accurate database to mine (refer to as datamining) when decisions need to be made on everything from equipment replacement to employee award programs.

The second reason is compliance with the Department of Transportation regulations, as published and enforced by the Federal Motor Carrier Safety Administration. The FMCSA regulatory recordkeeping requirements will be discussed later in the Compliance Management section. However, if a carrier is using a complete and effective recordkeeping system for operational purposes, it should meet or exceed the FMCSA requirements.

One key point about recordkeeping: As far as your internal tracking and the FMCSA are concerned, if you didn't document it, it didn't happen. This lack of documentation can create several problems. First, you will not have records to make sound decisions in the future. Second, you may end up fined for not complying with the regulations, even though the only regulations you are not complying with are the recordkeeping requirements. The documentation that shows what was done in the shop is the repair order, or RO.

There is also one other compliance issue to consider, whistleblowers. Any employee (technician, driver, dispatcher, etc.) has the right to complain to either the DOT or OSHA about unsafe conditions that the company has refused to address. When it comes to complaints about unsafe equipment, if a driver is able to show safety concerns were brought to you (such as the driver turned in a DVIR listing safety-related defects) and it is determined that you failed to act on them (due to a lack of documentation), you could be in serious trouble.

An example would be a driver complaining about the truck constantly "pulling" to the right. If a technician checked the tires, suspension, and alignment, and took the truck on a check-ride, but did not complete an RO for the inspection because he "really didn't do anything," you have no proof that the complaint was addressed. The proof that you addressed the driver's safety concerns in such cases should be on the associated ROs.

Aside note on whistleblowers. If you determine who the whistleblower is, you cannot take adverse action against him or her due to the complaint. To do so can trigger serious consequences for the company, and potentially the supervisors and managers involved.

To sum this up, a good RO and RO system (some carriers and shops refer to this documentation as a "work order") provides a detailed and accessible history of the vehicles and all work done to them.

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Simple, handwritten ROs

In a small shop the repair order is the primary piece of paperwork because it:

- Communicates to the technician exactly what has to be done (in some cases it may even be generated by the driver).
- Authorizes personnel to order the necessary parts or withdraw the parts from the inventory.
- Acts as a purchase order for parts and services outside the shop, i.e. tires and batteries or an alternator rebuild.
- Provides a record of work performed by technicians.
- Provides a record of work performed on the vehicle.

Basic information. You expect the RO to identify the vehicle, the date, mileage at the time of repair, the reason for repair, the parts used, who performed the repair, and the cost. This information is called historical data; it is simply a collection of maintenance facts.

RO forms vary in complexity. The number of people who handle the RO is small in a little shop, but as the shop grows, the maintenance department may need a repair order with more detail. In the first repair order example (small shop) the “instructions” section of the RO is meant to be completed in writing by the person issuing the RO and read by the technician, supervisor of an outside shop, etc. It’s possible, though, for the reader to misunderstand the orders if they aren’t written clearly. There may not be too many choices for reason for repair (“Other” can invite a variety of definitions for the same thing).

Another problem with this type of RO is the maintenance pro has to go through lots of lines of handwritten material to figure out what’s going on in the shop!

To get a clear picture of your operation, you should be able to take the ROs for a single unit from the past year or so, and make some conclusions about your maintenance plan. Try not only to look at maintenance facts or historical data, but how the information categories can help you spot potential problems.

The RO should be a treasure chest of facts, but they are of little use until you put them to work.

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Historical data — This section (top right) of the RO identifies the company and the unit, and tracks its mileage or hours (“odometer,” hubometer, or hour meter, or just “meter” reading might be a better word choice!) through its service life. Mileage/hours can be checked, too, against fuel tickets, driver’s logs, or dispatch records, etc. The meter’s reading:

- Is the basis for a PM schedule.
- Pinpoints the time when any component failed.
- Shows vehicle utilization (when you compare it with other units in its group).

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- Shows downtime problems (when you compare it with other units in its group).

Breakdown category on the RO — This RO area is extremely important to your operation. It doesn't take long to discover if you have a problem with breakdowns — but how many are too many? One of the maintenance shop's primary goals is to have no breakdowns at all. So this "reason for repair" will be the first one to act upon and try to reduce frequency.

How is it done? PM, of course. That's the primary purpose of PM in a nutshell — to cut out breakdowns and reduce costs of downtime. If you are seeing "Breakdown" checked a lot and a variety of components listed, you should review your general PM practices. If a combination of "Breakdown" and certain component repairs seems always to be on the ROs, this tells you something else. Earlier replacement of this component will need to be done on existing vehicles during PMs, and a more robust component should be looked at on new vehicles.

Driver's Report category on the RO — The Driver's Report category has much food for thought. First take a look at the driver:

- Do some drivers complain more than others?
- Are the drivers knowledgeable on the equipment they are operating?
- Does one vehicle get more driver complaints?
- Are drivers kept informed about the results of their complaints?
- Is there good paper communication (the driver inspection report) between driver and shop?
- Are maintenance inspections finding problems that the drivers are not reporting?
- Does fleet management need to look at a better method for screening, training, or testing drivers?

Inspection category on the RO — How do you define the Inspection category? Is the entire vehicle inspected at one time? Is this different from scheduled PM inspections? Be sure that the person completing the RO knows whether a diagnostic check of the vehicle falls into this category.

PM category on the RO — The temptation in the PM category is to combine the work with other procedures. The truck is brought in for a driver complaint, so let's do the PM too. Another situation that arises frequently is while the technician is doing a PM, a major problem requiring repair is discovered (unrelated to the PM). Some operations will include this work in the PM category. But combining information like this throws off the RO. Only one box should be checked in the reason-for-repair section. Use another RO for the second procedure.

"Other" leaves too much room for interpretation if it's not given some conditions! If you use a simplified RO, let the preparer know exactly what the choices are.

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The parts section in this simple RO again requires that you read and work through word descriptions when you try to get a feeling for which components need work most often. Have you standardized these identifications? You can keep an eye on prices and perhaps select a more competitive supplier by watching the ROs.

Now may be a good time to think about parts-flow to technicians. Could you put in a better system? Do your technicians check out their own parts? How could that system be streamlined? Would you like to improve your inventory system? Some things are missing from this simple form if you want to improve your parts control.

Note, too, that there are no provisions on this RO for analysis of failed parts unless it is included in the technician's repair description. Do you keep failed parts? Do you discuss them with technicians? Do you want to capture the reason a part was replaced or repaired for later analysis? If so, you will need to add some additional information onto this RO.

This RO doesn't help with warranty claims either. No separate identification box is set aside for this important category. Warranty recovery and failed-parts analysis are two areas sometimes neglected by smaller fleets whose people simply don't have the time to follow-up. Do you fall into this group?

Task and time recording — Tasks and time as recorded by technicians are the major items of interest if you are trying to make the shop more efficient. If the technicians do not get specific instructions in this area, there can be problems later.

There are provisions on this RO for logging in and out of the task, so by looking at this portion of the ROs, you can compare time spent on the same task by two technicians. However, it is important the technicians correctly record their work for this type of RO to work. If the technician records only a PM, but in the course of performing the PM repairs several defects, it can create problems. If the technician does not record the repair work correctly, then it appears the technician was slow when performing the PM.

To address these situations you will need to answer a few questions. How good are your technicians' work descriptions? Have you standardized terminology? Does your RO have a place for a technician's comments beyond the "work accomplished" description? Are you able to track a technician's non-work time on the job (such as waiting for parts)? Are all the people who handle the vehicle during the service process represented on the RO? Washers, chasers, helpers, and fuelers need to be included. And finally, do you have a way to estimate repair time and then compare it to actual time?

Also, is there a way to indicate if the repair is "rework"? Rework involves having to repair something that was already repaired once. In the case of rework you not only want to know it is rework, but why the rework was necessary (part failure or technician error) and who did the original work. This simple RO does not have any way of recording this (other than the technician's hand-written notes).

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Another issue you need to be able to track is time spent by technicians on “direct” and “indirect” work. Direct work is time spent repairing, maintaining, inspecting, or otherwise working on vehicles. Indirect time is time spent doing other required tasks, such as set-up, waiting for parts or assistance, waiting for a scheduled vehicle to appear, travel time to a disabled vehicle or to pick up parts, cleaning up after a job, training, etc. It is time that is necessary for the technician to do his/her job correctly, but it is not time spent directly doing their actual job.

A simple view of indirect time can be created by comparing time “punched in” to the times on ROs. If the technician had eight hours on the clock for the shift, but only had six hours of time on ROs that day, then the technician had 2 hours of indirect time. The trick is having enough data to determine if the indirect time was time well spent, or if it was unproductive time that was either unnecessary time on the clock or indirect time that could have been prevented (such as running to a parts store for parts for or waiting for parts to be delivered). Some shops, in an attempt to capture more realistic data when it comes to direct and indirect time instruct their technicians to make sure to detail out set up, clean up, waiting time, and other indirect issues on the correct RO, and then these hours are pulled off of the ROs and recorded separately. Other indirect time (such as training time, bench rebuild time for a part not assigned to a specific vehicle or job, and time spent waiting for another assignment) is then captured using another mechanism.

Just an FYI: A standard goal in the industry is to see a direct/indirect ratio of 85/15 (85 percent of the technician’s time should be direct time). If you cannot achieve this, then it is generally accepted that process improvements are needed to get the technicians away from spending time on unnecessary tasks.

Yearly totals will help decisionmaking —Tracking the repair hours per vehicle over the past year gives you an idea of how many technician hours are needed to maintain the fleet. This information in turn helps determine how large a staff of technicians is needed. Do you suspect that your crew is overstaffed? Are there too many crisis situations involving overtime, followed by “slow” periods?

Determining man-hours necessary and scheduling maintenance will help even out the workload and keep the staff “lean.” Working with the dispatch group to spread out the workload can help avoid this “overload”/“no load” work situation in the maintenance shop.

Vendor area on the RO —In many cases you may be using outside vendor services. These are most commonly used to provide extra capacity to the shop (overflow), provide long-term repair capabilities (engine rebuilds, etc.), and provide service and repairs to vehicles that are not housed at the home facility. Of course another reason for using vendor repair is an on-the-road breakdown (not a preferred situation).

This short list of questions may trigger actions that may apply to your situation when it comes to vendors:

- What are the reasons for buying outside maintenance?
- Are minor repairs done off-site because of breakdown emergencies?

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- Are they done outside because your own technicians are tied up?
- Are repairs being done by a vendor because of a lack of qualified technicians to perform specialized repairs?
- How many hours is it taking vendors to complete maintenance tasks and how long are vehicles kept waiting for service at vendor locations?
- Will doing more work in-house reduce downtime?
- Will doing different kinds of work in-house pay off?
- Can you increase efficiency in-house to accommodate more work?
- Will the use of a vendor shop reduce downtime?
- Will using a vendor shop for either very short or very long maintenance tasks improve shop turnaround times?

Whatever the reason the outside vendor was used, the work performed by the vendor should be RO'd into the company system, and the RO should clearly indicate that the work was performed by an outside vendor.

Do you need a more detailed RO? You should give some thought to whether your shop's RO is sufficiently detailed. In a small operation people can operate by word of mouth and things usually get done! But when data is needed for decisions, the need to get information from the past ROs becomes important no matter how small the company. Try remembering how many times repairs classified as "breakdown" were performed on a vehicle over the last four years!

As the maintenance pro, you may not have the time to draw conclusions from handwritten comments on the simple ROs. If this is the case you'll want a more complex RO, one that can be completed quickly. Check-off items rather than instruction/description lines standardize information. A series of check-off codes means that even more information can be itemized on the RO.

VMRS ROs

The American Trucking Association's Vehicle Maintenance Reporting Standards (VMRS) is a coding system that is used throughout the world as an industry standard. The VMRS has been developed over a period of time to cover every aspect of the maintenance operation, from assigning component codes down to individual parts to failure codes like "bent, foreign material present, not drilled, poor metal finish," etc. And you probably already know that by standardizing reasons, causes, and actions into codes, these maintenance facts can be entered into the computer for easier processing.

The RO is the most important source document for a computerized maintenance system. The second RO example uses VMRS codes. However, it would work equally well whether your maintenance operations were computerized or not.

In many cases the VMRS ROs only require the technician to check a box. The checkmark then identifies the coding. In other areas the technician simply writes in the two letter code that matches what was performed, or found. Wherever the RO form does not provide a check box (such as where

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More advanced VMRS RO systems will incorporate more data in the same structure. As well as asking the technician to provide a reason for the repair and parts used, the VMRS can also ask for the specific reason a part failed and had to be replaced. All told, VMRS includes over 80 “code keys.” Each code key captures specific data pertaining to the vehicle and the maintenance or repair performed on it. The code keys are “strung” together to create a sentence explaining who, what, when, where, and why to each and every repair or service.

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Many OEMs are now accepting VMRS downloads into their online warranty systems, making claims filing considerable easier. If the carrier codes the repair once using the VMRS, the OEM may not require recoding to match their system.

This is one of the drawbacks to using any handwritten system. Many OEMs require coding of repairs, meaning the written repair order will need to be changed over to the VMRS coded system before any warranty claim can be filed.

Analyzing Data

Analytical data—There is a minimum set of data we want to collect and use. We want to be able to identify the vehicle, be able to determine what happened to it, what was done to correct it, by which person, where, and at what cost. These maintenance facts then can lead to analysis. To accomplish this the ROs must:

- Capture the correct data.
- Capture the data at the earliest possible moment.
- Be free of errors and omissions.
- Be quality checked for accuracy.

The analysis that follows must:

- Make comparisons that are meaningful to you.
- Put the comparisons in a report format that is easy to understand.

For example, consider a simple monthly report that lists each fleet vehicle that includes the following information:

- Total mileage on the vehicle.
- Mileage run in the past month.
- Fuel consumed during that month.
- Average miles-per-gallon for each vehicle.
- Oil consumed for each vehicle during that month.
- Miles-per-quart or miles-per-gallon engine oil consumption.
- Maintenance cost for each vehicle.
- Maintenance cost per mile for each vehicle.

This would be an uncomplicated report that is easily read. You don't have to be an expert to look at the numbers and figure out that one truck had a real fuel-economy or oil-consumption problem. Good maintenance reports are only possible if you choose the items of information that you need and create a recordkeeping system that makes sure the correct data is captured and nothing gets lost.

But the fleet can't afford a computer system to keep track of all this, you say. Even with a manual system, i.e., preparing the RO by hand, you should standardize the information as much as possible (even consider using numeric codes rather than long hand-written explanations). This

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will shorten the RO completion time and organize your recordkeeping. Also, having RO standards in place will make manually compiling data faster and easier. Finally, should the fleet decide to computerize or switch to the VMRS system, you'll be prepared with data that is already standardized.

A word of warning. It's as easy to get too many stacks of paper that you cannot analyze as it was to lose control of the ROs in the first place. That's why it's a good idea to start slow when compiling reports and analyzing data. Remember that reports should:

- Be easy to generate with existing data.
- Give a picture of a vehicle's health by providing up-to-the-minute cost and repair information from the records.
- Identify high-cost maintenance areas.
- Spot and correct trends.
- Point out problem vehicles, components, and personnel.

These days you can get very sophisticated computer systems which include all kinds of very useful management data, or you can start slower and upgrade your system as you go along.

Reports can also remind you of upcoming PM requirements. One report that many carriers run daily is a report that identifies vehicles that are coming due for PM. Also, reports can be used to track the vehicles that have or have not had specific work performed (such as recall work or upgrades).

More advanced reports can be summaries or comparisons of the fleet's historical data. Reports can compile a list of RO items according to vehicle, driver, PM schedule, technician, or vehicle make. Analytical reports compare the compiled data, i.e. vehicle downtime hours versus maintenance hours or elapsed miles since the last PM versus elapsed miles since the last repair situation.

Computerization is money well-spent when it comes to developing and using analytical reports. Computers make storing and moving numbers around fast and easy. You can spend lots of time comparing this to that in a matter of seconds. But is it useful?

Computer salespeople are fond of showing you reams of printouts from a huge variety of reports to make a sale. The question to ask is how useful are the results of the analysis? Or, phrased another way, is there action that can be taken based on what is found in the report? If not, the report is of little value.

One key point — computerized shops do not have problems generating reports on components if the data is entered correctly. If the system is not using a standard reporting system (such as VMRS), the computer is of little use. Vague entries in a computer system create the same problems as vague entries in a paper-based system.

Tracking ROs to extend component life should be one of the goals of any datamining. Do you recall how life-cycle studies were used to determine

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maintenance cycles? If components are carefully tracked, a maintenance pro can better decide when to trade based on what projected costs are likely to be and what components to consider upgrading on the next generation of vehicles.

Manufacturers routinely use computer programs to compare old-vehicle costs and new-vehicle costs to help the fleet personnel in purchasing decisions. There is no reason the maintenance pro cannot use the data generated through the ROs to make the same decisions internally.

Components have a service life and can be tracked if you have all the necessary information. Costs per component can be monitored, and a cpm per component can be calculated. When spec'ing major components, a manager needs to know more than the purchase price. He wants to know what the future maintenance costs of those components across the service life are likely to be.

This is applying life-cycle costing to the component. Just like a vehicle, components costs include:

- purchase price,
- repair frequency and costs,
- PM costs,
- replacement costs, and
- loss of revenue from vehicle downtime.

These are all figured into the cpm by adding them up and dividing by the mileage at the time of replacement. By pulling information from ROs, the cpm of one component in your fleet can be compared to that of another make.

The bottom line is that the fleet needs maximum life from components as well as from vehicles.

RO tracking and reports from the information collected is your ace in the hole. One key point — you have a greater stake in repair-tracking than cost-tracking. Think of it this way, wouldn't you like to catch component failure before it happens than be able to clearly define what the failure cost?

Can road failures ever be eliminated completely? In the not-too-distant future, you'll be able to spec components hooked into electronic sensors that will signal imminent failure. But until the red light or buzzer is installed in the truck — and at a reasonable price — you'll have to rely on the observant eyes and trained ears of fleet personnel and reports from the maintenance records.

Expected component life system (ECLS), which was discussed in the Determining Maintenance Schedules chapter, is one critical output of the recordkeeping system. Simply stated, ECLS means changing the part before it fails. The information needed to implement ECLS is in the ROs and the reports that can be generated. One fact that can be assessed from the ROs is the mean time between failure (MTBF). MTBF studies are performed by mining the data provided by ROs (or the computerized

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maintenance records). As discussed earlier, MTBF is the average time and/or mileage that a part is known to fail at. Determining the MTBF is a fairly simple exercise if you have the records (ROs or computer records).

Begin by locating and logging the past repairs of a group of like-vehicles. Be sure to log the length of time the component was in service and the mileage at time of repair or replacement. From this simple data set you can determine the MTBF. If your records are computerized, it can be even easier. Simply ask for the report.

You won't see immediate results with ECLS — patience must be your strong point. Initially, maintenance pros trying to implement the idea have met resistance from management and members of their own staff. It requires accurate data, time to track and analyze the data, and a commitment to acting on the information discovered. Today, thanks to positive fleet experiences with PM and ECLS, changing components before failure has become accepted practice.

The more detailed the records, the better. It is important that the data be available to mine. If, when the ROs were completed, the technicians were not recording either historical data or components and systems being repaired or replaced, the MTBF cannot be determined accurately. This is where having standards in place and using a system such as VMRS becomes critical. The data must be there, and be in a usable format.

As you go through the ROs, zero in on the “instructions/work accomplished” and language. Can you tell exactly what happened to the component, based on what is written there? Was the component changed due to mileage, wear, damage, or a driver complaint? When it was removed, what condition was it in? If the shop has been using a simpler form that requires written rather than check-off or coded responses, insist that the entries be concise. A vague “won't run” or “changed” is no help. Why it wouldn't run and why it was changed are important details!

Using truck system, assembly and part identification codes, failure codes, and reason for repair codes on the RO speeds up the search and also paves the way for changing over to a computer or VMRS system.

The data can provide guidance on everything from when to replace components in the PM program, to when vehicles should be replaced.

Even if your vehicles go out-of-house for some work, you need to monitor those ROs in just the way we have described — both costs and repairs! Demand good work from your vendors. Compare vendors and change if necessary. Insist that they operate according to the standard that you have set up.

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Putting the data to work

Here is a case study in putting all the data available into use to determine when components should be replaced based on the records kept at a carrier.

Begin with these steps:

- Go through your ROs and write down the mileages at the point where all key components failed.
- Average the total for all vehicles in your fleet; this brings you to a MTBF for your fleet on the components you are studying.
- If you already have a standard in place, how is the fleet performance comparing to the standard for the component? Are you having failures of the component before the standard calls for changing it?
- If no standard exists for the component, choose a mileage under the MTBF at which your fleet will replacement the component.

You should always group like-vehicles in your own fleet when making this kind of comparison. By doing this, you develop more accurate analysis, and you will be able to compare the different manufacturers or generations of vehicles.

Here is an example of why you need to group vehicles rather than studying the fleet as a whole. While going through the analysis you notice that a specific make and model of engine is requiring a rebuild at considerably less mileage than other makes or models. If you had grouped all the vehicles together your MTBF for engines would have been lower as a fleet. You may have “thought” you were doing more rebuilds on those engines, but you would not have been able to prove it. By having accurate data and separating the data correctly for analysis, you know you have a problem.

After grouping vehicles, and tracking and analyzing the data, you determined on average that:

- Alignments are being done at 100,000 miles.
- Engine tuneups are being done at 100,000 miles.
- Alternators are being replaced at 200,000 miles.
- Fan clutches are being replaced at 150,000 miles.
- Turbo chargers are being replaced at 250,000 miles.
- Water pumps are being replaced at 160,000 miles.
- Engine rod and main bearings are being replaced at 250,000 miles.
- Air compressors are being replaced at 250,000 miles.
- Fuel pumps are being replaced at 300,000 miles.
- Rear axles and transmissions are being rebuilt at 550,000 miles.

Again, if you are using a computerized system and/or a VMRS-like system, the task will be much easier.

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The next fact you need to determine is: how does this line up with your maintenance schedule? Are the components being replaced or rebuilt on schedule as part of the PM program, or are they being replaced as the result of a failure? Worse yet, how many had to be replaced on the road?

If you have never had a particular component fail (every time the component was changed it was in good condition and only changed due to the PM interval), you could try extending the mileage. If there are too many failures, decrease it. Remember that if a truck's operating environment changes, you need to look at the standard again. Similarly, if a component design changes, a heavier-duty component becomes available, you may try extending the interval.

When the standard mileage interval comes around, you can decide action at that time. If something else needs to be done on the truck, fine. Bring it in. If an inspection, etc. is coming up next trip, you can delay the component change, because there are some "maneuvering" miles built in.

The point is that you decide, you control, using the data provided from your ROs.

The Computer and the Shop

Throughout this section of the manual we have made references to standardizing and simplifying your maintenance records so that they will be ready for processing. The computer excels at keeping track of facts and figures, and making long and tedious manual calculations quickly and easily. It is also good at doing repetitious tasks. And a computerized system is the best way to store extensive records in an organized fashion. It will work with the same data in different ways; for example, we have seen how the information on one RO can be used to track a problem component or check the reason for an unscheduled shop visit.

Up until recently, computerization was beyond the reach of the small fleet maintenance shop because of the great expense required to set up and operate a system. However, the personal computer has put computer capability within the budget of most fleet operations. Besides being relatively inexpensive, personal computers are easy to run and are quickly installed. Even if the fleet expands suddenly and decides to computerize on a larger scale, many personal computers are capable of being part of network systems. It's therefore possible to have a personal computer in the shop which is connected to the larger fleet system.

If you have a manual system that is operating smoothly, but you wish to investigate computerization, take some time to check out magazines and buying guides. Trucking and association magazines regularly have features on computer software (the program that runs on the computer) specially designed for the transportation industry. You will naturally be interested specifically in maintenance programs or maintenance modules that are part of a larger truck fleet package.

If other computerized fleet shops have operations similar to yours, check out how well the computer is serving their needs.

The first software package intended for personal computers and designed for vehicle maintenance (from 5 to 600 units), was HERCULES,

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developed by a company called Computer Task Group. The program ran on Apple and IBM personal computers. Today maintenance programs for personal computers are being developed constantly. They range from simple tracking systems to very complex and detailed software systems mostly suited for larger fleets. The price of the software will generally dictate the level of user.

Another alternative is “*Keller’s Maintenance Manager*.” This is a versatile software program that can help you meet annual vehicle inspection requirements, track maintenance and repairs, plus establish a cost-control program. The software enables you to efficiently handle the recordkeeping and track the status of specific mechanical components that must pass DOT’s annual vehicle inspection requirement. It also allows you to create detailed maintenance histories for both tractors, trailers, and other equipment. With this multi-faceted software, you can perform such functions as analyzing equipment costs, tracking vehicle usage, and creating tractor/trailer preventive maintenance schedules and cost analyses.

What can you expect of maintenance software? A basic maintenance software program tracks fuel, oil, and repair costs and schedules preventive maintenance intervals according to your system (PM). Inventory control for parts is often the next task that a manager likes to see computerized. As with most maintenance software systems *Keller’s Maintenance Manager* has an optional Parts Inventory module.

Ask software suppliers which personal computers their programs will run on and ask to see samples of their reports so that you’ll see exactly what information is given and how it is presented. Even better, take a look at an interactive demo that allows you to actually do some sample entries of information.

During your investigation of maintenance software, you should discuss your department’s needs at length with a competent consultant or salesperson. You will probably start by selecting some off-the-shelf software. Such packaged software has usually been debugged (errors identified and corrected) and proven in actual maintenance shop use. Consequently, there may be no dealer support offered — just a user’s manual.

If this is the case, check the user’s manual carefully and inquire from the dealer whether help will be available for you or your employees. It may pay off in the end to purchase maintenance software from a known supplier that also provides some kind of software support for users of the maintenance program. If you are part of a fleet, other transportation-related operations such as routing, freight billing, driver settlements, etc. may be part of an integrated fleet system (data is only entered once and is then available for other parts of the operation) in addition to the usual business functions like accounting, payroll, etc. Chances are a maintenance module is also available as part of the fleet’s system. If your shop is part of a private fleet, the main business of the company is not trucking, so you’ll have to examine any maintenance software more closely to make sure that it is compatible with the company’s other software and hardware.

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The hardware which performs the task includes the computer or micro-processor itself and other components (peripherals), like the keyboard, display screen, printer, and storage in the form of hard-drive disks and disk drives (CD ROM or CD RW). Large fleets with several terminals may link the independent computers to a network or mainframe system. The hardware must be “powerful” enough to handle the tasks you want it to perform at the speed which you desire.

Maintenance records form a database, a large body of information which is continuously updated. It’s organized in such a way that any piece of information or collection of data can be identified, analyzed, and summarized. Databases are simply your files; a vehicle history, for example, is stored on a disk instead of paper — the information is added and updated as needed. The larger your maintenance operation is, the more records you will have and the more time it will take to sort and process whatever data you want to appear in a summary report. This aspect, too, will need to be discussed with your salesperson.

Consider who will be working with the computer in your operation. At the beginning, when building up the database by keying in past history and repair order data, you’ll probably do some of the work yourself to see how the system works and then hire a clerk to complete the chore. (You’ll be running both the manual system and the computer system concurrently for a couple of months as a check when the computer first goes “on-line”.) Will this individual continue to input daily information? Do you want the mechanics or parts person to handle the keyboard? Will you be doing it? Remember that good reporting depends on error-free information going into the system.

There is always one large concern with any shop system. Is it user-friendly? When the system is demonstrated, check how easy the program is to use; does it “prompt” the user, for example? Are there point and click or pull-down possibilities, or will everything have to be typed. Can other computer files be imported rather than having to be typed in? Can the system work with onboard computers on the equipment (with the correct software installed of course) and laptops that may be in use in the shop?

How “user-friendly” the system is and how well it cooperates with other computers already in use may be very important in how quickly it is accepted by employees. It’s true that some measure of discipline is also required in getting full value out of any computer. When computers first became available, users soon realized that one had to input data almost every day to really put the machine to work. Data must be entered methodically and on a regular, timely basis. The more user-friendly and cooperative the system is, the more readily it will be accepted.

One of the advantages of having an in-house system is the immediate availability of the latest information. However, if data is several days old before it’s even entered, you will not see the full advantage of the system. You’ll have to establish an orderly flow of information within the shop to accomplish this. What sort of reports will you be looking for from the maintenance software you buy?

We have discussed how coding the ROs (the use of VMRS or a similar system) can make the information contained on them easier to process.

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Similar information can be code-keyed in from parts receipts, fuel and oil receipts, outside vendor invoices, etc.

Your challenge will be to manage all this data, so it pays to start slowly and know what you want. Deciding what reports you want the computer system to generate can help you determine what you need to be entering up front.

Cost comparisons are the most frequently requested reports for any fleet. They give month-to-date, year-to-date, and life-to-date costs per mile (or other measurement) for vehicles and components. Component analysis by life-cycle tracking (vehicle and component histories) is another aid to the small fleet. Identifying repeat failures can lead to better PM scheduling in order to check the component before it fails or to allow better specs to begin with.

Troubleshooting. A manual shop system doesn't offer the quick spotting of rework jobs and problem components that a computerized system does. And don't underestimate the value of a computer printout when dealing with component and parts vendors about prices, warranties, etc. Nothing supports your argument like accurate documentation.

PM scheduling tells which vehicles are due for inspection/service according to mileage, hours, days, or weeks. An overdue vehicle summary report is thus possible. PM scheduling and reporting should be tested before making a purchase commitment. In some systems, the scheduling portion of the maintenance program can be fed with dispatch information, putting the maintenance personnel on notice that a specific unit that is due for work will be at a maintenance facility on a specific date or specific time, making scheduling shop time much easier.

Some programs can generate ROs or purchase orders (in the case of an outside vendor shop) based on this information that can include the "necessary parts" list for the scheduled work.

Trouble alerts (flags) are something else these systems can provide. If a technician or supervisor puts in a specific part or job number, and the cost or hours are way over or way under the norms, some systems will immediately report this or "flag" the part or job for inclusion in the next error report. The key then will be to figure out if you actually did pay \$200 for a windshield wiper, or if someone has made a recording error. Common problems are that someone used the wrong part number (such as replaced the wiper motor but used the wiper part number) or grouped work that belonged to another job to the one in question. There also is the possibility that you actually did pay \$200 for the wiper, and you would want to know that to make sure you did not use that vendor again! Either way, you would want to know about the incident so you could investigate it!

Fuel consumption reports mpg performance of different vehicles, based on the fuel receipts. It may be possible to print a summary report comparing the same vehicle over time or several vehicles (in order of fuel economy).

Inventory control lists maximum and minimum levels for each part and can automatically print out a "need" list when levels are at the minimum.

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If your RO form has time-in/time-out recording space for mechanics' time, you'll be able to assess **shop productivity** according to your standard repair time. You can compare a mechanic's individual progress over time and measure his performance against that of other employees.

Direct versus indirect time. Having the ability to get a report showing both shop-wide and individual direct versus indirect time can help provide the information necessary to make the shop more productive and efficient, or verify that it already is productive and efficient.

A report on **scheduled maintenance versus unscheduled maintenance** is a good indicator of the health of your program, and therefore a report you will want from your system.

Summary

All of this recordkeeping, tracking, and analysis should mean better vehicle utilization, better scheduling of PM and component replacement, and a reduction of other repairs, which should lead to a lower cost per mile. It also provides the proof that the maintenance plan is working.

Evaluation of one manufacturer's product versus another is a nice benefit of effective recordkeeping. Also, your warranty claims will have some teeth when you submit examples of careful recordkeeping.

Also, recordkeeping and PM go together. Any time equipment changes (new components, new tires, new vehicles) you may need to modify your PM schedule and/or inspection/service checklist. Your recordkeeping and the reports it can generate are what will show you what changes are necessary in your PM standards.

Let's finally review what documenting and recordkeeping should do for your department:

- Identify fuel and oil consumption problems.
- Identify part and component failures for analysis.
- Identify rework situations.
- Identify high-cost maintenance areas.
- Identify trends in repairs and costs (up or down).
- Identify cost-effective vehicle and component models, makes.

Notice that we've used the word "identify" every time? That's all your records can do. You have to take action to correct the problems or negative trends identified.

Information is essential to good management and good decision making. Reports (whether computer-generated or hand-generated) are helpful only because they put information at your fingertips more quickly. But they are only a tool. You'll need to keep all lines of communication open in order to make good decisions that benefit the fleet. Improving your maintenance recordkeeping won't solve any problems for you. It will only identify them so that you can take corrective action.

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Good information is essential to good management, and the maintenance shop is no exception. Records can help you manage your maintenance standards and keep the fleet's vehicles running safely and economically.

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Shop Operations Operational Planning	Notes
The operational plan — What is it? The operational plan is an essential component to any business plan. It tells you and others how you are going provide your product or service, in this case your mechanical department services, to the end users. That is, how are you going to get your service out of the garage and into the hands of the people you want to use it. Furthermore, how are you going to describe and justify the plans, goals, and actions of your department and your people to upper management so that they embrace and accept the idea of an in-house maintenance facility. Operational plans are typically structured to answer the following: • What are the major objectives of the department • What are the major tasks that need to be completed to meet these objectives and who is responsible for them • What is the financial impact (positive and/or negative) that this department and operational plan will create for the company This is important because you are now dealing with practice and not theory. Up to this point, you may have only discussed the “possibilities” of a maintenance shop but now it is a reality and you must prove its worthiness to the rest of the company. Operational planning deals with the fundamentals of your department or facility and all to often, overlooking fundamentals due to the perception that things will take care of themselves leads to the downfall of the department and possibly even the company. What should an operational plan cover? Operational plans should be specific to your department. Not all departments require the same level of complexity when it comes to the operational plan. It’s important to note that your operational plan needs to make sense to you, your employees, and upper management. It needs to be detailed enough to make sure that all pertinent areas of operation are addressed but clear enough that anyone reading it understands the content. Basically, what you must accomplish with your operational plan is an explanation of how you are going to deliver your service (the shop and all it provides) to the customer (the drivers, employees, etc) and what you and your employees are going to be doing on a daily basis from the time you open to the time you close.	

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Why do operational planning at the department level?

The success of any company's operational planning effort is in direct proportion to the degree that such plans are developed and implemented at the unit or department level. For departmental managers to accept the responsibility for doing an effective job of department planning, they must perceive that the effort required will result in a benefit for them individually and for their department, as well as for the total organization. If the perception is that planning is just more work with no direct payoff, the Maintenance Pro is not going to participate in the operational planning process in a productive way.

Department operational planning provides a vehicle for both understanding and influencing the total organization's plan and those portions of the plan for which the department manager will be held accountable. The assumption is that those that are on the front line of productivity are more likely to know what is required to achieve desired organizational results than those who may be several levels removed from the action. It is difficult for a V.P. of operations in the main office to create an operational plan that is realistic and productive, if he/she has not operated at the "floor" level and has not coordinated this plan with the Maintenance Pro.

Department planning is not something that is done in a vacuum, solely by the Maintenance Pro. The Maintenance Pro has several "others" with whom planned and coordinated efforts are necessary. These include employees, people in other parts of the organization, higher-level management, suppliers, and customers. The establishment of a clear operational plan for the maintenance department, with particular emphasis on objectives and action plans, identifies what roles these "others" need to be playing in order for the planned results to be achieved.

Furthermore, a department operational plan created in this manner allows for a sound basis of getting the active involvement and commitment of all employees as well as establishing clear accountability for results. In addition, department action plans provide a means for clearly identifying others with whom early coordination and mutual support are essential for plan implementation.

The six elements of operational planning

Operational analysis — This is an assessment of the current status of the department's performance and of the specific issues that have substantial impact on the department during the year. These are identified from:

- A review of the strategic plan for short term needs
- A review of the prior year's operational and maintenance plan concentrating on performance issues
- Pinpointing other issues and problems likely to impact the department during the plan year

Shop Operations

Key results areas —These represent those priority areas within which results need to be achieved during the projected operational planning period. While operational analysis brings attention to critical issues or problems, the use of key results areas ensures continuity in performance areas that may not be represented by a problem. At the maintenance department level, this would consist of the expected outputs of the department and more specifically, the expectations of employees of the department, quality improvement, cost control, and employee moral.

Indicators of performance —The indicators of performance identify those measurable factors within the key results area on which specific objectives may be set. Since there are many ways in which results can be measured, it is important that management clearly identify and agree on those indicators that will provide the best visibility on desired results.

Indicators that can be quantified, such as units of production (man-hours/job), cost of parts and materials per job, and percent of return work due to failure, are all very useful and usually easy to track. However, other indicators that are not as easily quantified, such as employee satisfaction, new product/process introduction, and new program/process implementation, are also valuable in assessing the type of results desired. In any case, the indicators selected must be understood and agreed to by those involved.

Operational objectives —These represent the specific, measurable results to be accomplished within the time span of the of the operational plan. In other words, what are the exact expectations in a measurable form, of the maintenance department for the upcoming year? These objectives derive from the key results areas and incorporate indicators of performance as the measurable factors into the objectives themselves.

At the department level, objectives need to be narrow, precise, and specific. They contribute toward the broader organizational objectives but relate mainly to the specific department. For specific results that are not continuous in nature and may not require detailed action plans, such as minimum gross margin or monthly mechanic production quotas, the use of performance standards may be more useful. A standard of performance represents a level of achievement to be reached and maintained on an ongoing basis.

Action plans —Actions plans represent the specific actions required to accomplish each of the operational objectives. They may be stated in one or a combination of the following three forms:

- Specific activities or events that are not necessarily interrelated
- A series of interconnected events following an analytical or problem-solving approach
- A series of smaller or shorter-term objectives

Action plans include specific time frames, resource requirements, and accountability. They also should include appropriate feedback mechanisms so that management can verify that the plan is being met.

Budgets —The primary purpose of a budget is to indicate the level of financial resources required for the department to achieve its objectives. While budgets appear as the final element in the operational plan, they

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are an integral part of the process and, as such, they normally provide a financial structure for plan operation. Operational planning, including the preparation of budgets, should be seen as an interrelated process throughout, with information generated in one element directly influencing the content of another.

Maintenance specific operational planning

Maintenance facilities are possibly the easiest to make operational planning decision on. The number of vehicles, the frequency with which they will require maintenance and repairs, and the amount of time spent on maintenance and repairs, will provide the justification for the size and cost of a maintenance facility.

If a fleet of 50 vehicles is operating vehicles that require 4 hours per month in preventive inspection and maintenance, the facility needs to be able to provide 200 hours of preventive maintenance per month. Assuming the vehicles can be scheduled to keep them "spread out" during the month, this alone will be enough work for one to two technicians. This is arrived at by dividing 200 hours by 160, the average number of hours a technician will work in a month = 1.25 technicians.

If the same fleet is also seeing vehicles spend an average of 2 hours a month in the shop for unscheduled repairs the company would need to provide 100 shop hours per month for repairs. If you divide 100 by 160, this justifies an additional .62 of a technician. You will then need to adjust this for vacations and other time off.

When combined with the preventive maintenance requirements, this now justifies two technicians and maintenance bays. Next, take all other responsibilities, the time to complete them, plans for future growth and factor those into the maintenance facility following the same model.

Each technician will need their own work space, so the facility would need to provide space for either one or two technicians (normally a service bay with a workbench and work area next to it).

If you intend to do your own heavy maintenance (engine and transmission rebuild and replacement, etc.) you will need to provide additional floor space in the maintenance facility. This will allow these long-term repair projects to sit in the shop and not cause delays in the other maintenance functions. If additional space is not provided the floor space will have to be cleared every time another vehicle needs routine maintenance or repair.

For planning purposes, figure that five percent of your fleet could need heavy maintenance at any given time. If the fleet has 50 vehicles, then two to three of them could potentially be in for heavy maintenance at any given time.

Other considerations when making maintenance facilities decisions include parts storage, wash bays, inside equipment storage, oil and grease movement systems, racks or pits, and maintenance office space (if not sharing office space with operations).

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How much privacy do you wish to provide for supervisors and other employees? How much of a support or clerical staff are you planning for (if any)? If you want full privacy for all employees, your facility will become quite large. Each employee will need a space for storing job-related materials, and some supervisory personnel will need private work areas.

One general concept applies. The more employees you have, the more space will be required. How many employees you have, how much workspace you intend to provide each employee with, and how many employees you intend to provide with private space, will determine your facility requirements.

Here is a worksheet that can help with these calculations.

MECHANIC STAFFING WORKSHEET

A. Calculating the mechanic-hours available for a year:

Number of days per week $\times$ 52 = _____ days

Subtract number of vacation days - _____ days

Subtract number of holidays - _____ days

Number of available working days for one mechanic _____ days/year

Number of available working days per mechanic $\times$ 8 hours = _____ hours/year

Subtract rest room/coffee break, personal cleanup hours,
_____ minutes/day $\times$ available working days - _____ hours/year

Subtract estimate of hours (use ROs) of other daily shop tasks, unrelated to repair, i.e. bay cleanup, parts checkout, shop meetings, training, _____ minutes/day $\times$ available working days - _____ hours/year

Subtract estimate of hours spent on other activities, i.e. shop meetings, safety meetings, training sessions, sick leave, personal time off _____ hours/year

Total hours available to work on vehicles per mechanic _____ hours/year

B. Calculating the annual shop PM/repair hours for a single vehicle (from last year's ROs):

Vehicle Number _____	Annual Mileage _____	Year _____
Type of Repair?	How many times?	Total hours?
PM Inspection/Service	_____	_____ hours
Repair (unscheduled)	_____	_____ hours
Tire work	_____	_____ hours
Total for vehicle	_____	_____ hours

If fleet has fewer units (particularly if vehicle age varies), complete a repair hours summary for each unit to give a more accurate picture.

C. The total number of vehicle service hours for all fleet units divided by available mechanic hours = number of mechanics needed

_____ service hours $\div$ _____ mechanic hours = _____ mechanics

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On-road repair plan

One key operational plan that needs to be in place is how you intend to deal with on-road repairs. There are several plans in use at carriers. Here is a sampling of some of the practices used in these plans.

Parts and repairs PO

Some carriers require a driver to get a purchase order (PO) for any purchase of parts or services on the road. This PO can be required for every purchase, including at preauthorized maintenance locations.

The POs are assigned out of a book (or computer program) that assigns them sequentially. The technician or supervisor must “sign for” the PO, authorizing the repair. Other required entries are the date, vendor, location, driver, vehicle, and reason for the repair. This way, the PO can be tracked back to date of issue, vehicle, driver, etc., and who authorized the purchase is also recorded.

The advantages of using a PO system is the Maintenance Pro:

- has a clear accounting of purchases being done on the road,
- can control on-the-road purchasing (through the authorization step), and
- can keep track what drivers and vehicles are requiring more on-road repairs.

Full or partial on-road repair

On-road repairs have the possibility of getting very expensive. One possible solution used by some carriers (in certain circumstances) is to have partial or temporary repairs done on the road (or use inferior, cheaper parts). This is normally done only to get the vehicle roadworthy. Once it returns to the maintenance facility, it is then fully repaired. This is a decision that should never be taken lightly.

If you have decided to not fully repair a vehicle, you have exposed the company to a considerable risk. If the vehicle is involved in a crash, you could end up accepting an excessive amount of liability, even if the defective parts had nothing to do with the crash. Here is the question you need to ask yourself: Are you willing to accept responsibility and explain why you knowingly allowed a vehicle in less than perfect condition to operate on the roadway? If you can say that the decision was made with the safety of the driver and public in mind, and in compliance with the regulations, you should be safe taking this path. If the best you can say is “the vehicle shouldn’t be placed out-of-service if it is inspected,” you may want to reconsider your decision.

The next consideration is: How much are you actually saving by having the driver bring the defective vehicle in, rather than having it repaired on the road? If the additional downtime or repair costs in your facility will swing the calculation to the point that the total repair costs will be equal to the road repair, you may as well have the repair done on the road.

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Using inferior part is another short-term solution, and possibly the least risky. The disadvantage of doing this is the same disadvantage as having temporary repairs done on the road. You will have to repeat the repair when the vehicle returns. Here again, this second repair (and the associated downtime) may increase the total cost of the repair to the point that the repair may as well be done on the road in the first place.

One option that should always be avoided is operating a vehicle that is clearly in violation. This has disaster written all over it. We discussed the possibility of having to explain your actions if you allow a driver to operate a vehicle after partial or temporary repairs. Imagine trying to explain to an authority why you knowingly allowed an unsafe vehicle to operate on the roadway. "Because it was cheaper to get it here for repairs" will not help.

Contracted shops

One method many carriers use to reduce on-the-road repair costs is to establish contracts or agreements with repair shops in primary operating areas. By predetermining repair costs (agreed on shop and parts rates), the Maintenance Pro at these carriers can keep road-repair costs minimized.

Along the same lines some carrier equip the vehicles with parts that are known to fail (or training the driver to perform simple, but common repairs). One fleet that was experiencing problems with fan belts placed a fan belt in the equipment box of each vehicle. This way, all that had to be paid for at the higher rate was the labor to change the belt.

Summary

Operational planning, to be truly successful, is dependent on the active support of all departments within an organization. For this support to happen consistently, department managers must perceive such benefits as:

- A feeling of being in control
- More productive use of personal and department time
- Improved communication and coordination with others

The process for developing departmental operational plans is similar to that for the total organization, although departmental plans will be narrower in scope and will cover more detail. Department plans can be facilitated through:

- Identification of department issues and expectations in support of those at the top
- Review of the objectives and action plans of the department and the organization
- Classification of objectives into routine/regular, problem-solving, and innovative

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Finally, the members of upper management need to reinforce the importance of involvement and commitment by department managers in the operational process. Without their active support, operational planning is unlikely to produce the desired organizational or departmental results.

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Vehicle Systems and Specifications Requirements and Accessories	
The purchasing process There is little doubt that equipment purchases represent a significant investment for any size carrier. Therefore, the process of selecting the best possible equipment at the best possible price is critical. A Maintenance Pro should have a positive role in this process as they are the front-line expert when it comes to the operational specifics of the vehicles. Among the most important aspects of the purchase process is making sure you purchase equipment that is designed for the job and the company. This can be both a pleasant and challenging task assigned to any Maintenance Pro. But whatever equipment is selected, the Maintenance Pro must know that he/she is going to have to live with the vehicle and its components for years to come. Several areas must be considered when deciding what vehicles to purchase for the organization, including: • Productivity — Depending on your type of operation, productivity could mean maximizing payload or available trailer space within the legal limits for the vehicle's size and weight. In order to maximize productivity, the equipment must have sufficient power (while delivering acceptable fuel economy), and components and accessories capable of carrying the load, to safely accomplish the work it is intended for. • Life-cycle — As stated previously, equipment purchases represent significant investments. One way for companies to ensure a decent return on these investments is to extend the productive life of the equipment. Carriers can accomplish this by establishing a proactive and aggressive preventive maintenance program. On the other hand, many carriers operate under a definite equipment trade-in schedule. But even in these situations, maximizing return on equipment investment needs to be a top priority. • Driver-friendliness — With driver turnover a major challenge facing the trucking industry, purchasing equipment that is driver-friendly has become vital. Fortunately, with advancements and improvements in vehicle ergonomics, there are more options available than ever before. • Matching the equipment to the job — Buying too much vehicle means that you're spending more money than is necessary to do the job. Buy too little and the vehicle will not be able to perform as the vehicle engineers intended. Buying too little vehicles can also lead to overloading or overworking, which inevitably will cause premature wear and tear on the vehicle and its components, increasing maintenance costs for the vehicle.	

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- Cost — Purchase, operational, and maintenance costs must be considered. New equipment may be expensive to purchase, but may be able to show a better Return On Investment (ROI) based on lower operational and maintenance costs. This is because newer equipment tends to be more efficient to operate and will be less prone to expensive maintenance and overhauls. Also, warranty coverage provided by the manufacturer can help absorb some of the carrier's maintenance costs.

The up-to-date Maintenance Pro must also be aware of proposed state or federal regulations that might affect the vehicle's size, weight, and emissions control in the future. Many new vehicle configurations evolve from these limits. As emission controls become tougher, new fuel controls and exhaust systems must be developed to meet the requirements while still maintaining or improving efficiency. In addition, new or revised regulations might impact the specifications of safety accessories and components.

Another thing to take into consideration is the evolving and/or changing scope of the organization's service. The operation itself must be reviewed. Have changes occurred that require a different kind of equipment? Will the vehicles be traveling to a new geographical area? Are new marketing strategies being planned that will require the vehicles to perform a variety of tasks? Can one new vehicle replace two old vehicles because of operational changes or vehicle improvements?

Whether purchasing with the intent of using a life cycle, or making decisions based on present performance of the vehicles, the Maintenance Pro must work with the other managers (operations, safety, and finance) and making a conscious decision on vehicle replacement.

As equipment is the largest investment at a carrier, we will want to spend a considerable amount of time discussing the process of specifying, or spec'ing vehicles. Whether leasing or purchasing, the first step is to determine the requirements for the new vehicles. It is best to have this determined before calling the first dealer for information.

Once you have your specs, the next step is to approach dealers for their input and pricing. If you do not have your specs in place, the dealers will try to sell you what they believe may be best suited to your application (and possibly most expensive).

One area that carriers need to be familiar with is "economy of scale." The more identical units the vehicle manufacturer can build in a "run," the more willing the dealer and manufacturer will be to provide a discount. If a carrier purchases one vehicle per quarter, rather than four on the same order, the carrier will see a higher cost per unit due to the dealer and manufacturer being unwilling to provide a discount.

Vehicle Systems and Specifications

Equipment specification

While the Maintenance Pro may not personally develop or select new vehicle specifications, he or she should be familiar with the principles involved. At the very least, the Maintenance Pro needs to be involved in the process to provide input as to how the new equipment specifications will impact operations, maintenance, and reliability based on past experience, among other issues. Tomorrow's headaches can be avoided if these items are considered during the selection process.

Undoubtedly the first questions to be considered early in the process will concern the product that is being hauled or the payload. The questions should go something like this:

- What is the product?
- How is it shipped?
- What does it weigh per case, gallon, pallet, etc.?
- How much is shipped per trip?
- What does the total payload weigh?
- What are the dimensions (cubic feet, gallons, etc.) of the payload?
- How is the product loaded? Unloaded?
- Are there any special handling procedures for the payload?

As you review this list of questions (and try to think of more), think about what effect the product hauled has had on the vehicles. Have there been any persistent problems with the vehicles? Are the crossmembers adequate? Should flooring be strengthened? What about sidewall, liner, and flooring materials? Is a lift gate or other special equipment available that can make the vehicle and driver more efficient?

This process must be undertaken any time new equipment is to be purchased. It must also be repeated every time there is a change in the customer base which affects the products being hauled. Vehicles purchased with the intent of hauling only dry products may receive unintentional structural damage if you try to haul refrigerated or wet products in them. Mismatching the equipment to the product can also increase cargo claims and customer complaints.

Where the vehicle runs is as important to informed spec'ing as knowing what it carries. Anyone looking at a new vehicle needs to ask:

- What kinds of roads are used?
- What is the terrain like?
- What region of the country will the vehicle primarily operate in?
- How many hours are run during the day? at night?
- What are the speed requirements for a vehicle performing this kind of operation?

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- Are there any special driving requirements (such as off-road operation)?
- Will the vehicle return nightly? If not, how long will the driver be “living in it?”

Once again, think back to see if any problems or complaints can be traced to the operating environment of the vehicles.

Answering these questions will begin the process of deciding what driveline, tires, and vehicle configuration will be required.

Much like the product information, the operating environment the vehicles are operating in should be reviewed with every vehicle purchased and any time there is a change in the customer base. Vehicles that were purchased to operate in a local application may not be well suited to operation in an over-the-road environment. The Maintenance Pro needs to be constantly aware of the products the vehicles are carrying and operational environment in which they are being operated.

“We have always bought model X with engine Y and kept them eight years” is not a sound method for deciding on new equipment. Changes in products or the operational environment may lead to accelerating vehicle purchases to replace vehicles that no longer match the fleet’s needs.

After drawing your own conclusions about the requirements for the new vehicle, it can be helpful to get input from the drivers and technicians. Suggest a meeting, a brainstorming session on what went wrong on the old vehicles and what participants would like to see on the new ones.

Talk to the technicians about the old vehicles. Were there any features that made repair difficult? Were any components hard to get at? Were any special tools required (that they didn’t have!)? Were some parts always on back order? In other words, was there anything about the vehicle that required special pains to repair and irritated technicians in the process? They won’t appreciate having the same hassles in a new vehicle. Ask them to point out the “model” vehicles in the fleet and describe specifically what makes them easier to maintain. Take advantage of the input they can provide.

Vehicle Systems and Specifications



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Ask the drivers to critique the vehicles and, more importantly, about the performance of the vehicles on the road. What improvements have they observed in other vehicles? Is there any equipment that might speed up unloading or loading procedures? What special “extras” might motivate him/her to take better care of the vehicle? Ask drivers to make specific recommendations about the improvements they’d like to have in a new vehicle (promising nothing, of course!). Management isn’t obligated to take every suggestion, but listening doesn’t take long and it’s the first step in problem-solving. You can’t fix what you haven’t heard about.

It takes time to develop new specs and while the dealer will already have most of the available choices narrowed down, there are always additional components that may save enough money in fuel economy and/or maintenance costs to justify a higher initial price. It’s been estimated that only 20 percent of the total costs over the life of the truck relate to purchase price, so putting some extra cash into components now may be worthwhile.

You should be knowledgeable about new equipment options that are becoming available. Talk to other people in the industry to learn how the products are working out for them. Ask your truck dealer for opinions about components. If the dealership you work with has a service department, ask how components from different manufacturers have performed. Keep a file of ideas that look interesting and don’t hesitate to ask for advice.

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Equipment Specification Guide

The above information has got you to the point where you now have a general idea of what you are looking for in a vehicle. The next step is to take the information gathered so far and work with the Operations Manager, Safety Manager, and dealers to spec the equipment. Here is a guide to follow that may help you to not overlook any key considerations when reviewing components.

- Product carried.
- Operational requirements.
- Cab configuration.
- Driveline (engine, transmission, drive axle(s)).
- Frame.
- Non-drive axle(s).
- Brakes.
- Electrical system.

Cab configuration. You know all the pro and con arguments about the cab-over (COE) versus the conventional cab. Each has its advantages and the final choice may depend on where the vehicle will operate or whether the drivers have a strong preference for one or the other.

Drivers like the conventional for its easy entry and exit and the extra room in the cab. Conventional also gives the driver a smoother and quieter ride. Here are some of the other benefits to conventional vehicles:

- The conventional costs less to purchase (when a sleeper is not required).
- It has better aerodynamics. Air flows easily around the nose of the conventional for better fuel economy.
- The optional lighter front can mean better maneuverability in certain applications.
- The longer length means the gross vehicle weight (GVW) can be spread over more truck, hence heavier legal loads can be hauled.
- Inspection is easier because the engine and steer axle components are easily accessible.

Conventional trucks are available in a variety of cab designs. One variation may offer the maximum in aerodynamics, while another may offer improved durability and less susceptibility to minor damage. One variation that is popular in certain applications is the “short nosed” conventional, properly known as the cab forward conventional. These trucks typically have a smaller hood area, and therefore a shorter wheelbase, which is accomplished by “tucking” the rear of the engine into the firewall. Combining a cab forward design with a setback steer axle has allowed for very maneuverable conventional trucks.

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The greatest advantage to the COE vehicles is the short overall length and small turning radius. This means maximum maneuverability, especially good for city driving. The COE has become more popular in the light and medium duty markets, specifically in the “city” and “vocational” applications (garbage trucks, local delivery straight trucks, etc.). It is very seldom used by heavy duty fleets anymore. The cab forward, setback steer axle conventional trucks have taken the place of the COE in the heavy duty market. The COE does have some advantages:

- The short length also means that more payload volume can be accommodated in the body.
- Forward visibility is better.
- The short wheel base allows for easy handling.
- Overall better visibility and better maneuverability in confined areas.
- Once exposed (by tilting the cab) the engine and driveline are easily accessible. However, driver inspection is more difficult since the cab covers the engine entirely.

Engine. If you are in the heavy-duty market, the first step will be balancing the horsepower and torque to the expected working loads and environment the truck will be operating in, as the “gas verses diesel argument” does not apply.

Engine performance is judged by two elements, torque and horsepower. Torque gets a load moving; horsepower keeps it going at a particular speed. Engine torque can be measured by a dynamometer; horsepower can’t be measured, but it can be calculated from the torque measurement and the rpm using this formula: $\text{Horsepower} = \text{Torque} \times \text{rpm} \div 5,252$ (a constant developed by engineers).

Torque can be multiplied by mechanical means (i.e. a gearing system), but since horsepower is work done by the engine within a given time period, it cannot be increased or decreased by mechanical means. Accessory equipment such as alternators or fans, can drain away horsepower, however. So engines frequently carry two ratings for torque and horsepower — gross and net. The gross rating refers to its performance on a testing stand; the net rating is based on the performance of a fully-equipped vehicle.

Having said that, what engine is right for your equipment and operation? Perhaps the biggest thing to consider when selecting an engine package is to appreciate what the truck is going to do. What kinds of weights will it be pulling? What’s the nature of the work? Is the company more concerned with fuel economy or maintaining highway speed and having power left in reserve? “Roadability” (ability to get to and operate at road speeds on the roads the vehicle normally operates on) and “gradability” (the ability to pull the normal grades the vehicle will be exposed to both effectively and efficiently) are two engine concerns that are directly related to the torque and horsepower of the engine. The selection of the right engine must be based on these issues. If the vehicle is overpowered, there will be a loss in efficiency, but if it is underpowered roadability and gradability

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will be affected. Also, underpowered vehicles tend to suffer from more mechanical problems.

The first question you will have to address if you are purchasing in the light or medium duty classes is the old gas vs. diesel question. You have probably been through this routine before, but let's review some of the advantages and disadvantages of each.

Gasoline engines

Advantages:

- Cost less to buy.
- Are a good choice for light duty trucks (under 19,000 pounds) that operate less than 40,000 miles a year.
- Are lighter weight than similar size diesel engines.
- Can be serviced by a wider range of mechanics.
- Generally are cheaper to repair.
- Start better in cold weather.

Disadvantages:

- Need scheduled maintenance more often.
- Consume more fuel.
- Lower power to size ratio.
- Less longevity and durability.

Diesel engines

Advantages:

- Lower overall cost of operation.
- More fuel efficient.
- Need less maintenance.
- Generally require less repairs.
- Simpler design-less to fail.
- Have longer overhaul intervals.
- High power to size ratio.
- Longer warranties.
- Run more efficiently during stationary applications (i.e. pumping).

Disadvantages:

- Cost more "up front."
- Higher torque requires heavier driveline components.
- Must be serviced by technicians with specialized training.

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Most American and foreign-made medium and medium-heavy trucks sold in the U.S. are equipped with diesel power and this trend is expected to continue. Smaller, lighter diesel engines are available today even for the light-duty trucks and similar vehicles traditionally powered by gas.

When talking medium duty or “midrange,” know what you’re talking about. The term can refer to engines whose prices fall somewhere between the gasoline engines and the big diesels. Engines that are limited in the range of work they perform - either by weight carried or time operated at full power - may also be called midrange. Horsepower classifications, too, can run from 140 Hp – 250 Hp or 210 Hp – 290 Hp, powering from 20,000 lb GVW to the heavier weights. If you are selecting vehicles in this range, you’ll have to be careful not to underpower. Asking a midrange diesel to do a heavy-duty job is inviting a premature overhaul.



On the other hand, you should be sure that you’re only buying what you need. A midrange engine paired with lighter-weight chassis components might be just the ticket to better fuel efficiency. The fleet may need to start thinking about what’s needed to pull the load and not fall back on “old habits.” Once on the road, the drivers who complain about a lack of power may find that they’re getting there just as quickly.

Nearly all engines manufactured today are electronically controlled to one degree or another. Some of the smaller engines have only a small fuel/air management system, while most of the heavy duty engines are fully computerized. In the heavy duty engines, when the driver operates the throttle the Engine Control Module (ECM) adjusts the fuel and air flow to most efficiently achieve the performance the driver has requested.

Along with controlling the management of the fuel system, the electronic engines all have a memory. The memory is intended to shorten the diagnostic cycle in case of engine problems. How large, what the memory “remembers,” and ease of access to memory, are factors to be considered when choosing an engine. Some manufacturer’s ECMs will remember everything from a misfiring injector to hard braking done by the vehicle.

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Fully electronic engines offer several advantages. First, they are considerably more fuel efficient than the older technology engines. This is accomplished by the computer and software constantly tracking engine performance and demands, then determining the most efficient way of operating. This decision is made several times a second.

Second, the engine electronics on some vehicles can be programmed to shut down the engine to protect it from damage. Should the oil pressure or level go too low, or the coolant level go too low or temperature too high, the engine will warn the driver and then turn off.

Third, the “memory” can be set to display “trouble codes” to the driver if a “check engine” or “shut down” warning light has come on. By activating the system the driver can get the trouble codes displayed on the dash. This memory can also be downloaded during PMs, shortening maintenance times. Downloading at each PM also builds a record on the way the vehicle was treated and operated. This can become critical in warranty discussions.

Fourth, the engine can be electronically “limited.” Part of the programming allows supervisory personnel to set the vehicle to go no faster, or generate no more power, than a pre-set limit. Once the speed, RPM, or power limit is reached, the computer will limit the amount of fuel to only what is required to maintain the desired speed, RPM, or power.

Finally, the engine’s memory can become useful in case of a performance problem or an accident. This feature can also be used as a method of tracking driver performance or discovering driver abuses such as over-speed, over RPM, excessive hard braking, and excessive idling.

If you are not going to train maintenance personnel and purchase the equipment required to “communicate” with the modern electronic engines (usually a laptop computer or similar device and specific software), part of the engine selection decision will need to be ease of access to manufacturer service. This way you will still be able to take advantage of the electronic engines without purchasing the necessary equipment and getting the training for your maintenance personnel.

As the engine is normally the most expensive component on the vehicle to purchase, maintain, and repair, another consideration when deciding on an engine is the warranty that the engine manufacturer offers.

Transmission and axles. The spec’ing process for the transmission should consider the ease of operation combined with the company’s ability to train and retain skilled drivers. Manual transmissions require less maintenance and are cheaper to purchase, but require a higher degree of skill by the driver. Automatic and automatically shifted transmissions are easier to operate, but generally are more expensive to purchase and maintain.

Most automatic transmissions available for trucks are in the 4 to 5 speed range. Most automatically shifted and manual transmissions are in the 7 to 10 speed range. Fewer gears generally equals better fuel economy. The trick is to make sure the transmission performance and gearing matches the engine performance, with the fewest number of gears.

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The newer high torque engines do not generally require the complicated 13, 15, or 18 speed (or more) manual transmissions any more, except in special applications.

Automatic transmissions are now available in both hydraulic and gear drive configurations, both of which are electronically controlled. The hydro-drive transmissions use sensors and controls to shift the transmission at optimum shift points based on load, demand, and engine speed. Automatically shifted gear drive transmissions use electronic sensors and controls to shift the gears at specific RPMs. This transmission offers the best of both worlds. It maximizes efficiency and fuel mileage by not losing power to the hydro-drive system and does not require the driver to have a high level of skill to shift the transmission.

Rear axles just keep lumbering along, carrying the load, transferring the torque, supporting the suspension, handling braking shocks, and generally acting as the workhorse component of the vehicle. Selection of type, capacity, and gearing is keyed directly to the vehicle's job and operating environment. For example, some waste-haulers consistently spec heavier rear axles, it's cheaper to over-specify than to repair original equipment, they say.

New faster axle ratios have been developed to handle the slower speed engines and low-profile tires, designed for fuel economy. Brakes are based on the carrying capacity of the axle, so correct spec'ing here can prevent over-braking conditions as well. In heavy duty applications be sure to check into filtration systems that can keep the axle lube oil clean.

Engine and the total gear ratio, that is, the combination of transmission and rear axle ratios, make up "geared road speed" which is the maximum speed at which the truck will run with the transmission in top gear and the engine operating at its top governed rpm. Geared road speed is the engineered speed, governed by the mechanical factors of the engine and powertrain.

If you want a higher geared road speed, you'll have to make other mechanical changes. Faster transmission or axle ratio for example. Many rear axle ratios are offered to accommodate engine speeds that run from the low-rpm diesel to the high-rpm gas.

The real test for a vehicle's power is not necessarily shown by the engine power curve, but rather in its gradeability, or measure of the slope on which it can travel without loss of speed.

Gear-fast/Run-slow! As an engine becomes increasingly powerful (as with today's 500+ horsepower engines), the increased power is coming from high-torque/low-rpm settings as opposed to the more traditional low-torque/high-rpm approach.

Under gear-fast/run-slow, geared speed is higher than the cruise speed, allowing the engine to cruise at a modest 1400 to 1600 rpm. However, even at these low revolutions, the axle must be able to run fast at high-way speed.

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Frame. Now that you have determined some of the basic information, the next step is to select a frame that can support the projected GVW, type of operation, and driveline.

The backbone of the frame is the side rails and crossmembers. In an effort to lighten the vehicle, an aluminum or aluminum alloy frame may be suggested. Whether a steel or aluminum frame is used, the strength rating of the frame must match the components and intended loads.

Heavy-duty applications may require a frame analysis, but generally if you are staying within the GVW that the truck was designed for, the standard recommended frame should be sufficient. The exception may be if you added any extra equipment or additional load to your vehicles. This might call for frame reinforcement.

When spec'ing the frame, also consider the suspension. Spring complaints may not be enough reason to bring a vehicle into the shop, but they can affect driver performance. Know ahead of time the weight that the truck must haul so that the springs can be spec'ed at the proper size. If the vehicle runs out loaded and returns empty most of the time, a solution may be more complex.

Air spring suspensions cost more than steel, but users insist that they require less maintenance, last longer, and increase truck value at trade-in time. They also have the ability to adjust the ride to changing weights, something spring suspensions cannot do. Also, air-cab suspension might ease driver backache — and make the cab last longer.

Non-drive axle(s). Weight rating of axles and tires are the main concerns when spec'ing axles. If the axles are correctly spec'ed, the brakes and other components will match the rest of the vehicle. The other concern is the location of the axles. In some applications the only other axle on the vehicle will be the steering axle.

One type of steering axle configuration that has been developed to help in weight distribution, as well as maneuverability and ride, is the “set-back steer axle.” In this configuration the steering axle is “set back” from the front of the truck, rather than in its traditional location directly behind the bumper. By placing the axle further back on the frame it is in a better position to assume more of the cargo weight, thereby lightening the weight carried on the drive axle(s). This position also allows for a shorter wheel base, leading to a reduced turning radius, which means a more maneuverable unit. Also, the setback axle allows for the use of longer springs which creates more spring flex, improving the ride of the unit.

Whether the vehicle is spec'ed with a standard or setback axle, the weight rating of the axle must match the projected load. This is critical with the steer axle, or the vehicle may suffer from steering difficulties.

Other axles can be either “dummies,” designed to stay on the ground and carry weight, or “lift” axles which can be lifted off the ground when not needed for load bearing. Dummies are a much simpler axle, costing less to install, while lift axles are more expensive to purchase but have reduced operating costs. As with steer axles, the key consideration is making sure the axle matches the weight that will be placed on it.

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Brakes. Air-brake buyers have a choice of three types:

- S-Cam brakes, the oldest and heaviest choice, are the least expensive, simplest in design, and mostly trouble free. This is especially true since the introduction of the automatic slack adjuster and the non-asbestos lining materials.
- Wedge brakes, much lighter in weight and self-adjusting, can fade at high temperatures and require more air pressure to activate (nearly 10% of the brakes sold are wedge).
- Air disc brakes also require more air pressure, but they produce more torque, hence a more stable stop; they are self-adjusting and don't fade, but they generally have a shorter overall life and the pads have to be replaced fairly often. They aren't difficult to replace, however, and are becoming a more popular choice.

Capable of performing just as well as the air-braking systems (or better in some applications), a hydraulic system doesn't have the contamination problems that air-brake systems can suffer from and it weighs and costs less. There are fewer maintenance demands; timing problems are negligible and the system works well with automatic adjusters. When combined with electric or surge brakes on a trailer, these brakes work well in the light to medium class vehicles.

Electrical system(s). When spec'ing the electrical system, the output of the charging system must be matched to the total maximum demand of the electrical system. If you "underbuy" in the electrical system, the vehicle will be prone to draining its own batteries and requiring jump starting. This is one area where overbuying is a good idea.

One other consideration in the electrical system is the use of "shore power" to run accessories. This can be accomplished in two ways. The first is to have all accessories powered by 12 volts, and provide the vehicle with a system that converts 120 volts to 12 volts to operate the accessories. The other option is to have a system that converts 12 volts to 120 volts to operate the accessories when the vehicle is not connected to 120 volt shore power. Either of these can be combined with a "gen-set" mounted on the vehicle to provide 120 volt power to the shore system if the vehicle cannot connect to a shore line for some reason.

Battery selection for sleeper trucks will need to be viewed differently, due to the high loads placed on batteries when the truck is not running by driver accessories such as microwaves, inverters, televisions, DVD players, computers, video games, etc., if the vehicle will not be equipped with a gen-set. One Maintenance Pro refers to the electrical load on a parked sleeper truck's batteries as a "hotel load" as the typical sleeper cab's electrical load is the same as the electrical load in a hotel room (possibly a bit of an exaggeration, but not much of one)!

Due to this loading, the batteries will need to be selected based on their ability to cycle from a low voltage to operating voltage repeatedly. Consideration will also need to be given to the ability of the batteries to accept repeated "jump starts."

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Another option is to consider a battery system that protects a “core charge” to start the truck (one battery or battery pack never supplies power to the cab and is reserved strictly for starting, or the battery system cuts power off to the cab when the battery voltage drops to a certain level).

Available accessory equipment

Air dryers reduce water, oil, and carbon contamination - the curse of any air-braking system. They operate on the principles of condensation, use of a drying agent (desiccant), or centrifugal force to clean and dry the compressed air before it is delivered to the system. If you think an air dryer might help reduce brake problems, check out its maintenance manual before you buy.

Engine braking has become important because the fuel-efficient truck models roll more easily and the new fuel-efficient engines have reduced natural engine-braking ability. Retarders fill the need for additional engine-braking; they spare the braking system, while allowing the driver to control the retarding power. They fall into four categories:

- Exhaust retarders have a control which closes the exhaust pipe, thereby creating back pressure in the exhaust system to slow the engine.
- Engine retarders and engine brakes change the valve timing or injector functions in the engine, thereby limiting the number of cylinders working (the venerable Jake brake is of this type).
- Hydraulic retarders cause the engine to work against a fluid system contained in a closed housing that is part of the transmission.
- Electric retarders consist of electromagnetic coils which produce a drag force on the truck's driveline or trailer axle.

Maintenance-free batteries:

- Require less frequent checks for water levels,
- Reduce actual water loss from the cells, and
- Minimize corrosion.

Whatever the choice for batteries, don't allow price to be the only consideration. Vibration test information can be an important key to how long a battery will last, yet one manufacturer reports that fleets seldom request this information when considering a brand. A new container material, structural foam polypropylene, is available instead of the usual hard rubber and thin-wall polypropylene. This newer material weighs less and seems to offer better resistance to vibration.

Fuel heaters can keep the flow going smoothly. Choose a mechanically simple model that heats the fuel before it goes into the first fuel filter and also prevents overheating of the fuel. Since the primary fuel filter and its supply line are the most common component affected by cold weather, it may be helpful to choose a model located in the engine compartment; avoid those mounted outside the frame rails where they are exposed to wind.

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Water separators can be used in combination with a primary fuel filter or separately to keep water and other contaminants in fuel from reaching the engine. Since they must be drained regularly to prevent freezing, be sure they're conveniently located.

Aerodynamic accessories can significantly increase fuel mileage. Air resistance is a truck's second greatest impediment to movement, and therefore optimum fuel economy. Only weight impacts miles per gallon more. Efficient aerodynamics smooth the flow of air over, under, and around the vehicle. It is not uncommon for some aerodynamic truck/tractor designs to save carriers as much as 4–5 cents per mile in fuel savings. When spec'ing accessories for fuel economy, start with the full-cab roof fairing. Make sure it matches the height of your trailers. A proper roof fairing can improve Miles Per Gallon (MPG) performance up to 15 percent when compared to operating without one.

Other aerodynamic accessories include:

- Cab extenders, which are designed to bridge the gap between the truck cab and the trailer. The goal of these extenders is to attempt to reduce the gap to less than 18 inches.
- Side skirts, which cover the fuel tanks and battery box, and smooth out the overall profile of the truck.
- Air-dam front bumpers and aerodynamic hoods which are designed to ease air flow around the front of the vehicle.
- Other aerodynamic accessories (or aerodynamic location of accessories), such as mirrors, air intakes, air horns, and grab handles.
- Trailer air deflectors including nose and rear "bubbles," side skirts, and axle air deflectors. Any of these options can increase fuel economy by 1–3 percent.

Tire size does matter since a truck's overall gearing changes with the diameter and circumference of its tires. Tread type also impacts fuel economy because a tire's tread helps determine rolling resistance. For example, a lug-type drive-axle tire in winter will improve traction, but will also lower fuel economy by 2–4 percent. Tire technology has improved dramatically recently. With improvements in tread designs, casting designs, rubber compounds, and friction reduction, definite and significant savings can be realized by spec'ing the right tires for your equipment.

There are many other accessories that you may be aware of, that don't necessarily relate to the functionality or dependability of the vehicle. When purchasing vehicles you can often get wrapped up in the bells and whistles that are offered. Caution should be used when presented with a laundry list of added "features" as these do not generally help the vehicle's operation and they negatively impact the bottom line.

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Vehicle Systems and Specifications Improving Fuel Efficiency Driver habits and performance Driver habits and performance can be one of the largest factors in fuel mileage. The driver's driving techniques can influence fuel mileage as much as a mile per gallon. Communicate correct driving techniques to the drivers and emphasize the importance of using them. Here is a list of driving techniques that can improve fuel mileage: • Progressive shifting, • Low RPM driving, • Operating at a slightly slower speed, • Maintaining steady speeds, and • Idle reduction. Progressive shifting and low RPM driving. Training drivers on progressive shifting and low RPM driving is typically a safety/training department function. However, by downloading engine data at the time of service the Maintenance Pro may become involved in the process. High RPM spikes and high average RPMs are typical of a driver not using progressive shifting or constantly operating at high RPMs. Typically, these drivers believe that to get the engine to perform correctly the engine must be kept at high RPMs and that maintaining high RPMs will reduce the number of shifts that are necessary. Both of these points are false. As you know as a Maintenance Pro, torque, not high RPMs, is what makes an engine perform well. Keeping the vehicle at high RPMs keeps it above the peak performance areas. Also, if the driver is downshifting at high RPMs, the driver is never giving the engine a chance to pull (downshifting before even getting into the engine's peak torque range). Finally, there are software programs that can be installed on engine computers that limit the RPMs at various road speeds. These programs force drivers into using progressive shifting. This should be considered if the majority of the fleet has a problem with not using progressive shifting. Slower speeds. Some drivers believe that a vehicle can be equipped to operate efficiently at any speed, if the driveline is correctly configured. What these drivers need to understand is that speed equals air resistance. No matter how efficient the driveline is, air resistance cannot be avoided. Fuel mileage drops as much as 5 to 8 percent for every 5 miles per hour over 55 miles per hour (depending on vehicle configuration), no matter how well it is geared. Graphing the air resistance can many times demonstrate the issue to the drivers.	

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Here again, typically the people who train drivers will be involved in the actual training. However, downloading data and observing high speed spikes and high average speeds will get the Maintenance Pro involved. The Maintenance Pro can also lend the training person expertise and facts in this area.

Speed reduction through the use of the vehicle fuel management computer is another high-tech solution. By reducing the speed at which the vehicles are operating, the company can realize a considerable fuel mileage improvement. This will normally generate a considerable push-back from the drivers (and possibly increase driver turnover), as reducing the speed at which the vehicles operate will reduce their income.

Here is an additional note on speed reduction. Speed limiters are the law in the provinces of Ontario and Quebec, Canada. The intent is to reduce pollution, increase fuel mileage, and improve highway safety.

All large trucks operating in the provinces of Ontario and Quebec must have their speed limited to no more than 105 kilometers per hour, or 65.2 miles per hour. The present provincial speed limit for large trucks on major highways in these provinces is 100 kilometers per hour, or about 62 miles per hour.

The carrier operating the vehicle will be responsible for compliance with the law. Carriers that have the technical know-how and correct equipment (hardware and software) should be able to do the programming themselves. If the carrier does not have the know-how or equipment, the programming will need to be done at a dealer or repair facility that has the correct capabilities.

As much as is practical, the speed limiter will need to be tamperproof. Once it is set at the appropriate speed, the driver is not to have the ability to alter it. Proof of not having an operating speed limiter will be a speed citation exceeding 105 kilometers per hour. In theory, a speeding violation in excess of 105 kilometers per hour could result in two citations — one speeding citation issued to the driver and another citation issued to the carrier for not having an operating speed limiter on the truck.

Here is a key point: This law applies to every truck over 11,000 kilograms (roughly 24,250 pounds) operating in Ontario and Quebec, **regardless of**

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where the vehicle is registered. Trucks entering Ontario and Quebec from other provinces or the United States will be required to comply with this law.

In the United States several major trucking associations and motor carriers, and several safety organizations have petitioned the United States Department of Transportation to consider similar regulations. That rulemaking is now underway, with a proposed rule due to be published some time in the future.

As well as limiting speed, the power of the engine can also be adjusted in many cases. Be aware, reducing the power the engine can generate may have the same effect on driver performance as reducing the vehicle speed, and may cause the same problems.

Maintaining steady speeds. A Maintenance Pro can notice certain driving behaviors when downloading the vehicle computers, and when performing maintenance, that indicate a driver is not maintaining steady speeds. Common indications are a high number of hard-brake incidents on the vehicle computer, and excessive brake wear on the vehicle.

What is typically causing this (high number of hard braking incidents and excessive brake wear) is the driver having to make radical speed changes due to not finding a good cruising speed and “running with traffic.” This driving habit causes a reduction in fuel mileage, as well as being potentially dangerous. As the Maintenance Pro, you may not be training the driver on good defensive driving techniques, but the information generated by your department can be critical to the people that do.

Idle reduction. Idle reduction can be accomplished through the use of various programs. The Maintenance Pro will need to be actively involved in the program. If the carrier decides to implement a fuel bonus program, the implementation would need to include initiating the use of hardware to track the actual percentage of idle.

Also, to make the program more acceptable to the drivers, the idling goals will need to take into consideration resting time for drivers of sleeper berth vehicles. The allowable idle time would have to vary based on the season, type of auxiliary equipment in use on the vehicle, and the primary run area of the carrier. As an example, drivers that spend a good deal of time in the northern states during the winter months will need to idle their vehicles for warmth, unless auxiliary equipment is used that can reduce the idle time.

One program is the use of a driver bonus program aimed at reducing idle. As with any bonus program, the difficult part is establishing the correct monetary reward. The concept with any bonus is to “share” the rewards of the desired improvements with the drivers. If the bonus is incorrectly set, the carrier can actually lose money due to the program.

If the carrier is already seeing low idle percentages, the program cannot financially support itself.

The next idle reduction method would be the addition of idle reduction hardware such as an auxiliary power unit (APU) to heat and/or cool the cab without running the vehicle’s main engine. The diesel-powered APUs that are presently available can heat or cool the vehicle for a complete

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driver rest cycle using less than one-half of a gallon of fuel (as compared to $\frac{3}{4}$ to 1 gallon of fuel per hour of idling in heavy-duty vehicles).

Idle reduction hardware that can be installed on the vehicles includes:

- Phase charging systems that can cool the vehicle for up to eight hours without running the vehicle engine,
- “Shore line” systems that use 120-volt power from an outside source to heat and/or cool the cab while the vehicle is parked,
- Generators (gensets) that provide 120-volt or 12-volt power to the cab to operate heating and cooling systems,
- Heating and cooling “tubes” provided at truck stops that connect to the cab to provide heat and cooling to the cab,
- 12-volt heating and/or cooling systems that use extra battery packs, and
- Diesel cab heaters.

Several of these hardware systems use no fuel. Of course, there is the initial cost of the idle reduction equipment and the cost of installation, but this can be offset by the fuel savings, federal tax breaks, and other program involvement. One such program is the Environmental Protection Agency’s (EPA) “Smartway Transportation Partnership” program. This program provides low interest loans and grants to carriers who are willing to reduce emissions through the reduction of fuel usage.

There are also potential problems with heat generation, driver acceptance, and equipment compatibility that need to be addressed with these systems.

As with any other cost reduction plan, the company as a whole will need to study the costs and benefits of installing the idle reduction hardware.

Installation of idle reduction software is another high-tech solution to idling. The fuel management computer on most modern medium- and heavy-duty vehicles can be programmed to shut down the main engine after a predetermined number of minutes of idling.

There are software systems (some requiring hardware upgrades) that will automatically shut down and start up the main engine to warm or cool the cab of a sleeper truck based on the driver’s desired cab temperature. This allows for fuel savings by not running the engine if the driver does not need heat or air conditioning.

The starting point for any of these initiatives is the development and strict enforcement of a no-idle policy (if not sleeping in the cab, the truck is not to be running). To verify compliance with such a policy, the carrier may need to use (or install) onboard hardware and/or software to track driver performance. Typically, the Maintenance Pro becomes involved in these programs due to the increase in vehicle maintenance or improvements that are required. Also, vehicle maintenance checklists may need to be modified to include routine downloads of onboard computers.

The key is to equip the vehicle and motivate the driver to reduce idle. You cannot do one without the other. Simply telling drivers to reduce idle may not lead to any reduction if the drivers are already at the minimum.

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Providing the vehicle with hardware or software may assist the driver in lowering the idle time.

Implementing a fuel bonus

Many drivers respond well to simple monetary bonus programs. A fuel bonus is such a program. Fuel bonuses can be used to motivate drivers to reduce idle time, keep their speed down, and improve their shifting.

The downsides to a fuel bonus program are the cost of administering the program, lack of fairness when comparing vehicles and run areas, and driver frustration.

As with any bonus program, the company will need to set the bonus levels carefully. Performing a study to determine how much money improved fuel mileage can save is the first step in establishing a bonus. If the program cannot generate enough savings to cover the direct costs and administrative costs of running the program, it should not be undertaken.

The lack of fairness (or perceived lack of fairness) is caused by several factors. Drivers that are assigned older, less efficient vehicles or operate on routes that require the vehicle to work harder, will have to make more sacrifices to make the bonus.

Setting the bonus levels low enough that they are achievable by all vehicles is one method to overcome this, although it is not preferred. Drivers with more efficient vehicles will not have to work to improve their fuel mileage, thereby reducing the overall effectiveness of the program. Establishing "brackets" for the different equipment is a fairer and more effective method. Example: Drivers with 2000 to 2003 vehicles must get 6.5 miles per gallon to qualify, while drivers with 2004 to 2006 vehicles must get 6.75 miles per gallon to qualify. If you are maintaining accurate records of vehicle performance based on vehicle groups (see the recordkeeping section of this manual), determining the appropriate level for each group is possible.

Driver frustration with a fuel bonus program can be caused by drivers believing the goals are unattainable. Another potential source for frustration occurs when drivers' maintenance or operational requests are not met, leading the drivers to believe the company contributed to the loss of the bonus.

If operating with a fuel bonus, the Maintenance Pro (and the maintenance department in general) will need to be extra sensitive to driver write-ups and complaints. You will need to be prepared to be challenged if the driver reported problems, but the problems were not resolved, and the driver believes that the unresolved vehicle problems cost him/her the bonus.

PMs will also need to be done on time, every time. This will keep drivers from being able to claim that they did not make the fuel bonus because of a lack of maintenance.

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Equipment specifications

When spec'ing your equipment, fuel economy should be a major consideration. Fuel is normally the second largest operating cost for any motor carrier (just behind wages when measured as a cost-per-mile factor). Consequently, making a conscious effort to spec your equipment for maximum fuel economy makes for a sound business practice.

An aerodynamic vehicle design, combined with a productive and efficient gear ratio and the right engine, can make a tremendous difference in your fuel costs. However, when it comes to spec'ing for fuel economy, some specs or equipment modifications make more sense than others.

Spec'ing equipment that will maximize your fuel economy efforts is the best overall route to take. In general, today's vehicles are far more fuel-efficient than in the past, but you need to choose appropriately for the job the vehicle is going to be expected to do in your operation. The following are a few that will have the most impact:

Cruise Control. As a starter, plan to specify cruise control on any new equipment. Then program the control just under top-governed speed. Drivers will usually willingly give up two to three miles per hour in return for the freedom of not having to have their foot on the throttle all the time. It's almost a sure thing that cruise control will save fuel over what the driver can do manually.

Speed. Fuel economy tests have clearly shown that each one-mile-per-hour increase above 55 consumes $\frac{1}{10}$ gallon more fuel per mile. That means that a rig going 65 mph will get one less mile per gallon than the same rig going 55 mph, on an average. The faster a vehicle goes, the more horsepower it requires and the more fuel it consumes. Add variances in terrain and various additional factors to this picture, and you can see the importance of keeping drivers attuned to fuel economy.

During the spec'ing process you will want to consider ordering vehicles that operate at the slowest acceptable speeds, not necessarily the fastest.

Air Intake Restriction. Another specific thing to keep in mind is the fact that too much air intake restriction can cause up to a 4 percent drop in fuel economy. Why? For the first 80 percent of its life, the typical air filter gets dirty rather slowly, but once you pass that point, the filter plugs with dirt and other foreign substances more rapidly. As this happens, air intake restriction increases and the engine has to work harder to pull in air.

Engine manufacturers say the loss in horsepower equals the percentage loss of fuel economy. According to Donaldson Company engineers, increasing air intake restriction from 5 inches to 25 inches (in water) can result in a 3.4 percent horsepower loss. For a truck that runs 100,000 miles per year and gets 6.5 mpg, that works out to 43.5 gallons of fuel every month!

Exhaust Backpressure. Too much exhaust backpressure causes you to lose fuel economy too. How much is too much? Almost all turbocharged diesels have a maximum allowable backpressure of 3 inches mercury (Hg). By using a 1.5 inch Hg muffler, you can get as much as 1.5 percent fuel economy improvement. Before you spec all new mufflers, however, be certain that the replacements meet existing or proposed noise standards.

Vehicle Systems and Specifications

The diesel particulate filters (DPF) and selective catalytic reduction (SCR) systems that are being placed on vehicles to meet the emissions requirements can increase backpressure if not correctly spec'd and maintained. Many of these systems can be ordered with a "tell-tale" device or diagnostic system that notifies the driver (or maintenance through the onboard data system) that the system is approaching the need for service.

It is also important that these systems be monitored and maintained as part of routine PM to avoid excessive backpressure.

Fan and fan clutch. The engine cooling fan places a significant load on the engine when it is engaged. The less it runs and the smoother it engages, the better the fuel mileage. How and when the fan engages is determined by sensors in the cooling system and the fan clutch. When looking at engine fan systems and fan clutches, be sure to consider the affect they will have on fuel mileage.

Tires. Don't forget about tires in this picture. Fleets are increasingly spec'ing radial tires. They stand up better and give more tread life for the money. But a factor that managers often miss is that bias-ply tires require significantly more horsepower (40 to be specific) to maintain 55 mph than steel-belt radials. Using more horsepower translates directly into fuel consumption, so be sure you spec well when it comes to tires.



One other point about tires is the problem of under-inflation. If your tires are under-inflated, you can lose 1.5-3 percent of your fuel mileage. Because of the direct effect that tire inflation has on fuel economy (and the operational cost of purchasing and repairing tires), many fleets have gone to, or experimented with, electronic tire monitoring and automatic inflation systems. These after-market options continually monitor tire inflation and notify the driver if tire pressure is low in a tire. In the case of the automatic inflation systems, the system will bring the tire back up to

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pressure after notifying the driver. Finally, be sure regular inflation checks are provided in your inspection system.

Tire size and type are also a critical decision. Tire size matters because a vehicle's overall road speed performance (and therefore the RPM requirements) changes with the diameter and circumference of its tires. If the driveline is not matched to the tire size, the vehicle may be operating at a higher than necessary RPM just to maintain the cruising speed. The reverse is also true. If the tires are too big for the vehicles the vehicle may be running at too low of an RPM when cruising, leading to other problems.

Tread type also impacts fuel economy because a tire's tread helps determine rolling resistance. For example, a deep lug drive tire will improve traction, but will also lower fuel economy by 2-4 percent.

Overall, tire technology has improved dramatically. With improvements in tread designs, casting designs, rubber compounds, and friction reduction, definite and significant savings can be realized by spec'ing the right tires for your equipment.

Equipment Replacement. Fuel consumption records should be one set of information used in making the decision to repair or replace a fleet vehicle. Weighing a 4.5 mpg figure for an older vehicle against a 6.5 mpg for a new one is a variable in the replace/repair equation that should be considered.

Lose weight. One option to improve fuel mileage is to reduce the weight of the vehicle. There are several spec'ing options that can accomplish this. Here is a short list:

- **Lightweight frame and body materials.** When spec'ing the vehicle, discuss the use of lightweight frame and body materials (aluminum, plastic, fiberglass, composite materials, etc.). Most manufacturers offer vehicle models that use lightweight materials to lower the vehicle weight. The question that needs to be answered if you consider this is: Is the lightweight model vehicle going to be strong enough to do the job?
- **Vehicle size.** Another consideration with the frame and body is "how big." Drivers and fleet managers may love and want big vehicles (whether it is a bus or a truck), but would a smaller vehicle make more sense? The more the vehicle weighs, the lower the fuel mileage.
- **Lightweight axle components.** The main axle component that can be lightened up (besides the axles themselves) is the wheel assembly. This can be lightened by using aluminum rims rather than steel, or by switching to a "super single" configuration in place of duals. Super singles have several advantages when it comes to fuel mileage (improved rolling resistance, lighter), but come with the disadvantage that one low tire can stop the vehicle.
- **Fuel capacity.** With fuel weighing over seven pounds a gallon, the more fuel the vehicle carries, the more weight it is carrying. Excessive amounts of fuel (there are truck-tractors built that can carry 400 gallons of fuel) do nothing other than add unnecessary weight to

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the vehicle. Correct spec'ing normally calls for the vehicle to carry a maximum of one workday's worth of fuel.

Aerodynamics. Air resistance is a vehicle's second greatest impediment to movement, and therefore, optimum fuel economy. Only weight, and the rolling resistance it creates, impacts miles per gallon more. Efficient aerodynamics smooth the flow of air over, under, and around the vehicle. It is not uncommon for some aerodynamic vehicle designs to save carriers as much as 4-5 cents per mile in fuel savings.



When spec'ing trucks for fuel economy, start with the full-cab roof fairing. Make sure it matches the height of your trailers. A proper roof fairing can improve miles per gallon (mpg) performance up to 15 percent when compared to operating without one. Roof fairing considerations include:

- **For raised-roof sleeper cabs.** Most are slightly shorter than a trailer's roof. Therefore, if you have these types of vehicles, you might want to consider adding a small fairing accessory. Without this retrofit, you may lose from 4-10 percent of the benefits of a full roof fairing.
- **For low-height trailers.** Installing a full-height roof fairing on a tractor that hauls primarily low-height trailers (flatbed, tanker) would actually add resistance. For this type of operation, you might be better off with flat-roof or mid-roof fairing that better matches your trailer fleet.

Other aerodynamic/air-deflector options. Most aerodynamic options are equipment packages or after-market add-ons. These include:

- Cab extenders, which are designed to bridge the gap between the truck cab and the trailer. The goal of these extenders is to attempt to reduce the gap to less than 18 inches.
- Side skirts, which cover the fuel tanks and battery box and smooth out the overall profile of the truck.
- Air-dam front bumpers and aerodynamic hoods which are designed to ease air flow around the front of the vehicle.
- Aerodynamic accessories (or aerodynamic location of accessories), such as mirrors, air intakes, air horns, and grab handles.

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- Trailer air deflectors including nose and rear “bubbles,” side skirts, and axle air deflectors. Any of these options can increase fuel economy by 1-3 percent.

Electronic engines. With regard to spec'ing for fuel economy, all new vehicles come with electronically-controlled engines. However, one key issue is what are you, as the vehicle owner, going to be able to do with the electronic engine? Does the manufacturer allow the vehicle owner to reprogram the engine control module (ECM)? Are you able to download data retained in the ECM? Does the ECM only communicate with proprietary software or hardware? If so, can you get the software and/or hardware to reprogram the ECM to improve fuel economy?

Updateable software. If you are using electronic engines (or are going to start using them), another consideration when spec'ing with an eye toward fuel mileage is spec'ing engine control systems that can be updated. Engine manufacturers occasionally update their software, and some of these updates can result in an improvement in fuel mileage. This is a different issue than the “reprogramming” discussed earlier. Updating involves the manufacturer being able to install new operating programs or software into the engine computer, not simply “adjusting the parameters” in the existing software.

Gear fast/Run slow. Gear ratios in the transmission and rear axle(s) determine how fast the engine spins (RPM) at any given road speed. When spec'ing for fuel economy, each must be selected with the other in mind. The best way to use gearing for fuel economy is to “gear fast/run slow.”

Spec your vehicles so that they could run fast, but set the vehicle software to cruise at a slower speed than they are capable of. This lower cruising speed will also mean a lower cruising RPM. The lower the engine RPM during cruising, the less fuel is consumed.

Be careful to not over do it. You are trying to make sure that the engine is operating at the lower end of its power band when cruising, rather than the upper end of the power band. If you gear too fast, the engine will be below its power band when cruising which can create wear and performance problems (the driver or the vehicle has to do a lot of downshifting to maintain speed/power).

Most trucks, tractors, and large buses are geared for a top speed of 75-80 miles per hour (mph) at 1800 to 2100 RPMs. With this engine/gear package they cruise efficiently at 65 mph with the engine operating at between 1300-1500 RPM (when equipped with engines with a power band of 1200 RPMs to 1800 RPMs). At this operating range the vehicle uses the least amount of fuel possible.

Inspection and Maintenance

One key area to focus on when looking to improve fuel mileage is inspection and maintenance. Spec'ing and maintaining go hand in hand. Specific inspection and maintenance items on the vehicles that can have a direct effect on fuel mileage are (these items are also considered when spec'ing vehicles):

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- Tire type, inflation, and condition,
- Bearing condition,
- Brakes and brake system operation,
- Fuel system protection and integrity,
- Engine oil type, level, and condition, and
- Engine performance.



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Be sure the vehicles are receiving their scheduled maintenance and drivers are performing their daily inspections. Remember, something as simple as an under-inflated tire or a dirty air filter can be lowering the vehicle's fuel mileage.

Driver inspections are critical. If the drivers are not spotting under-inflated tires, bad bearings, dragging brakes, fuel leaks, and oil problems, the vehicle may be losing fuel mileage until it comes in for scheduled maintenance. To avoid this, make sure drivers are trained in inspections and have a program in place that verifies they are doing their inspections.

Be sure the maintenance department is listening to drivers for potential performance problems that may be reducing fuel mileage. If a driver complains of a drop in fuel mileage, or any other performance problem, do a detailed inspection of the vehicle to determine the problem. If the problem becomes common, consider adjusting the spec's on future vehicles.

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Summary

Equipment specification is a key area in improving fuel mileage. There are questions the Maintenance Pro should bring to the vehicle manufacturers when spec'ing equipment. Here is a list of considerations in vehicle specification:

- Are the engines properly sized and set for the workload being placed on them?
- Does the engine have a programmable system that allows the Maintenance Pro to set the performance parameters and download performance data?
- Is the transmission and axle gearing keeping the engine in the correct RPM range for maximum fuel mileage?
- Are there intake gauges or warning devices available that can alert the driver or maintenance department of an air intake restriction?
- Are there backpressure monitoring devices available to make sure that the DPF or SCR system is not restricting exhaust flow?
- Are the tires and bearings reducing or increasing rolling resistance?
- Is there a cost-effective tire monitoring system available to keep tires at the proper inflation?
- Are there more effective aerodynamic vehicles or option packages available?
- Is there a vehicle package that can significantly reduce the vehicle weight?
- Does our maintenance match our specifications? In other words, are we maintaining the vehicles in such a way as to increase, rather than decrease, fuel mileage?

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Vehicle Systems and Specifications Emission Systems	
Emission standards The national emission standards are issued by the Environmental Protection Agency (EPA). The actual regulations on heavy-duty engines are included in the regulations portion of this manual. As a Maintenance Pro it will be your responsibility to make sure the vehicles continue to comply with the standards that cover the vehicle. There are two key compliance areas you need to be concerned with. First is the actual emissions standards. The emission standards are issued based on the date of engine manufacture. As an example: If the date of manufacture was previous to 2004, the engine would have to meet the standards that were in place at the time of manufacture (the 1998 standards). The vehicle can be upgraded to a later standard (there are several EPA programs that provide grants or loans for just such a purpose), however, it cannot be allowed to fall below the standards that were in effect on the date of manufacture. It is a violation of federal law to tamper with or remove any emissions components. The vehicle is subject to inspection and testing to verify that it is complying with the emission standards that were in effect at the time of manufacture. If the vehicle has been altered or cannot pass an emissions test due to alteration or lack of proper maintenance, the company can be fined. The second requirement that the Maintenance Pro needs to be concerned with is the emissions labeling requirement. Each vehicle and engine are provided with a label stating which emission standard the vehicle/engine was built under. It is a federal requirement (and a state requirement in many states) that these labels be present on the vehicle. If the label is missing (most commonly a problem with engines) you will need to locate the engine identification number and contact the engine manufacturer for a new label. It may be a good idea to add this to your annual or quarterly PM inspections. As well as the federal emission standards there are state requirements. California is seen as the leader in the emissions area, having tougher standards in some areas than the EPA. Most original equipment manufacturers (OEMs) have been designing their vehicles and engines to meet the California Air Resource Board (CARB) standards, as well as the EPA standards. Overall, the CARB standards for heavy-duty diesel engines are nearly identical for most model years. Key differences between EPA and CARB are the CARB regulations requiring the updating of older diesel-powered vehicles and auxiliary equipment (reefers, unloading pumps, cab heaters, and auxiliary power units) to	

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meet the more recent emissions standards. CARB (just like the EPA) requires that all diesel engines meet the emissions standards that were in place at the time of manufacture (no matter the size or intended use). However, CARB is also in the process of requiring the updating of older diesel-powered vehicles and auxiliary units to meet newer particulate matter and NOx emissions standards under various “phase-in” schedules. See the section in this chapter entitled “CARB” for details on CARB’s latest regulatory action in these areas.

Diesel engines used in heavy-duty vehicles are divided into service classes by GVWR. Light heavy-duty diesel engines are engines used in vehicles with a gross vehicle weight rating (GVWR) of 8,500 to 19,500 pounds (14,000 to 19,500 pounds in California; CARB holds vehicles under 14,000 pounds to the same standards as light vehicles) — the exception is personal passenger vehicles with a GVWR of up to 10,000 pounds (these are treated as passenger vehicles in the standards). Medium heavy-duty diesel engines are used in vehicles with a GVWR of 19,500 to 33,000 pounds. Heavy heavy-duty diesel engines (including urban buses) are used in vehicles with a GVWR of 33,000 pounds or more.

We will look only at the heavy-duty engine standards. For model years up to 2003, a simple standards system was used.

1988 to 1998 EPA Emission Standards for Heavy-Duty Diesel Engines, grams per brake horsepower hour (g/bhp/hr)				
Model year	Hydrocarbons (HC)	Carbon Monoxide (CO)	Nitrogen Oxide (NOx)	Particulate Matter (PM)
1988	1.3	15.5	10.7	0.60
1990	1.3	15.5	6.0	0.60
1991	1.3	15.5	5.0	0.25
1994	1.3	15.5	5.0	0.10
1998	1.3	15.5	4.0	0.10

In October 1997, EPA adopted new emission standards for model year 2004 and later heavy-duty diesel truck and bus engines. The goal was to reduce NOx emissions from highway heavy-duty engines to levels approximately 2.0 g/bhp/hr beginning in 2004.

The new regulation also introduced a new method for calculating emissions. Rather than considering hydrocarbons and nitrogen oxide separately, the standards created a combined category of nonmethane hydrocarbons combined with nitrogen oxide (NMHC + NOx). Manufacturers were given the flexibility of meeting one of these two options:

2004 EPA Emission Standards for Heavy-Duty Diesel Engines, grams per brake horsepower hour (g/bhp/hr)		
2004 option	NMHC + NOx	NMHC
1	2.4	n/a
2	2.5	0.5

All other emission standards remained the same (CO and PM) as the 1998 standards.

The next set of standards, passed in 2000, apply to the model years 2007 to 2010. These standards will require a lowering of particulate matter and NOx emissions over this three year span. Here are the standards:

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2007 to 2010 EPA Emission Standards for Heavy-Duty Diesel Engines, grams per brake horsepower hour (g/bhp/hr)			
Model year	NMHC	NOx	PM
2007	2.5 NMHC + NOx	1.5	0.01
2010	0.14	0.20	0.01

To meet these new standards, OEMs have had to create new technology and emission components (covered below), because simply improving engine electronics and combustion technology cannot meet the new standards. To sum it up, after-treatment of the exhaust has become necessary as of the 2007 standards.

Also, meeting these standards (in particular the new PM standard) required the development of “clean fuels.” This is also covered below.

Diesel particulate filters

As regulations continue to reduce the amount of allowable particulate discharge by a heavy-duty diesel engine, manufacturers have had to develop new technology. One of these new technologies is the diesel particulate filter, or DPF.

The concept of a DPF is not new (they have been around since the 1980s). With the emissions standard changes in 2004 and 2007, OEMs began adapting the technology to on-road heavy diesels.

One point about DPFs — they are not required. What is required is that the particulate discharge be below the regulatory thresholds. To meet these requirements most OEMs have decided to install DPFs.

The principle of a DPF is similar to most filters. The DPF cleans exhaust gas by forcing the gas to flow through the filter which “scrubs out” the particulates. The DPF then oxidizes the trapped particulates, converting them into less harmful components. There are a variety of diesel particulate filter technologies on the market. Several DPFs use a filter material that is also a catalyst that helps reduce other emissions (carbon monoxide and hydrocarbon byproducts).

There are several types of DPFs. Most use a ceramic wallflow honeycomb filter design. This type of filter uses cordierite (a ceramic material that is also used as catalytic converter cores) as the filter medium to trap particulates. These filters also have a honeycomb design to attempt to provide more air flow areas than a standard filter.

Any DPF will be subject to soot and ash build-up. This is normally taken care of through “passive regeneration.” This occurs when the exhaust flow temperature becomes high enough to oxidize the built up particulates. Some systems use “active regeneration,” which increases the exhaust temperature to increase regeneration and improve exhaust flow. All active regeneration systems use extra fuel, whether through burning to heat the DPF, or providing extra power to the DPF’s electrical system.

No matter what regeneration system the vehicle uses, the DPF must still be removed and cleaned or replaced as part of normal PM (manual regeneration if you will).

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How often does this need to be done? That depends on the normal operating temperature of the exhaust, the quality and type of fuel burned, and the age and condition of the engine and air filter. Air filter? Yes! If the engine is not getting the correct amount of air, the engine will not burn fuel as completely, leading to an increase in particulates.

DPFs must be used with ultra-low sulfur diesel fuel (ULSD — 15 parts per million sulfur). Use of regular diesel fuel in a DPF-equipped vehicles could eventually clog the filter. This could lead to exhaust back-pressure increases and engine damage.

One issue with DPFs is the increase in exhaust system temperature. The system must be at an adequate temperature and flow for the DPF to work correctly. Also, slowing the exhaust flow (even slightly) will increase the heat that the exhaust system must absorb. The more restricted the DPF, the higher the temperature is likely to go.

A critical component is a diagnostic module. This will notify the driver if the back-pressure caused by the DPF exceeds an OEM determined threshold.

Exhaust gas recirculation

Exhaust gas recirculation (EGR) is a NO_x emissions reduction technique used in many diesel engines to meet present or upcoming emission standards.

EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders, intermixing the incoming air with recirculated exhaust gas dilutes the mix with inert gas, lowering the flame temperature, and (in diesel engines) reducing the amount of excess oxygen. The exhaust gas also increases the specific heat capacity of the mix, lowering the peak combustion temperature.

Because NO_x formation progresses much faster at high temperatures, EGR serves to limit the generation of NO_x. NO_x is primarily formed when a mix of nitrogen and oxygen is subjected to high temperatures. By keeping temperatures lower, the generation of NO_x is reduced.

There are some drawbacks to EGR. Adding EGR to a diesel engine reduces the specific heat ratio of the combustion gases in the power stroke. This reduces the amount of power that can be extracted by the piston and can increase the amount of particulate in the exhaust. If the engine uses EGR, there may be additional capacity requirements pertaining to the DPF.

Another consideration with EGR systems is how they get the exhaust gas into the engine. Modern systems utilizing electronic engine control computers, multiple control inputs, variable geometry turbochargers, and servo-driven EGR valves to accomplish this. These systems will require additional maintenance and must be considered when developing PM schedules.

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Selective catalytic reduction

Selective catalytic reduction (SCR) is a means of converting nitrogen oxides (NO_x), an unwanted emission from a diesel engine, with the aid of a catalyst into diatomic nitrogen (an inert gas) and water.

To accomplish this, a gaseous reducing agent (urea in the case of on-road diesel engines) is added to the exhaust flow in a materially- and geometrically- controlled environment. The ensuing chemical reaction causes the conversion of NO_x into nitrogen and water, which are then discharged out of the SCR unit with the exhaust flow.

SCR systems do come with some problems, the primary one being the additional maintenance requirements. If the unit is allowed to run out of urea, it will not function. Also, it is another area of the exhaust system that will see additional heat.

Much like the DPF, the SCR unit needs to be removed from the vehicle and cleaned or replaced as part of PM. As with the DPF, there is no magic number as to when this must be done, due to the variables within each operation and the differing conditions that the vehicles and engines can be in.

Another problem is if the SCR system fails, it could create additional back-pressure on the exhaust, leading to a loss in performance and additional heat problems.

All major engine manufacturers in the medium and heavy-duty engine market have gone to SCR to meet the 2010 emission requirements. Most use a combination approach, combining SCR with engine performance adjustments (electronic control adjustments, and air and fuel flow adjustments) and/or EGR to achieve the required NO_x levels. One original equipment manufacturer attempted to meet the requirements on their engines through the use of EGR-only technology (some of their 2010 to 2012 engines did not have SCR). However, all manufacturers are now using SCR to meet the requirements.

The reducing agent that the manufacturers have settled on for on-road diesel engines is urea. As a result, vehicles built with SCR-equipped engines need to be spec'd with a "diesel exhaust fluid," or "DEF" (urea) tank. The size and serviceability of the tank needs to match the carrier operation unless the carrier is willing to purchase DEF on the road at retail prices. Example: An over-the-road vehicle will need a larger DEF tank than one involved in local delivery that receives weekly maintenance. The other consideration is the additional weight that a large DEF tank (when full) will add to the vehicle.

Maintenance Pros need to consider the following in relation to the SCR-equipped vehicles:

- Vehicle specifications involving the DEF tank and SCR unit.
- Inventory levels for SCR replacement parts.
- Inventory levels for DEF.
- Technician training on the DEF systems and SCR units.
- Inspection procedures for the DEF/SCR system.

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- Preventive maintenance items relating to the DEF system and SCR unit.
- Replacement intervals or replacement decision points for SCR units.
- Driver training pertaining to inspecting, filling, and troubleshooting the DEF and SCR systems on the road. An initial decision in this area will need to be made. Do you intend to allow drivers to do anything other than inspect the system?

As more vehicles using the SCR systems come into use in the fleet, these issues may require the Maintenance Pro to revisit the initial inspection, maintenance, and inventory decisions made in relation to the SCR systems.

Clean fuels

Ultra-low sulfur diesel (ULSD) is a diesel fuel with substantially lowered sulfur contents. Traditional diesel fuel contains roughly 500 parts per million (ppm) of sulfur. ULSD contains less than 15 ppm of sulfur.

As of 2006, almost all of the petroleum-based diesel fuel available in North America is of a ULSD type. The move to ULSD is necessary to allow the application of newer emissions control technologies that substantially lower emissions of particulate matter from diesel engines. New emissions standards, dependent on the cleaner fuel, have been in effect in the United States since model year 2007.

On June 1, 2006, refiners were required to produce 80% of their annual output as ULSD, and pumps were required to label diesel fuel, diesel fuel additives, and kerosene pumps with EPA-authorized language disclosing fuel type and sulfur content.

While sulfur is not a lubricant, the process used to refine ULSD reduces the lubricating properties of the fuel. The lubricating characteristics of the fuel lubricates and protects the various parts of the engine's fuel injection system from wear. The processing required to reduce sulfur to 15 ppm also removes naturally-occurring lubricity agents in diesel fuel. To manage this change, ASTM International (formerly the American Society for Testing and Materials) adopted the lubricity specification defined in ASTM D975 for all diesel fuels, and this standard went into effect January 1, 2005. Engine oil manufacturers have also adjusted their products to compensate for the changes in the fuel formulation created by the refining process of ULSD.

CARB

CARB, who are they and what do they do?

CARB (or simply ARB inside California, is the California Air Resources Board) is a unique, non-political agency in California that was created to move air-quality decision out of the political process. CARB regulates everything from power plant emissions to windshield washer fluid. Basically, anything entering the air in California is under their authority.

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CARB has several programs that have an impact on the transportation industry. Some of these programs only apply to California-based equipment, while others apply to any diesel-powered vehicle operating in California (regardless of where it is registered). This section of the manual includes a listing of the CARB requirements that apply to all vehicles operating in the State of California. Vehicles registered in California have additional requirements (periodic smoke inspection requirements and special regulations on utility, public agency, and trash collection vehicles in California).

While CARB and some of the CARB programs are unique to California and California-based vehicles, many other states have similar rules. It is important that a Maintenance Pro be familiar with any emissions requirements (such as periodic emissions testing) that are in effect in the state where the vehicles are based.

Drayage Trucks emissions

This program applies to all trucks that haul into, out of, or within port and rail facilities in California. This regulation requires the registration of all trucks entering and operating in ports and rail facilities, and establishes emissions reduction requirements that began phasing in as of January 1, 2010 (vehicles can be registered at www.arb.ca.gov/drayagetruck). As of January 1, 2010, class 8 trucks equipped with pre-1994 engines are no longer allowed into the facilities. As of the most recent phase-in, class 7 and 8 trucks equipped with model year 1994 to 2006 engines must meet the 2007 emissions standards (as of January 1, 2014). This involves replacing the engine in the older trucks with a newer engine (2007 or newer) or replacing the truck with a 2007 or newer truck. The final step is all trucks operating in the port and rail facilities meeting the 2010 engine emission standards by January 1, 2023 (2010 and newer engines are fully compliant and will not require any updating).

Emission control label inspection program

This involves all vehicles operating in California. If the vehicle engine is missing its emission control labeling, the owner can be fined.

Heavy-duty diesel vehicle inspection program (HDVIP)

Under this program, any heavy-duty diesel vehicle operating in California can be inspected at any time to make sure it is meeting the emissions standards in place the year the engine was manufactured. Part of the inspection also includes verifying that the emission control system has not been tampered with. Many states have similar roadside emission inspection programs.

Heavy-duty diesel vehicles registered in California are also subject to periodic (regularly scheduled) emissions inspections. This is another emission program that many other states also have in place.

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Idling Reduction Program

Idling of any heavy-duty vehicle is limited to no more than five minutes in California. Also, any heavy-duty vehicle operated in California with a MY 2008 or later engine must have an automatic “shut-down” that turns the engine off after five minutes of idling. There are a few exceptions to this rule (Clean Idle vehicles, operating auxiliary equipment, loading and unloading passengers, etc.). However, idling to control cab temperature while the driver is resting in a sleeper berth is not one of the exceptions (this is one of the common misconceptions).

TRUs

CARB has rules in place that began phasing in as of December 2008 pertaining to Transport Refrigeration Units (TRUs). TRUs are defined as a refrigeration system (a system designed to heat or cool products) that is powered by a diesel engine that is used in the transportation of goods. This definition includes the standard refrigerated units (the diesel engine directly powers the compressor) and generator set (genset) refrigeration units that use a diesel engine to run a generator to provide power to an electric refrigeration unit. Refrigeration systems that do not use a diesel engine for power (are powered off a power unit’s main engine or are powered by “shore power”) are not considered to be TRUs by these regulations.

These rules will require all TRUs to meet the following emission standards:

- Low emission TRU (LETRU): 0.30 g/hr-hp emission if the diesel engine produces less than 25 hp, and .22 g/hr-hp if over 25 hp, or be equipped with an emission system meeting the Level 2 Verified Diesel Emission Control Strategy (VDECS) retrofit standards.
- Ultra low emission TRU (ULETRU): 0.02 g/hr-hp if the diesel engine produces over 25 hp, or be equipped with an emission system meeting the Level 3 VDECS retrofit standards (diesel engine less than 25 hp must meet the Level 3 VDECS retrofit requirements and have no other compliance options).

Here is a breakdown of the specific rules based on the compliance dates:

- August 1, 2009: All owners and operators of California-based TRUs must file with CARB and secure an Air Resource Board Identification Number (ARB IN) by completing an application (for each TRU) that includes owner information, TRU information (year, make, model, identification number, etc.), engine information (year, make, model, horsepower, identification number), compliance status with the performance standards, and how compliance was achieved. Once CARB has assigned the TRU an ARB IN, the company has 30 days to display the number on the TRU. This is the only requirement that out-of-state TRUs do not have to meet (voluntary compliance is allowed for out-of-state TRU owners and operators).
- December 31, 2009: TRUs with an engine from model year (MY) of 2001 or earlier must meet the LETRU requirements.

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- December 31, 2009: TRUs from MY 2002 must meet the LETRU standards.
- December 31, 2010 (enforcement began March 31, 2011): TRUs with an engine from MY 2003 must meet the LETRU or the ULETRU standards.
- December 31, 2011: TRUs with MY 2004 engines of less than 25 hp must meet the LETRU or ULETRU standards. MY 2004 engines of 25 hp and greater must meet the ULETRU standards.
- December 31, 2012: TRUs with an engine from MY 2005 must meet the ULETRU standards.
- December 31, 2013: TRUs with an engine from MY 2006 must meet the ULETRU standards.
- December 31, 2014: TRUs with an engine from MY 2007 must meet the ULETRU standards.
- December 31, 2015: TRUs with an engine MY of 2001 or earlier must meet the ULETRU requirements.
- December 31, 2015: TRUs with an engine from MY 2008 must meet the ULETRU standards.
- December 31, 2016: TRUs with an engine from MY 2002 must meet the ULETRU standards.
- December 31, 2016: TRUs with an engine from MY 2009 must meet the ULETRU standards.
- December 31, 2017: TRUs with an engine from MY 2010 must meet the ULETRU standards. MY 2003 engines that met the LETRU standards in 2010 must meet the ULETRU standards.
- December 31, 2018: TRUs with an engine from MY 2011 must meet the ULETRU standards. MY 2004 engines of less than 25 hp engines that met the LETRU standards in 2011 must meet the ULETRU standards.
- December 31, 2019: TRUs with an engine from MY 2012 must meet the ULETRU standards.

CARB does account for engine changes. However, all an engine change will do at this time is change the compliance date. Example: If you place a MY 2009 engine into a 2003 TRU, you have changed the compliance date for the TRU from December 31, 2010 to December 31, 2016.

If you cannot justify bringing the TRU into compliance, you do have the option of removing the TRU from service and using the vehicle for the transportation of dry goods. However, the TRU must be completely disabled in such a manner that the engine cannot operate (removal of the engine, removal of the refrigeration unit from the TRU, removal of a significant portion of the engine, etc.). Also, whatever is done to disable the unit must be visually verifiable.

There are several administrative actions pending that may have an impact on the TRU implementation. Carriers that operate TRUs in California

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should plan on meeting the compliance dates. However, be sure to monitor industry news for possible changes in the TRU requirements.

Diesel-fueled auxiliary power systems

Diesel-Fueled Auxiliary Power Systems (also referred to as APUs) use small diesel engines to generate power for cab heating, cab cooling, and operating ancillary appliances. These units can also be used to heat the engine block in cold weather and recharge the vehicle's battery.

A Diesel-Fueled Auxiliary Power System operated on a truck equipped with a 2007 or newer engine must be fitted with a verified Level 3 particulate control device (85% particulate reduction efficiency), or have its exhaust plumbed into the vehicle's exhaust upstream to use the vehicle's particulate matter aftertreatment device (DPF). Also, the Diesel-Fueled Auxiliary Power Systems must be approved by CARB and the vehicle must have an approved "Verified Clean APS" label affixed to the hood of the vehicle.

A list of approved Diesel-Fueled Auxiliary Power Systems is available through the CARB website at: <http://www.arb.ca.gov/msprog/cabcomfort/cabcomfort.htm>.

For trucks with 2006 and earlier model year engines, any California- or federally-certified Internal-Combustion Auxiliary Power System may be used.

Fuel-fired cab heaters

Fuel-Fired Heaters (also know as Fuel Operated Heaters) provide heat to the cab and the engine block, and use only a fraction of the fuel that would be used by idling the vehicle's primary engine. They can be paired with cooling technologies (such as battery-electric, vehicle-battery, or thermal energy storage systems) for a more complete heating and cooling package.

Fuel-Fired Heaters operated on trucks equipped with 2007 and newer engines must meet emission standards specified in California's Low Emission Vehicle Program (as indicated on the unit).

A list of approved Fuel-Fired Heaters is available through the CARB website at: <http://www.arb.ca.gov/msprog/cabcomfort/cabcomfort.htm>.

On trucks equipped with 2006 and earlier model year engines, any Fuel-Fired Heater may be used.

The reason for the regulatory distinction between pre-2007 vehicle engines and 2007 and newer engines in these two areas is CARB wants to see less emission being generated by the auxiliary unit than by the vehicle's main engine. If an older auxiliary unit is placed on a 2007 or newer engine, this may not be the case.

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Regulation to reduce emissions from in-use on-road diesel vehicles, a.k.a. the “Truck and Bus” rule

In 2008, CARB passed rules requiring that all diesel-powered trucks and buses with a weight rating of 14,000 pounds or more be brought up to the 2010 diesel particulate matter (DPM or simply PM) and Nitrogen Oxide (NO_x) emissions requirements. This will be accomplished by requiring all vehicles built before 2010 to undergo a retrofit. This rule is informally called the Truck and Bus rule or the Private Fleet rule (referring to privately owned vehicles, not private carriers). Much like the TRU rules, the retrofit requirements and schedule will be based on the MY of the vehicle’s engine. The implementation began by requiring vehicles with engines from MY 1996 to 1999 be retrofitted to meet the PM requirements by January 1, 2012, and ends when all covered vehicles with pre-2010 engines are retrofitted to meet the 2010 standards by January 1, 2023. Here is the implementation schedule:

Vehicle/Engine Model-Year	Compliance Deadline, Jan 1...	Requirements
Pre-1994	2015	2010 Engine
1994-1995	2016	2010 Engine
1996-1999	2012 2020	PM BACT 2010 Engine
2000-2004	2013 2021	PM BACT 2010 Engine
2005-2006	2014 2022	PM BACT 2010 Engine
2007-2009	2023	2010 Engine
2010	No requirements	Meets all requirements

*BACT — Best Available Control Technology, a.k.a. Particulate Matter (PM) Filter. “2010 Engine” means that the vehicle must be retrofitted with a 2010 or newer engine by the compliance date shown if it is to stay in service.

There are provisions in the regulation that allow a fleet to phase in compliance based on fleet averaging. This can allow a carrier to keep older equipment on the road if newer equipment is purchased to reduce the fleet’s overall emissions. There are phase-in programs available for small fleets, large fleets, early adopters, school buses, and vocational trucks. There is also a provision that allows “low-mileage” vehicles to operate in California without having been retrofitted.

CARB also allowed carriers with affected vehicles that were not able to get the necessary equipment due to a shortage of approved devices or the inability to secure financing to delay compliance. Carriers that could not secure parts in time had until July 1, 2014, to secure and install the necessary PM filter. Carriers that could not secure financing can delay compliance until January 1, 2017 (for up to three vehicles). To use these exceptions, the carrier must be able to show a “good faith effort” to comply. This includes having documenting that the parts were ordered in a timely manner and/or that the attempt at financing was done in a timely manner (such as in September/October/November 2013). If either of these exceptions are used, the proof of the good faith effort must be retained at the company headquarters and carried in the affected vehicles until the vehicle is retrofitted.

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There is a separate implementation schedule for lighter trucks and buses (with a GVWR of 14,000 to 26,000 pounds) starting in 2015. The basic principle is that once a lighter-duty diesel-powered vehicles's engine reaches 20 years old, it must be replaced with a newer vehicle up to the 2001 and later model years. The 2001 and later model years have a different implementation schedule. To start the program, covered vehicles with a 1995 or older model year engine would have to be replaced by January 1, 2015. Fleets had the option to install a PM filter retrofit by 2014 to make the vehicle exempt from replacement until January 1, 2020.

To use any of the exceptions or phase-in provisions, the company must also have registered with the program using the TRUCRS online registration tool before the applicable deadline.

Details can be found at the CARB website at <http://www.arb.ca.gov/msprog/onrdiesel/onrdiesel.htm>.

Please note: California has adjusted some of the requirements, phase-in schedules, and implementation dates to ease the impact of this rule. What is displayed here is the most recent information (as of September 2014).

Regulation to reduce greenhouse gas emissions

This regulation references a federal voluntary program called the United States Environmental Protection Agency (U.S. EPA) SmartWay Partnership Program. The U.S. EPA SmartWay Partnership Program aims to improve energy efficiency, reduce greenhouse gases (GHG) and air pollutant emissions, and improve energy security of the ground freight movement system by improving fuel mileage (reducing the amount of fuel burned).

Under the SmartWay program, U.S. EPA certifies tractors and trailers that have been demonstrated to be more fuel efficient than their traditional counterparts. At this time, there are SmartWay specifications for tractors with sleeper cabs and for 53-foot or longer dry-van trailers, and therefore, only these products can be certified by original equipment manufacturers under the SmartWay program. The SmartWay program also approves individual aerodynamic equipment for trailers and efficient (low-rolling resistance) tires for tractors and trailers.

The CARB regulation requires new and existing long-haul on-road tractors pulling 53-foot or longer box-type trailers and 53-foot and longer box-type trailers pulled by tractors, which operate on California highways, to be equipped with SmartWay-approved aerodynamic technologies and low-rolling resistance tires (there are no requirements related to buses in this regulation). For purposes of the regulation, a box-type trailer is a dry-van trailer or a refrigerated-van trailer. The regulation does not apply to tractors pulling other types of trailers, e.g., box-type trailers of lengths shorter than 53 feet, or to tractors pulling flatbeds, or logging trailers, drop-frame trailers, curtain-side trailers, or chassis trailers hauling shipping containers. Also exempt from the requirements of the regulation are authorized emergency vehicles and military tactical support vehicles, as well as short-haul and drayage tractors.

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Beginning January 1, 2010, a 2011 and subsequent model year tractor with a sleeper berth that pulls a 53-foot or longer box-type trailer on a California highway will be required to be a U.S. EPA-certified SmartWay tractor. SmartWay does not currently certify a tractor without a sleeper berth, i.e., day cab, and thus, these tractors would not be required to be SmartWay certified.

In addition, low-rolling resistance tires that meet U.S. EPA SmartWay specifications would be required beginning January 1, 2010, for a 2011 and subsequent model year tractor regardless of whether it has a sleeper berth or not. Beginning January 1, 2013, a 2010 and earlier model year tractor with or without a sleeper berth that pulls a 53-foot or longer box-type trailer on a California highway would be required to be equipped with low-rolling resistance tires. This would be the only retrofit requirement for these tractors.

Tractor compliance date requirements under this CARB requirement

Requirement	Model Year 2011 & Later Tractors with Sleeper Berths	Model Year 2011 & Later Tractors without Sleeper Berths	All Model Year 2010 and Earlier Tractors
SmartWay-Certified Tractor	1/1/2010	Not Applicable	Not Applicable
SmartWay-Approved low-rolling resistance tires	1/1/2010	1/1/2010	1/1/2013

The regulation requires model year 2010 and older tractors, and tractors equipped with 2 or more open-shoulder drive tires to use SmartWay verified low rolling resistance tires by January 1, 2013. However, CARB has clarified that tractors using new non-SmartWay drive tires manufactured before January 1, 2013 (based on the date stamp on the tire) can continue to use those tires for the useful life of that tread, or until January 1, 2015, whichever comes first. Any new drive tire placed on a covered tractor after January 1, 2013, must be a SmartWay verified low rolling resistance tire. Tractors using new non-SmartWay open-shoulder drive tires manufactured before January 1, 2013, can continue to use those tires for the useful life of that tread, or until January 1, 2015, whichever comes first. Any new open-shoulder drive tire manufactured after January 1, 2013, and installed on a covered vehicle must be a SmartWay verified low rolling resistance tire. Non-SmartWay open-shoulder retreaded tires manufactured prior to January 1, 2014, may continue to be used for the useful life of that tread, or until January 1, 2016, whichever comes first. Any open-shoulder retreaded drive tire retreaded after January 1, 2014, must be capped with a SmartWay verified low rolling resistance retread material on any casing.

For trailers subject to the regulation, there are two different implementation schedules based on the model year (MY). MY 2011 and newer 53-foot or longer box-type trailers must be either SmartWay certified or retrofitted with SmartWay verified technologies (low rolling resistance tires and aerodynamic technologies), as of January 1, 2010.

The older trailers (MY 2010 and older, with the exception of certain MY 2003 to 2009 refrigerated-van trailers which are addressed separately)

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must meet the same aerodynamic technology requirements as the MY 2011 and newer trailers either by January 1, 2013 or according to a compliance schedule based on fleet size which allows a phase-in over time.

MY 2010 and older trailers must also use SmartWay verified low rolling resistance tires by January 1, 2017. The MY 2003 to 2009 refrigerated trailers equipped with 2003 or newer MY transport refrigeration units have a compliance phase-in between 2017 and 2019.

53' trailer compliance options under this CARB requirement, beginning January 1, 2010

Trailer Type	Purchase Certified SmartWay Trailer	Retrofitted with SmartWay-approved low rolling resistance tires and SmartWay-approved aerodynamic devices	Retrofitted with SmartWay-approved low-rolling resistance tires and aerodynamic devices demonstrated to meet min. fuel savings per SmartWay Program
Dry-Van	Available	Aero = side skirts + rear or front fairing	Aero must provide 5% fuel savings
Refrigerated-Van	Not available on new trailers at this time	Aero = side skirts	Aero must provide 4% fuel savings

How the low rolling resistance tire requirements of the regulation will be implemented when it comes to older tractors and trailers, and vehicles using recaps, has been addressed by CARB.

Model year 2011 and newer tractors and trailers using retreaded tires comprised of a SmartWay casing capped with any retread material prior to January 1, 2013, can continue to use those tires for the useful life of the tread or until January 1, 2015, for tractors and January 1, 2017, for trailers, whichever comes first. Any tire retreaded after January 1, 2013, must be capped with a SmartWay verified low rolling resistance retread material on any casing.

These regulations do provide an implementation schedule for trailers built before January 1, 2010, with additional time provided for small carriers to comply, and a few exceptions (see below). Full details on the small fleet and general exceptions are available at the CARB website at <http://www.arb.ca.gov/cc/hdghg/hdghg.htm>.

Exempt from this regulation are:

- Custom extended sleeper cab tractors
- Curtain side vans
- Container chassis
- Drayage tractors and trailers that operate within a 100 mile radius of a port or intermodal rail yard
- Solid waste vehicles

There are also exceptions for emergency and military vehicles.

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What kinds of equipment will meet the requirements of this regulation? To comply with the regulation, you may purchase a SmartWay certified tractor and/or trailer, which will come equipped with the approved technologies. You may also comply by retrofitting your trailer with approved low rolling resistance tires and one or more of the following aerodynamic technologies:

- Trailer rear fairings
- Trailer front gap fairings
- Trailer side skirts
- Other SmartWay approved technologies

The type or number of technologies required will be based on the percentage of greenhouse gas emissions reduction of each device. These required percentages can be found in the regulation at: www.arb.ca.gov/regact/2008/ghghdv08/ghghdv08.htm.

Some carriers have chosen to disregard this regulation and operate non-compliant vehicles in California and have not received fines. However, this is changing. CARB has received final approval from EPA and can now start on- and off-road (auditing) enforcement related to this rule.

On-board diagnostics

On September 8, 2008, the U.S. EPA granted the CARB waiver request related to on-board emissions diagnostics. Under this CARB rule, all heavy-duty vehicles operating in California built in MY 2010 or later must have an on-board diagnostic system that notifies the driver if the emissions system is not functioning correctly. The diagnostic system must monitor all vehicle systems and components that can effect emissions, such as fuel, catalytic converter, turbocharger, exhaust gas recirculation, particulate matter filter, cooling, and valve timing.

If a malfunction is detected by the system, the diagnostic system must immediately report the malfunction to the driver (via a dash display). The rule requires that the driver be notified as soon as any component involved in the emissions system malfunctions, not when the emissions exceed the regulatory limits. This regulation matches an existing regulations pertaining to light-duty vehicles.

There was initial objection to this rule in the OEM and transportation industries, based on having to design and install such a system to satisfy one state. However, that argument was put to rest when the U.S. EPA enacted a regulation similar to the CARB rule. Under the U.S. EPA rule heavy-duty engine manufacturers must begin building engines that have an emissions diagnostic system starting in MY 2010, and all heavy-duty diesel engines built from MY 2013 on must be equipped with a diagnostic system.

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Idle reduction laws

In an attempt to lower emissions being generated by on-road diesel engines, many states have enacted idle reduction laws. These laws limit the amount of time the main engine on a vehicle can be idled when the vehicle is parked. Vehicles equipped with APUs, gen-sets, and other idle or emission reduction systems are allowed to use these systems and still be considered in compliance.

Here are the states that have idling laws and a brief explanation of their laws:

- Arizona does not have a statewide law, but does have a law that requires counties above a specified population to have an idle reduction law. As a result, only Maricopa County limits idling (see below).
- California allows five minutes of idling unless the vehicle is marked with a California Clean Idle label.
- Connecticut allows an engine to be idled for three minutes unless the temperature is below 20 degrees.
- Delaware allows an engine to be idled for three minutes if the temperature is above freezing and for 15 minutes if the temperature is between minus 10 and 32 degrees. If the temperature goes below minus 10 degrees there is no limit on idling.
- District of Columbia allows three minutes of idling, unless the temperature falls below 32 degrees, then the engine may be idled up to five minutes.
- Florida allows 5 minutes of idling. The limit includes various exemptions, including when a driver is sleeping or resting in a sleeper berth (this exception is set to expire Sept. 30, 2013).
- Hawaii allows up to three minutes of idling to warm up or cool down the engine only.
- Illinois does not allow the idling of unattended vehicles under any circumstances. Illinois also has a state law regulating idling in the counties of Cook, DuPage, Lake, Kane, McHenry, Will, Madison, St. Clair, and Monroe, and the townships of Aux Sable and Goose Lake in Grundy County and the township of Oswego in Kendall County. In these counties and townships idling is allowed for 10 minutes of any 60 minute period. There are exceptions if it is necessary for the driver's rest when in the sleeper berth or if the temperature is under 32 degrees or over 80 degrees.
- Maine allows 5 minutes of idling in any one-hour period. There is no limit If the temperature goes below 0 degrees. The law includes various exemptions, including sleeper berth heating or cooling during rest or sleep periods.
- Maryland allows up to five minutes of idling.
- Massachusetts also allows up to five minutes of idling.
- Missouri allows up to five minutes of idling in any hour (30 minutes/hour when waiting to load/unload) in the following counties: Clay,

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Franklin, Jackson, Jefferson, Platte, and St. Charles. St. Louis County is restricted to three minutes of idling.

- Nevada allows up to 15 minutes of idling.
- New Hampshire allows five minutes of idling if the temperature is over 32 degrees and 15 minutes if the temperature is between minus 10 and 32 degrees. If the temperature goes below minus 10 degrees there is no limit on idling.
- New Jersey allows three minutes of idling if the temperature is above 25 degrees. If the temperature goes below 25 degrees the engine may be idled for 15 minutes if the vehicle is parked for over three hours. New Jersey does allow idling if the driver is in the sleeper berth resting, and the truck is equipped with a MY 2007 or newer engine, or if the truck has been retrofitted with a diesel particulate filter.
- New York allows five minutes of idling if the temperature is above 25 degrees. If the temperature goes below 25 degrees the engine may be idled if the vehicle is parked for over two hours.
- North Carolina allows five minutes of idling in any one hour period. Idling by vehicles marked with a California Clean Idle label is allowed.
- Oregon allows five minutes of idling in any 60 minute period. This extends to 30 minutes of idling in any 60 minute period if the vehicle is waiting to load or unload, or is loading or unloading. Oregon also allows idling if the driver is resting in the vehicle and the temperature is under 50 degrees or over 75 degrees.
- Pennsylvania allows five minutes in any 1 hour period. Idling by vehicles marked with a California Clean Idle label is allowed.
- Rhode Island allows five minutes of idling each hour if the temperature is above 32 degrees. If the temperature is between zero and 32 degrees the limit increases to 15 minutes per hour. When the temperature is below zero there is no limit on idling.
- South Carolina allows 10 minutes of idling. The law includes various exemptions, including sleeper berth heating or cooling during rest or sleep periods if the temperature is below 40 degrees or above 80 degrees, and the truck is at a rest area, terminal, or truck stop.
- Texas State Codes apply to only the following counties: Bastrop, Caldwell, Collin, Dallas, Hays, Kaufman, Tarrant, Travis, and Williamson and the following cities and towns: Arlington, Austin, Bastrop, Benbrook, Cedar Hill, Celina, Colleyville, Dallas, Duncanville, Elgin, Euless, Fort Worth, Georgetown, Hurst, Hutto, Keene, Lake Worth, Lancaster, Little Elm, Lockhart, Luling, Mabank, McKinney, Mesquite, North Richland Hills, Pecan Hill, Richardson, Round Rock, Rowlett, San Marcos, University Park, Venus, and Westlake. The Texas State Codes in effect in these municipalities allows for a maximum of five minutes of idling.
- Utah does not allow an unattended vehicle to be left idling.

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- Virginia limits idling to 10 minutes in commercial and residential areas.
- West Virginia allows 15 minutes of idling in any 60-minute period. Idling by vehicles marked with a California Clean Idle label and vehicles powered by alternate clean fuels is allowed.

As well as states having laws that prohibit or limit idling, many municipalities also have laws prohibiting or limiting idling. Some of these municipalities are in states that have idling restrictions. The difference is that the local law in these states is usually more stringent than the state requirements (the local law does not grant exceptions or uses a stricter time limit). Here is a list of municipalities that have restrictions on idling organized by state:

- Arizona: Maricopa County.
- California: Auburn, Cupertino, Fountain Valley, Palm Desert, Placer County, and Sacramento.
- Colorado: Aspen, Denver (city and county), Greenwood, Johnstown, Vail, and Winter Park.
- Connecticut: Branford, Mansfield, Norwalk, and Winsor.
- Delaware: Wilmington.
- Georgia: Atlanta.
- Illinois: Cook County (Chicago) and East St. Louis.
- Louisiana: New Orleans.
- Maine: Bar Harbor.
- Massachusetts: Cambridge, Chicopee, and Peabody.
- Michigan: Detroit.
- Minnesota: Minneapolis, Owatonna, and St. Cloud.
- Missouri: City and County of St. Louis.
- Nevada: Clark and Washoe Counties.
- New Jersey: Atlantic City, Bernards, Cape May, Closter, Franklin, Hillsdale, Princeton, and South River.
- New York: Brighton, Bronxville, Clifton Park, Flower Hill, Ithaca, Lawrence, Mamaroneck, Milton, New Rochelle, New York City, North Salem, Northport, Nyack, Port Chester, Queensbury, Rockland, Rye, Scarsdale, Somers, Suffolk County, Tuckahoe, and Yonkers.
- Ohio: Waynesville (only applies to buses).
- Oregon: Ashland.
- Pennsylvania: Alleghany County, Emsworth, Falls, Philadelphia, and Upper Providence.
- Rhode Island: Providence.
- South Carolina: Beaufort and Charleston.

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- Utah: Cities of Park City and Salt Lake City, and Salt Lake County.
- Vermont: Burlington.
- Virginia: Arlington and Fairfax Counties.
- Washington: Spokane.
- Wisconsin: Madison.
- Wyoming: Rawlins.

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Tire Management

Introduction

Tire Management is something a successful Maintenance Pro must be doing to keep tire costs in check. Management means control. You should be able to account for every tire purchased. From the time the tire is purchased, through rotation and recap, to the final destination, to the scrap heap. Are you able to track a single fleet tire accurately? Do you know how much your tires are costing the fleet? Do you compensate back if you receive warranty payment for a failed tire (much like parts)?

This tire chapter starts out by reviewing some purchasing considerations to think about. Tire inspections — who, what, where, and why, open up the first area of control. The second section is a familiar one: recordkeeping. If you think your vehicle recordkeeping isn't adequately detailed, tire records can make the situation even more interesting. Finally, we'll look at ways to extend tire life, from good driver technique to retreading.

Tire costs make up the second highest vehicle operating cost item (next to fuel) in heavier-duty trucking applications today (not counting the driver). It is similar in passenger operations. Failure to manage fleet tires properly can lead to doubling or even tripling that cost. Like all maintenance efforts, good tire management only comes from the combined efforts of every person coming into contact with the tire. Standardized inspection and maintenance procedures will keep your tire program running smoothly and efficiently; good records identify trends so that you can act to correct them. That's the game:

- smart buying
- good maintenance (by both drivers and the shop), and
- complete records.

The final step in any tire management program is failure analysis. This, when combined with recordkeeping, gives you insight into whether your program is working or not working.

Tire management won't work without all four of these elements being properly in place.

Purchasing considerations

As operations seek to reduce costs, they look to better fuel economy for their vehicles as the answer. In addition to engine and aerodynamic improvements, the increased use of radial tires today has contributed greatly to truck efficiency — but tire technology has also brought about lower overall tire costs. In the old days a 2¢ per mile cost was considered to be an excellent tire cost figure for a five-axle combination unit. Thanks to today's improved design and longer tire life, many Maintenance Pros are shooting for 1/10¢ (one mil) per mile and getting it. But not without a

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little work. Retreading plays a major role in their plans and only careful inspection and maintenance provide retread potential. Since good tire practices and retreading potential starts with the initial tire purchase, let's review some tire basics.

Tire size and load

As you know, tire specifications start with weight: the maximum load that the tire will have to carry. Other concerns are whether the tire will be positioned as a single or part of a dual assembly and how fast the unit will travel. Tire manufacturers have charts to determine the proper size with load and inflation data at normal highway speeds. At higher speeds the load per tire must be reduced to avoid temperature buildup. Single tire ratings are usually used for selection purposes because new tires are commonly used in the steering axle positions and they carry more load per tire there. So the steering axle tire size establishes the size for drive axle and trailer as well.

The largest size tire that the vehicle can accommodate is usually recommended. The lower inflation pressure of the larger tire reduces wheel rim stresses and adds more mileage to the tread life because of the reduced number of revolutions per mile. A larger tire size also means that the tire is probably operating well below its rated capacity so it will be in better condition for a recap when the tread is worn down. The tire which is seldom overloaded gives the best service.

Another consideration in tire selection is the California Air Resources Board (CARB) regulation requiring 53 foot box-type trailers and the power units pulling them to be equipped with low rolling resistance tires when operating in California. If the vehicle is covered by this regulation, you will need to verify that the tires being purchased meet the EPA SmartWay low rolling resistance standards (see the CARB section in the Emission Systems chapter of this manual for details on this rule).

Rims and wheels

The tire may meet the road, but it's mounted on the wheel and it's the wheel that supports the weight. Vehicle specs always include wheels, rims, and tires as a total assembly. There are two types of wheels commonly used: cast spoke and disc.

Cast-spoke wheels (also known as "Dayton wheels")

The cast-spoke wheel design incorporates cast spokes which are attached to the hub. The rim is then slid onto the spokes and clamped into position with compression wedges. This configuration is used in medium and heavy vehicles, and has the advantage of being extremely durable; however, wheel balance and tire alignment are trickier to achieve because the tire and rim adjustment is more complex, and the entire assembly (spokes and rim) is heavier than the disc wheels.

Disc wheels (also known as "Budd wheels")

In the disc arrangement, the entire wheel and tire assembly is secured by the wheel studs (six to ten-hole models), so wheel alignment is easier.

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Disc wheels are lighter than the spoke wheel assemblies. This is especially true if the rim is made of an aluminum alloy. Disc wheels also have less wobble, the side-to-side movement of the rotating wheel/tire assembly as it goes down the road, when compared to the spoke wheels.

In a disc-type wheel, the rim (the outside portion on which the tire is mounted) is permanently joined to the disc, so the rim can't slip. Since the conventional disc wheel is in one piece, it runs truer and is easier to balance; however, the disc wheel configurations require frequent retorquing. If the lug nuts are allowed to loosen, the rim may crack, leading to the rim separating from the vehicle.

There are two types of disc wheels: conventional disc wheels and piloted disc wheels. Installation of the conventional disc wheels in the dual-wheel application requires sliding the inner wheel over the studs, threading on and tightening the inner lug nuts (which are also the outer wheel's studs), then sliding the outer wheel over the inner nuts' studs, and threading and tightening the outer nuts. To remove, take the steps in reverse. Rather a lengthy job for mechanics, with many opportunities for errors, so it's not surprising that new wheel designs featuring hub piloting and single-nut fastening are getting the nod from maintenance-conscious fleet personnel.



Hub-piloted discs (also known as piloted Budd wheels)

The hub-piloted disc is an increasingly popular alternative to the traditional spoke and disc configurations, and conventional disc wheels. Unlike conventional disc wheels, this one is centered by the hub, not by the studs, and is attached by flat-faced holes and flanged nuts. There are big advantages to this system. Hub-piloted discs are easier to install, requiring only one lug nut per stud, and run as true and well-balanced as conventional disc wheels.

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Whatever rim is used, it must be compatible with the tire selected. Rim widths are approved for a given tire size, whether radial or bias ply.

There's a big difference between the demands made by a linehaul unit and a city delivery truck, just as there is a big difference in the tire demands placed on a school bus versus an over-the-road coach. Whether a tire is mounted on a steering, drive, or dead axle requires different tire tread characteristics. Tire rubber composition must be considered as well. So if you're interested in the best fuel economy, you'll be looking for solutions that decrease rolling resistance —the greatest threat to tire/fuel economy. If you are looking for durability in a tough service environment, you are going to want tires made of a tougher material/construction.

Types of tires

Two major types of tires are available to the industry today. The difference in bias-ply and radial tire construction is the angle of body plies and the presence of belts.

Bias-ply vs. Radial

In bias-ply, the fabric plies are wrapped diagonally and there are no belts. This construction offers a tough tire at a cheap price, but unfortunately has the shortest life. Bias-belted tires, less expensive than radials, are a compromise: belts are strapped around the circumference for additional strength. Radial tires, the most expensive variety, feature a design where the plies are wound radially across the width of the tire carcass, i.e., the cords run at a 90 degree angle to the tread centerline. A steel-belted radial has a steel belt system sandwiched between the ply and the tread rubber.

One of the biggest advantages of radial tires is improved fuel mileage. Most fleets that are running equipment on the road have switched to radial tires for this reason. Bias tires, which are more durable and cheaper than radial tires (but do not get anywhere near the same fuel economy), are primarily used in extreme and off-road applications.

Radial tires give the best value in many applications, especially for the long haul. Today's models last twice as long as those offered just a few years ago. Radials are a major contributor to fuel economy in linehaul operations because they reduce rolling resistance, which can account for up to 20 percent of a vehicle's fuel consumption. In fact, the greater the GVW, the better the fuel savings are with radials. The radial ply and steel cord belts give strength and stability. Some other advantages are:

- Better retreadability.
- Resistance to puncture.
- Higher load ratings.
- Improved road handling.
- Quieter running.
- Cooler running.
- Longer tread life.

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- More flexible casing yields a better ride.

The radial casing is worth three to four times as much as a bias-ply. It deserves good care. Even when it may no longer stand up to linehaul duty, you might get another two or three years of service in the city.

Low-profile radials

Low aspect-ratio radial tires, or low-profile tires, are gaining in popularity. Aspect-ratio refers to the relationship between the tire's section height (the distance from bead to tread), and its section width (the distance between the widest points of the inflated sidewall). Standard radials are about $\frac{9}{10}$ as high as they are wide, for an aspect ratio of 90. Low-profile radials run around 70 or 80, with the 70-series being even more squat in appearance. It stands nearly four inches shorter than the 80-series and five inches shorter than a standard. The shorter height makes the 70-series a popular choice for high-cube semi-trailers and other vehicles where height can be an issue.

Low-profile radials have all the advantages of standard radials, but offer some additional pluses:

- They weigh less, so you pay less federal excise tax on new tires.
- Their lower height means the user can operate a higher-profile vehicle (such as a high-cube trailer).
- Lower height may also help with the occasional overhead clearance problem (such as low bridges, signs, tree branches, etc.).
- Lower center of gravity contributes to better cornering stability and a safer ride.
- Shorter sidewalls yield more responsive steering capability when compared with standard radials.
- A more rigid belt package reduces flexing in the tread, which increases original tread miles and makes the tire a good retreading candidate down the road.
- Due to all these factors, the overall stability of the vehicle is improved.

Before you run out and purchase low-profile tires, however, keep in mind that some fleet tire habits may have to be changed. Smaller tires must be protected from overloading conditions. Changing a fleet's standard tire may mean changing speedometers or rear-axle gearing. If you go from 11R24.5 tires to the same low-profiles, the vehicle will be slowed down 2.8 mph at the same engine rpm if no changes are made. You may need assistance in comparing the different sizes and designations offered by the manufacturers. Diameter, loaded radius, and tire revolutions per mile are the data upon which to base comparisons. Special designs are available for steering axles and dead axle applications, like trailers, converter dollies, and tags. So if you're thinking about low-profiles in the future, order today's new equipment with 8.25 rims for convenient change-over later.

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Wide-base singles

As long as we are looking at weight reduction, the latest concept in lighter tires is the wide-base single or super-single. While you probably wouldn't realize any savings in the federal excise tax on a super-single (the tax is likely to be more), the possibility of exchanging a set of duals for one tire is an attractive idea for the fleet wishing to cut down on tire costs. And the big dual assemblies that we're used to in the U.S. pay a heavy price in rolling resistance (and therefore in fuel economy).

The biggest drawback in acceptance of the super-single is naturally the fear of a flat tire. Some operators may never be able to overcome this concern. In Europe, 30% of all tri-axles run singles. Yet, when the tires were introduced in the U.S. in the past, they were put into service conditions that are typical of line haul operations here: long distance, high speed, high torque, and high temperature. Today, though, improvements to the tire carcass have reduced the possibility of tire failure, and many tire experts believe that the super-single will see wide acceptance in the future.

Another concern with the super-single tires is wheel bearing wear. The super-singles may cause the wheel bearings to wear differently or more quickly in some cases (depending on many factors) due to the change in the way the hub carries its load. The change is caused by the change in the center of the tire area versus the center of the hub/wheel bearing relationship. Axle manufacturers and OEMs are presently looking at this and are trying to quantify the issue and develop best practices or design changes to eliminate any problems.

If you are considering switching a vehicle that presently has dual wheels to the super-single configuration, please consult with the vehicle OEM before beginning the conversion to determine if any additional modifications or maintenance considerations may be necessary (such as increasing wheel bearing inspections).

Super-singles will require drivers to pay closer attention to inflation. While they might be able to ignore a low tire in duals, singles will need to be checked carefully as part of every pre-trip inspection. Keep in mind, though, that it's a lot easier to approach a super-single than it is your standard dual assembly or even your standard radial. This makes required inspections much less of a headache than might be expected. Still, replacement tires aren't as easy to come by around the country as yet, so if you plan on taking advantage of the benefits of a super-single assembly, be certain to make sure that they are readily available in your area. Another plus: you won't have to worry as much about theft. It's impossible for a thief to take off with one of the tires!

In addition to the weight advantages, the super-single has other attractions when compared to standard wide-base tires:

- Greater lateral rigidity provides improved handling.
- Greater radial rigidity provides improved ride.
- Longer casing life means improved retreadability.
- Reduced weight means increased load capacity.

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The advantages over the standard radial tire include (in addition to the initial price as compared to duals and the weight savings):

- more fuel savings,
- greater lateral rigidity for more improved handling,
- increased exposure to cooling air for brakes and tires,
- better tire pressure maintenance because valve stems are easier to get at, and
- fewer tire/wheel assemblies for less maintenance.

Tread design

The basic types of highway tire tread designs are rib, lug, and special service (high traction, off-road).

With a groove design that goes around the circumference of the tire, rib tires are classified as “all position” tires. The open-groove tread offers good skid resistance and steering capabilities, so it works well on the steering axle. A five-rib design generally has less rolling resistance than a two- or three-rib tire.

Lug or cross-rib tires are designed for drive axles and are used for most over-the-road operations. The tread design has maximum resistance to wear and good traction. When placed on the drive axle, they normally deliver more mileage than rib tires. Although suitable for some off-road operations, they do not offer maximum traction as the special service tread designs. New tires designed specifically for trailers or tag axles usually feature a modified rib-lug pattern. The deeper the tread, the more rolling resistance. You’ll want to be sure you need the extra traction to make up for some loss in fuel economy.

Consider your transportation needs

When selecting tread designs, keep in mind that no one design will meet all your transportation needs. All driving applications, from interstate operations to urban deliveries, have their own built-in challenges and demands, and when purchasing tires it’s important to select the tread design that will be best for you and your application. Finding the right type of tread will help you improve your fuel efficiency and will also extend the lifespan of your tires, reducing costs due to maintenance, retreading, and purchasing. To find the right tread, start by considering your applications.

Linehaul operations

Linehaul operations involve long hauls on interstate highways with nothing more than gentle curves and grades. Although it is important for linehaul drivers to have good traction over a variety of road conditions, it’s also a good idea to avoid the more aggressive treads, which make for an inefficient ride when on linehauls. Smoother-tread tires, such as standard closed-rib highway-tread radials, will allow for greater fuel economy than all-weather tread patterns.

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Linehaul drivers should also take measures to avoid irregular wear to their tires, a major contributor to premature tire breakdown. To reduce irregular wear, select a tire with side grooves. These add flexibility and help the sidewalls absorb irregularities in roads. Equalizer ribs also help distribute pressure across the main tread ribs, further reducing irregular wear.

Regional operations

For operations that don't deal exclusively in interstate transportation, a new set of concerns arises. Regional runs require drivers to travel on small highways with rough surfaces and aggressive curves, and may also entail making deliveries in cities. In these situations, it is important to have a fair amount of protection built into your tires to resist the effects of road abrasion and sidewalk and curb scrubbing. A reinforced shoulder and sidewall area will help protect your tires against these kinds of threats.

On/Off road

Trucks making frequent off-road deliveries will need to be equipped with tires that are resistant to cuts and drilling from stone chips, jagged rocks, and other off-road debris. Your belts and casings will also encounter a great deal of stress, so look for extra protection in the belt construction and tread thickness. If your trucks are running almost exclusively off-road, you'll want to consider tread depths up to $\frac{40}{32}$ nds.

Use specialized treads

Tire manufacturers have developed a wide variety of specialized tread designs tailored to meet the demands of each of your rigs' axles. By helping to minimize the strains and stresses unique to the different axles, the specialized treads allow your tires to do their job more effectively than ever, allowing for minimal wear and preventing premature retreads.

Steer tires

Steer tires will almost always require rib designs in order to resist irregular wear. Because steer tires must take on the immense burden of controlling the directional forces created by the driving tires, they too often succumb to cupping, a form of irregular wear resulting from the erosion of the shoulders. To help combat cupping, select tires specially designed with features such as equalizer ribs and defense grooves. These help protect your shoulders and can extend your steer tire life.

Drive tires

Although drive tires are not as susceptible to wear as steer tires, irregular wear is still an important consideration when purchasing tires for this position. Due to the strain of providing the driving torque that propels the vehicle forward, drive tires are subject to heel/toe wear and the more serious high/low lug wear. To beat these types of wear, you'll need to take one of two approaches. In applications that cause moderate-to-fast wear (wear rates of about 10,000 miles per $\frac{1}{32}$ -inch of tread wear or less, and removal mileage less than 225,000 miles), use open shoulder rib or

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lug tires. With more substantial wear (12,000 miles per $\frac{1}{32}$ -inch of tread wear or more, and removal mileage greater than 275,000 miles), select closed shoulder drive tires.

Trailer tires

Trailer tires have a big effect on fuel economy, so in order to be as fuel-efficient as possible it's important to find the right tires for this position. Look for tires with shallow treads that offer as little rolling resistance as possible, but don't forget about the threats posed by irregular wear.

On the other hand, if your tractor has spread axles, you'll want to select tires with deeper tread designs and strong shoulders and sidewalls to help guard against the scrubbing that occurs while turning.

Tube vs. Tubeless

Tubeless tires are generally preferred today, especially for linehaul operations. The ease of service and the use of fewer parts leads to fewer road delays. They also save weight (there are fewer component parts) and eliminate tube, flap, and ring problems. So if you're going to radials, specify tubeless tires.

A final word of advice about tire purchase is to know your dealer. Choosing the right dealer is extremely important if you wish to lower tire costs. Don't hesitate to shop around at a time when you aren't in a pinch for tires. The dealer will sense that you're under pressure and may not offer the best price. Find out the best time to buy and see what kind of deal you can arrange. Use past experience as a guide. Ask for test results if you are considering a new model. If the tire is a new design, find out how available they are in the geographical area where you operate. Inquire whether you might be able to test a new model before making a commitment to purchase more tires. Cold weather slows down the wear rate and tires that roll off the first $\frac{4}{32}$ inch in winter will have up to 15% more tread life.

How about field services? The small fleet maintenance shop is much less likely to have its own tire man. So if you have had more than your share of downtime because of tire problems, ask whether some recordkeeping, inventory, and other services might be offered by the tire dealer. Be sure that your dealer will take enough time to look at the total operation and help you select the right tires for your fleet. Then ask for a fair price and a warranty on the tires you buy. Find out how much help he will be when it's time to buy new equipment. He should not only be able to give you the latest information, but he might also be willing to give you a special deal if his manufacturer's tires are specified on any new equipment.

A final point to think about is purchasing directly from the tire company. Is your operation large enough? Do you have experienced personnel? Can you manage with no service at all and drop-off tires?

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Maintenance

Inspections

Good tire maintenance begins with regular inspections by the driver and the shop every time the vehicle is brought in for a PM inspection/service (or every time it goes through the inspection lane). Inspections can be divided into several parts: visual inspection of tire and rim, checking inflation, checking for matching on duals, and checking for mismatching of tire types (radials and bias-plys). A shop PM inspection would include all the above and add some additional checks, such as measuring tread depth prior to rotation, and checking vehicle and axle alignment.

Visual inspection

When performing the tire inspection the following should be checked first:

- Rims for bends, cracks, or bad lug holes.
- Wheels for broken studs and nuts; cap nut looseness (rust streaks); and oil/grease seals for leaks.
- Tires treads for any kind of foreign object embedded in the tread surface; check for puncturing objects; look for cuts, cracks, or separations.
- Tire sidewalls for bumps or bulges, tears, or cracks.
- Valve stems for caps and position (180 degrees apart on duals and clear of any wheel spokes).
- Tire pressure.
- For overheating by feeling the sidewall (during and after trip).

Inflation check

Maintaining correct tire pressures can reduce tire costs by up to 20 percent; incorrect tire pressures can only lead to tire problems. Underinflation is the major cause of tire failure; the increased flexing of the tire in motion causes excessive heating up of the tire components. It reduces the strength of the tire and leads to breakdown of the rubber compounds. The tire can separate or even catch fire from the extreme heat. Low inflation increases the rolling resistance of radial tires, which means higher fuel costs and less tread life. Tread separation, bruises, breaks, and blowouts can result.

Overinflation is less likely to happen, but it can cause tire damage, too. An overinflated tire is more rigid and so does not absorb road shocks as well, a problem that may cause serious damage to treads as the tire bounces and skids along the road. Overinflation also decreases the tire foot print. Only the center portion of the tread is in firm contact with the ground, rather than the entire width. The reduction in footprint will cause an extreme center wear pattern. Higher pressures can also over-stress the rim, causing rim damage. Finally, an overinflated tire is more prone to puncture or cuts from road debris.

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Air pressure checks

Air pressure should be checked and corrected when the tires are cold. If it is absolutely necessary to check hot tires, 15 percent should be added to the standard cold pressure. Drivers, who may not be familiar with such issues, should be told that air pressure in hot tires is never to be reduced.

Ideally, tires on vehicles just off the road should be allowed to cool for a couple of hours before pressures are checked. The tire gauges used to check pressures must themselves be checked frequently to make sure that they are accurate. If they are off by more than 5 psi, they should be replaced or repaired.

Take care to check the air pressure in all tires. Do not neglect the inside duals, which are frequently skipped because of their inaccessibility. To ensure that you're getting optimal fuel efficiency as well as your money's worth out of your tires, check all of them consistently.

The time interval for inflation checks should be established by you. Manufacturers recommend testing daily, at least once a week, or before the first run of the day, depending on the application. If you prefer more frequent checks, it is a good idea to use metal valve stem caps on the valve stems.

Drivers may need to be trained to make proper inflation checks, if the vehicles are not in the yard often enough. Drivers need to understand that each time a check is made, the air seal at the valve is opened and dirt can get into the valve and damage the seal. In addition, if the seal is damaged or broken, water may also be allowed to enter. This is quite dangerous: water can freeze and crack the seal. If the gauge isn't used properly, the tire could even lose pressure.

One truck fleet doesn't take any chances with human error. The radial tires are equipped with a blow-through-type valve, and pressure is mechanically checked every time the vehicles are brought into the shop for a scheduled inspection and maintenance. All the tractor/trailer tires are serviced automatically by hoses on each side of the service pit, which air and equalize the pressure in all the tires at the same time within 3-5 minutes. This system does away with operator mistakes. You don't need to go this far to assure proper checking, but make sure your people do the job consistently.

Maintenance tire pressure checks should be scheduled at least every 30 days. Tires lose about 0.33 pounds of air each day. For every eight-degree increase or decrease in ambient temperature, one psi of tire pressure will be gained or lost. No more than 6 to 8 psi should need to be added to any one tire during a regular airing or inflation check. Any tire found to be more than 10 psi below the others on the unit should be checked further to find out why. Tires below 20 percent of normal pressure should be removed, inspected, repaired, and aired in a safety cage.

One consideration to keep in mind is that proper inflation levels depend on the loads that are carried. Load/inflation tables, which can be used to determine the required minimum inflation pressure for a given tire size and maximum expected tire load, are available from tire manufacturers. The Rubber Manufacturers Association (RMA) also offers an excellent guide, or you can request tire manufacturers' inflation tables for the exact

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pressures and make sure they're used. Standardize the pressures across all fleet tires if you can. This will reduce the chance of an error.



SERVICE LOAD AND INFLATION TABLES
TIRES FOR TRUCKS, BUSES AND TRAILERS USED IN HIGHWAY SERVICE
RADIAL PLY

TIRE LOAD LIMITS (LBS) AT VARIOUS COLD INFLATION PRESSURES (PSI)																	
Tires Size	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	
HIGHWAY — 65 MPH																	
TIRES MOUNTED ON TYPE I, II AND III RIMS OR ON 15" DROP CENTER RIMS																	
7.50R17	D	2350	2460(D)	2570	2680	2780(E)	2880	2980	3070(F)								
	S	2410	2540	2680	2800(D)	2930	3060	3170(E)	3280	3400	3500(F)						
7.50R20	D	2620	2750(D)	2870	2990	3100(E)	3210	3320	3430(F)	3640	3780	3910(F)					
	S	2680	2840	2990	3140(D)	3270	3410	3530(E)	3660	3780	3910(F)						
8.25R20	D	3120	3270	3410	3550(E)	3690	3820	3950(F)	4070	4200	4320(G)						
	S	3190	3370	3560	3730	3890	4050(E)	4210	4350	4500(F)	4640	4790	4920(G)				
9.00R20	D	3690	3870	4040(E)	4200	4360	4520(F)	4670	4820	4970(G)							
	S	3770	4000	4210	4410	4610(E)	4790	4970	5150(F)	5320	5490	5670(G)					
10.00R20	D				4760(F)	4950	5120	5300(G)	5470	5630	5800(H)						
	S				4900	5220	5430(F)	5640	5840	6040(G)	6240	6430	6610(H)				
10.00R22	D				5070(F)	5260	5450	5640(G)	5820	6000	6170(H)						
	S				5310	5550	5780(F)	6000	6210	6430(G)	6630	6840	7030(H)				
10.00/90R20	D				4885	5070(F)											
	S				4945	5155	5370	5510(F)									
11.00R20	D				5190(F)	5390	5590	5780(G)	5940	6130	6320(H)						
	S				5450	5690	5920(F)	6140	6370	6590(G)	6790	7010	7200(H)				
11.00R22	D				5520(F)	5730	5940	6140(G)	6330	6530	6720(H)						
	S				5790	6040	6290(F)	6530	6770	7000(G)	7220	7440	7660(H)				
11.00R24	D				5800(F)	6080	6310	6520(G)	6730	6930	7130(I)						
	S				6140	6420	6680(F)	6940	7190	7430(G)	7670	7900	8130(H)				
12.00R20	D				5910	6140(G)	6360	6580	6790(H)	7000	7200(J)						
	S				6200	6480	6740	7000(G)	7250	7500	7740(H)	7980	8210(J)				
12.00R24	D				6650	6910(G)	7160	7410	7640(H)	7870	8100(J)						
	S				6980	7280	7580	7880(G)	8160	8450	8710(H)	8970	9230(J)				
HIGHWAY — 55 MPH MAXIMUM SPEED																	
14.00R20, 21	D				8120	8430	8740(J)	9030	9320	9610(L)							
	S				8510	8890	9260	9610	9960(J)	10300	10620	10960(J)					
14.00R24	D				9070	9410	9750(J)	10090	10410	10750(L)	11040	11350	11640(M)	11940	12220	12510(N)	
	S				9500	9930	10340	10730	11120(J)	11500	11870	12250(L)	12590	12940	13270(M)	13610	
16.00R20, 21	D				11110	11540	11950(L)	12360	12760(O)								
	S				11650	12160	12660	13150	13630(L)	14090	14540(X)						

Notes: 1. Letters in parenthesis denote Load Range for which Bold Face Loads are maximum.
CAUTION — Always use Approved Tire and Rim Combinations for Dumpers and Containers. See Page M2.3 for Approved Tire and Rim Combinations.

Engineering Data Book — Over-The-Road Tires

L9

(Courtesy of Goodyear Tire & Rubber Company)

You may need to impress upon drivers and maintenance personnel that proper inflation is the single most important item of tire maintenance, and that their cooperation is essential to a successful program. Inform them of the benefits to the fleet and to themselves: an inspection violation

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or accident can be avoided; their own safety is better protected; and operating costs can be lowered. Being on the lookout for potential tire problems keeps down-time and damage costs to a minimum.

Tools

Along with a training program, make sure everyone has the proper tools to assist in tire maintenance:

- An axe handle, hammer, or “tire buddy” is useful for checking tires when hot. “Thumping” tires is recommended any time the vehicle is parked.
- A good pair of pliers should be available for removing objects from the tires.
- A quality tire pressure gauge (providing drivers and technicians with one will communicate the importance of accurate checking).
- A tire depth gauge.
- A tire pressures log on the maintenance inspection reports, pre-trip inspection reports, or the post-trip Vehicle Condition Report.

Putting a tire-inflation record of some kind right on the vehicle also helps to standardize procedures. A tire-pressure sticker, for example, can list the time when the unit’s tires were last inspected and inflated in addition to standard pressure, etc. Placed at the same location for every unit (inside the door on the driver’s side for tractors, above the left rear tire on a trailer), the sticker can’t be ignored.

Don’t forget new tire procedures. After mounting them, check the pressure again after 24 hours. New tires can expand somewhat during the break-in period and some pressure loss is to be expected.

Inflation and valves

Air pressure can be maintained only if valves are in good condition. The best valve designs contain a rubber seal to prevent air leakage. Valve cores with metal-to-metal seats are preferred; plastic designs are more subject to heat deterioration unless they are especially designed for high temperatures. It is also recommended that grommets in air valves be changed every time the tire is changed.

Also, remember to be careful about letting contaminants into the valve stem and tire when you check or inflate tires.

Automated inflation systems

By following the above tips and checking your tire pressure regularly, you should be able to keep tire malfunction to a minimum; but as an extra precaution, it might be a good idea to look into one of the industry’s most recent developments for protecting one of your biggest investments. After all, it never hurts to play it safe when it comes to something as costly as a blowout or premature tire wear. Recently, manufacturers have developed a device that promises to provide even more protection against the dangers of under- and over-inflation. Automated inflation systems, currently being marketed by several major manufacturers, can ensure that

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your tires are at the right pressure where it counts the most — on the road.

These systems can be installed directly on the vehicle, usually on the axles themselves, and will monitor air pressure while the vehicle is in operation. If any tires fall below a certain air pressure, the system will inflate them to their proper level, with no driver involvement necessary. In addition, several models are equipped with warning lights that will indicate if a tire needs attention before a trip. Although each of the inflation systems on the market goes about its job in a different way, they all operate on the same premise, and should provide a safe and reliable way to maintain air pressure. If the system is working properly on the road, your tires should be, too.

Inflation air condition

A final word about air — keep it dry. Although some moisture is always present in inflation air, it's a good idea to take some steps to minimize it, since water in tires will result in rusty wheels, ply damage, and the potential for tire separation and failure. To keep water out of inflation air, use an air dryer on the shop air system and drain water traps often to keep compressed air lines dry.

To keep water out of tires:

- when mounting tires, make sure that the inside is clean and dry,
- use a lubricant that is not water-based; if that isn't possible, use water-base lubricants sparingly, and
- store tires in a dry place.

Tread check

Tires should be inspected regularly for unusual tread wear. Some wear can be predicted. Steer-axle tires usually wear faster when they are combined with tandem-drive axles than with single-axle drives. If they are applied during the summer, they'll wear faster than if mounted during another season. Left front tires generally wear faster than right front tires. Rotation of tires can even out tire wear for maximum tire life.

A typical rotation example might go as follows:

1. New tires are purchased for the steer-axle (where safety is of the utmost importance), and possibly for the drive-axle positions. If the purchase includes a new trailer, often the original equipment tires are moved to the steer-axle or drive-axle positions on the tractor.
2. After the steer-axle and drive-axle tires have worn to a certain depth, they can be rotated to a trailer.
3. Drive-axle tires can also be worn to certain depth (usually more wear than is allowed on steer-axle tires) and retreaded for the drive- or trailer-axle positions.

Some fleets, however, like to run some tread off a new tire in the drive position before putting the tire on the steer axle. This action buffs off the new higher tread, making the tire less susceptible to lateral movement

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(squirm). Another tire path might be running the tires on the steering axle to a $\frac{7}{32}$ nd inch depth; rotate to the tag axle to a $\frac{2}{32}$ nd depth; then to the retreader. Steering-axle tire tread depth cannot be less than $\frac{4}{32}$ nds by federal law; tires which are retread candidates should be pulled from service when the tread depth measures $\frac{2}{32}$ nds to $\frac{4}{32}$ nds. This pull-point protects the tire casing from too much road damage and permits the retreader to process the tire without touching casing plies.

Matching tires: Bias-ply and radials

The best vehicle and tire performance is realized when tires of the same size, load range, and construction type are used on all the vehicle's wheels. A fleet may have a mix of radial and bias tires in use within the fleet. Since radials differ from bias-ply in construction, load, and cornering characteristics, tire manufacturers have discouraged fleets from putting the two types on the same vehicle. Nevertheless, a mixture of tires can be used safely if these rules are observed:

- NEVER mix bias-ply and radials on the same axle.
- NEVER mix bias-ply and radials in a tandem- or multiple-drive axle combination.

Here are some additional considerations:

- Two-axle trucks, dual rear tires or two-axle trucks, wide-base single tires: radials or bias-ply may be used on front axle, rear axle, or both axles.
- Trucks with more than two axles: either all bias or all radials may be used on the **non-steer** axles.
- Trailers, single axle: either radials or bias.
- Trailers, multiple axles: either radials or bias on all axles; mixed OK, as long as each axle has the same type.

If your fleet is in the process of converting to radials, do so systematically to avoid mixing problems. Remember that the drive position is not the best place to start radials. We all know that rolling resistance is the principal enemy of tire/fuel economy; so radials offer the least benefit here because of the resistance caused by torque passing through the driveline to the ground. Convert the drive axles to radials **last** if you can.

Matching tires: Duals

Tires in a dual assembly have additional requirements. The tires must match, they must be the same construction type (bias, radial, etc.), they must have the same size designation, they must have essentially equal diameters/circumferences, and the spacing between the tires must be correct.

Matching

We have already seen that one cannot mix tires of different construction on the same axle. Mismatching can also occur when tires have unequal inflation or unequal diameter. Either situation forces the larger tire to

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take over the load share of the smaller tire; it becomes overloaded and a candidate for a blowout. If radials and bias-ply are mixed in a dual assembly, the bias tire will bear the load because radials deflect more under the load. It is therefore necessary to inspect dual-assembly tires frequently to ensure that they are matched, checking especially for inflation and making sure that any replacement tire will do its share of the work. Matching trailer tires will also improve tread wear in these free-rolling axle positions. If there are differences in wear (all other things being equal), rotating the lighter wear tire to the outside of a dual assembly can even out wear.

The maximum permissible diameter differences between the two tires having equal inflation pressures are:

- ¼" for 8.25 cross section (tubeless 9-22.5) and smaller sizes
- ½" for 9.00 cross section (tubeless 10-22.5) and larger sizes.

To determine if there is a difference, the tires should be measured 24 hours after inflation. The circumference of the tires is measured with a steel tape before mounting on the vehicle. Once on the vehicle, tire measurements can be checked by string gauge, straight edge, stationary tire meter, or large square.

Spacing and sizing

Air cannot circulate between dual tires if they are mounted too closely together. Heat decreases tire life and hastens tread wear, and can lead to catastrophic failure ("blow out"). Also, if the vehicle is severely overloaded, the two sidewalls could be too close to each other or even rubbing together, leading to overheated. Object stuck between the duals will lead to friction that can lead to excessive wear or a catastrophic failure. Instruct drivers to immediately remove any objects that become lodged between duals.

Too much space is equally undesirable. During turns, the outside tire will drag and scuff excessively. The distance between the centers of the two tires should be checked during PM inspections against the specifications and/or manufacturer's recommendations. If tire chains are used, additional spacing may be required.

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RIM WIDTH AND TIRE SPACING – RADIAL AND BIAS PLY TIRES

(As recommended by the Tire & Rim Association)

TIRE SIZE	ALTERNATE RIM (WIDE) DESIGN RIM* ALTERNATE RIM (NARROW)	TIRE SECTION WIDTH	MINIMUM DUAL SPACING WITHOUT CHAINS
7.50	6.5	8.65	9.9
	6.0*	8.45	9.7
	5.5	8.25	9.5
8.25	7.0	9.50	10.8
	6.5*	9.30	10.6
	6.0	9.10	10.4
9.00	7.50	10.40	11.9
	7.0*	10.20	11.7
	6.5	10.00	11.5
10.00	8.0	11.15	12.7
	7.5*	10.95	12.5
	7.0	10.75	12.3
11.00	8.5	11.75	13.2
	8.0*	11.55	13.0
	7.5	11.35	12.8

TUBELESS (HIGHWAY SERVICE)

TIRE SIZE	ALTERNATE RIM (WIDE) DESIGN RIM* ALTERNATE RIM (NARROW)	TIRE SECTION WIDTH	MINIMUM DUAL SPACING WITHOUT CHAINS
9	7.50	9.30	10.6
	6.75*	9.00	10.3
	6.00	8.70	10.0
10	7.50*	10.00	11.4
	6.75	9.70	11.1
11	8.25*	11.00	12.6
	7.50	10.70	12.3
12	9.00*	11.80	13.5
	8.25	11.50	13.2

(Courtesy of Goodyear Tire & Rubber Company)

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Alignment

Once upon a time, good maintenance for better tire wear simply meant a front-end alignment and wheel balancing now and then. That prescription worked reasonably well for bias-ply tires, which wear out at a faster rate. The new radials, though, wear much more slowly. So it's important to even out the tread wear and keep the carcass in the best possible condition. The consequences of wheel and tire misalignment are severe, affecting fuel consumption, suspension wear, driver fatigue, and safety. Tires suffer too.

If the front wheels point exactly ahead, but the rear wheels were out of line, they would begin to force the front wheels out of line too. An example: if the thrust angle were 0.25 degrees to the right, the front wheels would be pushed to the left and the driver would compensate as the tires side-scrub in reaction. Engineers calculate that under these conditions, a tire will scrub sideways for more than 11.5 ft/mile. That's a lot of unnecessary tire wear.

The Maintenance Pro must turn his attention to the structure of the vehicle — namely, its total vehicle alignment. Improper front-end alignment is a major cause of irregular wear on steering-axle tires. If drive and trailing axles are out of alignment, this condition causes irregular wear on those tires and also on steering-axle tires, as the driver makes steering corrections.

Although we are discussing alignment in the tire chapter, it should be mentioned that alignment affects fuel economy, but more importantly, it affects safety. Any time that a vehicle part is misaligned, whether it is engine or axle, an unsafe condition is created. This is especially true for tandem rear axle alignment. When all axles are parallel, the vehicle tends to go straight. When the axles are not perpendicular to the center line of the frame, the vehicle will go in the direction it is pointed. In a tractor-trailer combination, there is potential for jackknifing if the trailer axles are not aligned.

Before starting an alignment check, prepare the vehicle and take a moment to make sure that other parts of the vehicle's front axle aren't the source of the problem. Be sure to check:

- Tire condition, size, tread pattern, and inflation.
- Rims for bends, cracks, and missing balancing weights.
- Hub assemblies for tightness, bearing wear, and oil/grease leakage.
- Springs for breakage or "fanning" (normally caused by loose U-bolts).
- Tightness of axle mounts (hangers and shackles) and bushings.
- Front shocks for mounting and condition.
- U-bolts for tightness.
- Kingpins and bushings for wear.
- Steering linkage condition and ball joint tightness.

Tire manufacturers point to three areas of the vehicle where alignment can affect tire wear (and they should be considered in this order): frame

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alignment, drive-axle alignment, and front-end alignment. Although the front end is the most obvious place to begin, either when diagnosing a problem or beginning PM, it actually comes last in order of procedures. You want to be sure frame and rear axle alignment are correct before proceeding to the more expensive and difficult front end work (don't forget trailer tandems!). Every PM program should include regular checks to make sure that:

- the frame is square,
- the drive axles are parallel to each other and perpendicular to the frame and all drive axle attachment points (U-bolts, hangers, torque arms) are tight, and
- the front axle is square to the frame and has the correct camber, caster, and toe-in (improper toe-in contributes most to steering-axle tire wear).

Frame

One of the basic causes of total vehicle misalignment, frame rail or rails that are bent or improperly positioned, may be out of your control. Ideally, before beginning any alignment procedure, the frame should be perfectly square. Maintenance experts remind us that even when a new vehicle has a perfect frame, it doesn't take long before ordinary service, uneven terrain, chuck-holes, and uneven loads begin to distort that frame. So at least check the frame before continuing. Check for bends or cracks, loose frame rail to cross member bolts, and loose component mounts.

Drive axle(s)

Most Maintenance Pros conclude that if front wheels are accurately aligned with rear wheels, the vehicle will handle easily and safely regardless of whether the frame is perfectly square or not. Nevertheless, in the best of all possible worlds:

- the drive axle(s) should be positioned perpendicular to the frame or chassis center line and
- in the case of a tandem setup, the two axles should be parallel to each other.

Most drive-axle suspensions have provisions for setting alignment. The vehicle manufacturer and/or suspension manufacturer also have chassis service manuals that should be part of every shop library. But the checking procedure should be performed on a new vehicle and whenever a vehicle is in the shop long enough to perform the check. This is especially important for tandem drives. The recommended interval for a tractor is about 50,000 miles and, for a trailer, 100,000 miles. Minimum recommended time interval for a vehicle is twice a year; three times a year is ideal.

In order to put together a PM program to prevent misalignment problems, you'll need to schedule regular inspections of tires, suspensions, and steering assemblies, and perform alignment checks and corrections methodically. Many equipment manufacturers have field personnel to

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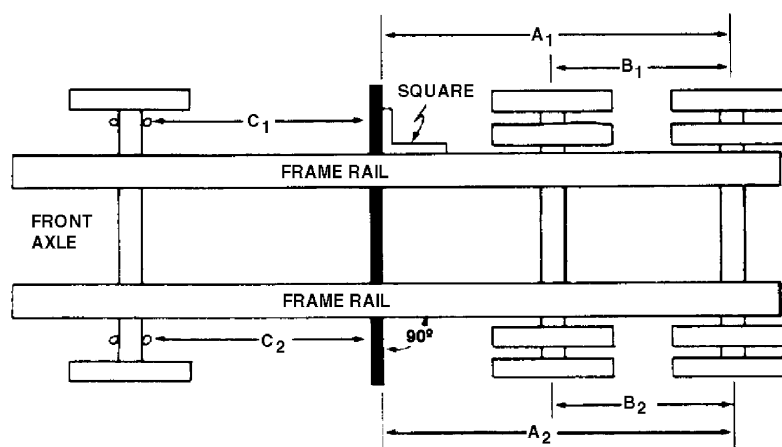
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advise and train fleet mechanics in this important area. Take advantage of their expertise.

The general procedure is as follows:

- Position tractor on level surface so that all suspension joints are free; release brakes; chock front wheels.
- **Securely clamp a nine-foot section of straight bar stock to both frame rails.** Use a carpenter's square to verify a 90-degree relationship between the bar and the frame rail. (See Figure to follow.)
- **With a trammel gauge or other device, measure from the bar to the center of the rear drive axle on both sides.** If the measurements differ by more than $\frac{1}{8}$ ", reposition the rear axle so that they're equal. The adjustment is made by changing the length of the torque rods, turning eccentrics, and/or adding shims.
- **In the tandem arrangement, measure from rear drive axle center to forward drive axle centers on both sides.** If the measurement differs by more than $\frac{1}{8}$ ", reposition the forward drive axle so that they are equal. After repositioning, move the vehicle backward and forward several times to allow suspension joints to set, then recheck both sets of measurements.

VEHICLE GEOMETRY CHECK



(Courtesy of Goodyear Tire & Rubber Company)

Front

To continue the check (and correction, if necessary):

- **Measure from bar to a point on each side of the front axle (outboard U-bolts are suitable) and confirm that both measurements are equal.** Reposition as necessary, according to directions in the chassis service manual.

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Front-end alignment also involves some settings that are important for radial tire wear performance:

- **Toe-in:** the difference in distance apart at the front and at the rear of the wheels (as seen in top view); “toe-in” exists when wheels are closer together in the front; “toe-out” exists when they are closer together in the rear.
- **Camber:** the tilt of the wheel (as seen in front view); “positive camber” exists when the wheels are closer together at the road; “negative camber” exists when they are closer at the top.
- **Caster:** the backward (positive) or forward (negative) tilt at the top of the axle (as seen in side view).

Decide what checks you wish mechanics to perform during which PM inspection and check that they have good training and equipment to do the job. You may not need a chassis specialist in the shop, but skilled observations can head off major problems.

In normal vehicle operations, these front-end alignments change according to the load; however, most measurements are taken when the vehicle is unloaded, so some increases in settings will be required. The vehicle manufacturer should have data to use as a starting point. Keep a constant eye on tire wear and the patterns that appear. If an irregular pattern shows up, it may be a clue to some improper setting.

Toe settings generally have the greatest effect on tire tread wear and are the easiest adjustment to make. Gauges for measuring toe settings are relatively inexpensive and easy to use. They should be part of every maintenance shop, even the smaller ones. Using these gauges should be part of every PM routine.

Trailer axles

Misaligned trailer axles can contribute to tread loss on radial truck tires. Trailer alignment maintenance includes the same two conditions that applied to tractor tandem-drives:

- the forward trailer axle is positioned perpendicular to the trailer center line, and
- in the case of tandem-axle trailers, the two axles need to be parallel to each other.

Trailer manufacturers provide alignment procedures. They generally follow the method outlined previously, using the kingpin center as the reference point. In the case of tandem-drive trailers, the rear axle is aligned in relation to the position of the front axle. Axle alignment checks must be conducted periodically as part of a PM program.

The alignment of newly-delivered trailers should be checked to make sure the undercarriage is in adjustment. After the vehicle is driven for a short time, the settling-in period, the chassis can be expected to shift to the right in the shackles. This center-line shift increases as the trailer ages. The longer the unit is run, the more wear you'll see in the shackles. As the use of doubles increases, axle alignment will become even more

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critical. If one or two axles on the front unit are misaligned, the alignment problem will grow progressively worse at the second trailer. We have been emphasizing proper alignment for tire wear. It is infinitely more important to think of these alignment checks as safety procedures.

Wheel/Tire balancing

With on-the-vehicle balancing equipment available, wheel balancing should not only be regularly checked on the steering axle, but also on all axles (including trailer) to achieve the longest tire tread wear. Out-of-balance conditions on the other axles create vibrations that are transferred to the driver, passengers, and cargo. Tire out-of-balance can be caused by careless mounting procedures, i.e. the improper seating of tire beads. (Use lubricant when mounting radial truck tires.)

Static balancing is performed while the wheel is motionless; weights are attached to the rim flange to offset an opposite heavy point. A better technique is dynamic balancing when the wheel is in motion. The heavy point of the wheel is found by rapidly rotating the wheel/tire assembly either on the vehicle or on a dynamic balancing machine.

Extending tire life

Now that you've invested in those radials, you need to keep them in good shape. We've already discussed driver inspections, inflation checks, and regular PM procedures. Good driving techniques can round out your tire program by contributing to longer tire life. Then we'll take a look at techniques to give the tire new life.

Driver techniques

Radial tires handle a bit differently than bias-ply. Because the sidewalls are more flexible and the tire grips the road firmly (the steel belts brace the tread, not the sidewall), radials on the steering axle yield laterally to absorb the strain of cornering. The driver feels more side-to-side movement which he or she may interpret as vehicle instability. The feeling is normal and is due to the increased sidewall flexibility of the radials. You can help by warning drivers in advance of the kinds of changes they can expect if they are not familiar with radials.

Tire life can be prolonged by sensible driving habits on the road. Since heat is the major enemy of tires, drivers should avoid quick cornering, abrupt starts and stops, and using trailer brakes to stop. Overloading at high speeds also creates unnecessary heat. Avoid spinning wheels, even in slippery conditions. Spinning rubs off the rubber and wastes fuel, and any foreign object lodged in the tire tread is simply forced in deeper.

Encourage drivers to keep the tires clean — they're easier to inspect for damage that way. Avoid parking in puddles of fuel or oil which can be harmful to tire rubber. Drivers already know the dangers of underinflation (and overinflation) and should be doing their part to maintain correct tire pressures.

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Drivers should be aware that keeping the casing in good condition makes for a quality retread. They shouldn't ride up on curbs or rub tires against structures.

Remember: Speed can be costly

It's not uncommon for some owners/operators to think that making deliveries at higher speeds will lead to higher productivity. But fleet managers are finding that this may not be the case. In fact, there is plenty of evidence to suggest that higher speeds may pose enough dangers to tire life (as well as reducing safety and fuel mileage) to offset any productivity gains you make in delivery time. The reason for this is that all tires are designed to travel comfortably at a certain speed. By exceeding this speed, you'll subject your tires to a lot of unnecessary wear, creating problems that are sure to contribute to your maintenance and tire costs. Driving at faster speeds creates an increased heat build-up — perhaps a tire's greatest foe. Excessive heat will lead to irregular wear, reduced durability, and premature tire breakdown. In addition, higher speeds will also have a damaging effect on your fuel economy.

Still, if you've considered these threats and decide to continue making high-speed deliveries, you should take a few precautions to minimize threats to tire life. High speeds change your tires' dynamics and load rates, so to help reduce wear to your tires, you'll want to adjust your tire pressure and reduce your load size. Also take care to adjust your maintenance schedule. A good PM program is critical if your tires are operating under high-risk conditions.

Retreading

The past few years have seen some big developments in the retreading industry. With improvements in both methods and materials, retreading service providers have grown dramatically in quality. Retreading is no longer dominated by the small, unreliable roadside shops. Today much of the business is handled by large and efficient companies that often provide a marriage of tire sales and maintenance, in addition to improved retreading services.

A decade ago, operators could hope for one or two retreads before sending their tires to the scrap heap. Now, though, with careful tire management and a good PM program, many operators are finding that they can get several more retreads — up to a total of six or seven. When new tread is added to a radial casing in good condition, the tire can run for hundreds of thousands of additional miles with proper care. Time was when many fleets wouldn't consider putting retreads on their vehicles. But with new radials pricing out at over \$300 apiece, and the technological improvements being made in the retreading process, it's the rare fleet that isn't taking a look at retread advantages. Retreading is energy-efficient for the U.S. too. It takes only 1/5 the amount of crude oil to produce a retread as is needed for a new tire.

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Retreading processes

Although retreading procedures vary according to the manufacturer, there are two basic processes: cold recapping and hot recapping. The former is based on the premise that heat can weaken the tire casing, so a relatively low temperature together with air pressure is used to bond the new tread to the casing over a period of time. In the other process, hot uncured rubber is applied directly onto the tire casing and cured in a chamber under heat and air pressure for several hours. Both processes have been used successfully and the choice made by any fleet is usually based on past experience or preference for a particular process.

Two other terms that you may hear are “mold” and “precure.” Precure is associated with cold-cap (55 to 58 percent of all recaps use precured tread rubber and 75 percent of radial recaps do) and mold with hot-cap designs. Time, pressure, and temperature are the variables in retread production. So ask questions about the retreading process you are considering and request test data. Because retreading has become so popular, new tire manufacturers will guarantee that their new tires are retreadable as part of the sales pitch.

The retread procedure

Whether the precure or mold process is used, retreading begins with a detailed inspection of the tire casing on a good tire spreader. Cracks, breaks, or punctures will show up under inspection with a light. Some defects can cause the casing to be rejected:

- excessive tread wear exposing the belts,
- too much bead damage from a bad rim or poor dismounting procedures,
- sidewall cracks that are too deep,
- loose or broken ply wires caused by running flat, and
- tread rubber separation that extends over too large an area.

Although repair technology to prepare a carcass for retread has greatly improved, it makes much better sense to pull the tire before extensive repair is needed. Retreaders have sophisticated machinery to analyze tire casings, i.e., using ultrasonic waves, high voltage electricity or laser beams to detect defects in the body of the casing. The casings can thus be graded and their potential for retread better assessed. These are high-cost pieces of equipment which demonstrate that retreading is here to stay and the technology can only continue to improve.

After the inspection, and any necessary repairs are made to the casing, it is buffed, and then rebuilt, either by adding a cushion gum bond between the new tread and the casing or by applying the uncured rubber right to the casing. The tire is then mounted for curing in a pressurized chamber. After curing and cooling, the new retread is again subjected to careful inspection.

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Is retreading for you?

Large fleets must investigate retreading as a major way to hold down tire costs. Some smaller fleets have a different philosophy. With smaller commercial carriers that run low mileage and light loads, it is not always practical to retread their tires. Instead, they buy only top-quality tires and sell the casings after a specified mileage. That way, any tire failures are probably covered by warranty. If they happen on the road, the driver is more likely to find a tire dealer to supply a new tire.

One director of maintenance, who has decided that retreading is not for his fleet at present, says that it's hard to match retreads if there's a blowout on the road. He prefers to put his confidence into the brand new casing offered by the new tire. While admitting that retreading technology is constantly improving and that retreads are as good as new if prepared properly, he says there's always a risk in buying a "used" tire. Retreading is still labor-intensive and so there's room for human error.

He's right on this point. You must be prepared to work closely with a retreader to make sure that the product meets your specifications and standards for quality. Even if you decide not to retread, there's gold in those "old" casings. Take good care of them and you should get a top price.

Know your retreader

If you'd like to try retreading, but are still hesitant, try talking to one of the more sophisticated dealers and ask for a test. It's even better if the dealer can offer both new tires and retreading services and is knowledgeable about both. Such a full-service supplier might offer road service for added security, not to mention more advanced retreading services, such as application-specific retreads. Discuss your operation specifically. A good dealer should be able to analyze how well your tires will take recapping and then propose retread patterns that will serve your fleet's needs. Run comparisons of retreads and new tires to test how well retreads perform for your fleet.

The retreader should be able to assist you in setting up test conditions for your fleet. Since tire inflations and tread depth will be checked constantly during the test, it's a good time to put some good maintenance procedures into practice. You'll also want to test during a busy season; running lots of miles helps build up data quickly.

Get all the particulars from your retreader about guarantees, expected mileage, etc. And talk to other customers to see if they have been satisfied with retreading services. There have been lots of retreaders entering the market as the concept has gained acceptance. In fact the sheer numbers have kept competition high, so prices have remained relatively stable. However, some retreaders aren't around any more. You don't want your dealer to close up unexpectedly, so choose wisely.

It also helps to standardize the fleet's tires as much as possible. Narrow your purchasing down to two or three brands and check them out for original tread life and how well they have been retreaded by fleets similar to yours. Remember, though, that not all casings will last through multiple retreads. Much depends on your operation and maintenance practices. One industry estimate figures that 20 percent of new tires don't make it

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to the first recap and only 55 percent last through a second. The challenge to fleets is to improve this figure: four to five retreads should be within the realm of possibility.

Retread requirements

A casing in good condition is the first requirement for a retread. In addition to good fleet PM procedures for inspection and inflation checks, a third way to improve casing life is prompt repair. All nail holes, cuts, cracks, etc. should be repaired immediately. Since most small fleets are limited to repairing simple punctures, working with a full-service supplier/retreader can ensure continuous care of your casings.

The extent to which tires can be repaired prior to retreading is amazing. In the future it may be possible to literally rebuild the entire tire! Repair services today are receiving less-worthy tires from the scrap pile.

For example, retreaders in the U.S. have concentrated their efforts on rebuilding the tread area from shoulder to shoulder. Yet European retreaders have been successfully rebuilding tires from bead to bead, repairing gouges or snags in the sidewall area. Even belt replacement has become possible. Outer steel belts can now be removed and replaced before retreading the tire. Section repairing, fixing larger areas of tread or sidewall damage by filling the gap with special rubber compounds or patches, is also growing.

Trucking operations have more flexibility when it comes to retreads. Retreads are limited to only non-steering positions on passenger-carrying vehicles. Also, passenger-carrying operations typically do not have trailers, which is where retreads on casings that are not in prime condition can be placed. A retread that isn't good enough for a drive axle can still fill a position on a trailing axle. The age of a casing should also be considered. A good retreader won't put a heavy tread on an older casing that is likely to die first.

If you're a dedicated customer of retreading and seek to improve the quality and durability of your retreads, you should note that steel/steel tires support retreads better than tires of any other composition. A fabric/steel construction, common in small tires (14-inch), do not hold up as well as they might because their casings are more susceptible to wear and damage from everyday operation. Steel/steel tires, on the other hand, use steel fibers and cords to help reinforce the casings and treads, and this construction allows them to resist casing damage, making them excellent and durable candidates for multiple retreads. The steel/steel tire has recently grown more available for medium-duty commercial trucks and buses, so you might want to look into the matter to see if they're worth the extra expense.

One final point on retreads. The CARB regulation mentioned earlier in this chapter applies to retreads as well. All 53 foot box-type trailers and the tractors pulling them that use recaps must be equipped with low rolling resistance retreads when operating in California. However, there are a few exceptions and an implementation schedule that allows existing retreads to be used to the end of their normal service life (see the CARB section in the Emission Systems chapter for details).

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Other alternatives for extending tire life

One procedure that has been used primarily for bus fleets but is seeing some growth in trucking is regrooving. This process cuts additional tread depth into the base rubber of the tire to add better gripping power. Most truck tires sold today have a layer of base rubber under the original tread of about $\frac{10}{32}$ inch. After a tire is run for a while, the normal tread wear results in some loss of traction. The tire is still structurally safe, but it may not be suitable for slippery conditions. If $\frac{2}{32}$ nds to $\frac{4}{32}$ nds of original tread remain, (most manufacturers recommend $\frac{4}{32}$ nds to $\frac{5}{32}$ nds) grooves can be cut into the base rubber to allow the tire to run an additional number of miles before retreading.

There are some regulations regarding regrooving. Only tires with enough undertread for regrooving and which are labeled “regroovable” are acceptable candidates. There are also regulations in terms of the placement of regrooved tires you need to be aware of. First, regrooved tires are not allowed on the steering axle of a bus. Second, tires that have a rating of 4,920 or more cannot be regrooved and placed on the steering axle of a truck.

The normal process for placing regrooved tires is to “move them back” on the vehicle. An example is front and drive tires being regrooved and then moved to trailers (drive tires can be regrooved and put back on the drive position, if desired). However, a minimum depth of $\frac{3}{32}$ inch must remain below the new groove.

Cross-grooving or siping refers to making cuts in the tire tread, perpendicular to the tread’s grooves. Proponents believe siped tires run cooler and have better traction. The general feeling, though, is that the possibility of irregular wear and structural damage to the tire negates any traction benefits. It’s probably better to select a tire that is right for the fleet’s operation in the first place than to begin experimenting with cutting into the tread.

Retreading and any other casing repair or modification depend on the proper pull-point — removing the tire from service at the optimum moment. Only good inspection and maintenance procedures can help you in determining pull-points. Everyone involved with tires in your fleet should be very familiar with the tire tread depth gauge. Use one that measures to 0.001 inch and is easy to read. Check out other tire monitoring and repair equipment so that the three keys to long tire life can be performed efficiently:

- inspection
- inflation, and
- prompt repair.

Recordkeeping

It doesn’t matter how large a fleet operation you are involved with, a good system of tire records is an essential part of doing business today. Even the owner/operator needs to know exactly how many tires are on the road

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or in the shop — or on the scrap pile. Only by knowing what you have, can you take steps to reduce costs.

Tire identification

Every *new tire* comes from the dealer with some identifying information already on it. Federal regulations, passed many years ago, recognized the need for tire control and safety. So every new tire bears a serial number that must be branded or molded on the sidewall. The letters “DOT” also appear on the tire to certify that the tire complies with the National Traffic and Motor Vehicle Safety Act and the Federal Motor Vehicle Safety Standards for tires. The serial number can include from seven to eleven characters (tire type can run from one to four characters and since listing the type is not required, this portion may not be included). Look for this kind of designation on the sides of any tire you see:

- The first two symbols are the manufacturer’s plant code, assigned by NHTSA.
- The next two symbols form the tire size code, which has been standardized across manufacturers.
- The optional tire type characters follow.
- The last three numbers are the required date of manufacture (the first two numbers identify the week and the last number gives the year); generally, most plants change the week designation on Sunday).
- This information may also be coded on the tire in a bar code or a RFID tag. These identification devices will normally include additional information above what is required by NHTSA.

Some carriers go one step further and assign their own identification numbers to tires.

Retreaded tires must carry a new serial number in addition to the original identification number. This number also includes a “DOT-R” as part of the string of characters. The retread manufacturer’s code is three characters rather than two (there are more retreaders operating). A size code comes next, followed by the optional one-to-four character tire type code. Finally, the date of manufacture appears as the same three-digit code. This retread serial number can be placed anywhere on the tire sidewall.

While there has been much discussion about a regulation that requires tires to be replaced once they have reached a certain age, there is no such regulation as tire service life is based on many factors. While the tire’s life will ultimately depend on many factors, including the tire’s storage history (was it stored properly before being installed, especially if there was an extended storage period?), service conditions, and the environment in which it operates, there are some general guidelines when it comes to tire age. Some tire manufacturers recommend that tires be replaced once they are six years old, regardless of use and condition. In other cases, some manufacturers cite 10 years as the maximum service age for tires, with more frequent inspections after the tire has reached six years old. However, you need to remember that incorrect storage (storing in direct sunlight or in areas with contaminated air) can significantly reduce the

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maximum service age of tires. Check with your tire manufacturer for specific recommendations.

Branding

Many fleets add an identification number of their own before putting the tire into service. Branding a tire helps you maintain accurate inventory records and discourages tire theft. Care must be taken not to brand too deeply or in the wrong spot on the tire. Once cracks begin in the sidewall, they can spread out, weaken the tire wall, and eventually work down to the ply wire, causing tire failure. So:

- Limit brand depth to $\frac{1}{32}$ inch; and never allow depth to go beyond $\frac{2}{32}$.
- Place the brand in the panel provided on the sidewall. If your tires don't have such a panel, position the brand on the sidewall, midway between the rim flange and the maximum tire section width.

Tire control

Good tire control means being able to track the tire from the moment of purchase to the time it is sold or scrapped. The biggest problem for most maintenance people is keeping track of a tire when it comes off the vehicle for repairs and is replaced by another. A computerized system makes the job of collecting data easier and the reporting procedure automatic, but manual records will work just as well if you are willing to spend some time at them. A combination system can also be used, where the technicians generate paper reports that are entered into the computer later. Whether using a computer system, a paper-based system, or a combination, three basic records should track tires for the fleet:

- **The Tire Inventory Record** lists all the tires in the fleet. They are logged in as they are purchased and assigned a fleet identification number. It is helpful if that number reflects the order of purchase, i.e. "507" could be the seventh tire purchased in 2005. Warranty limits can also be listed on their record. If the fleet has several terminals, a location code could also be included, i.e. "25-507." Listing your tires in order of purchase also reveals older tires at a glance. As tires leave service, remove them from the inventory.
- **A Tire Mounting/Dismounting Record** is kept for every unit that has wheels, even trailers. Wheel position is noted (by number) as is tread depth to maintain an ongoing record. Retreads are handled in the same way. Note that inspections are not listed on the Mounting/Dismounting Sheet; these would be part of a PM checklist (which should also log tread depth). Airings are listed on the inflation sticker, placed directly on the vehicle. Only when a tire is removed for rotation, repair, or retreading does it get listed on the M/D Record. If a tire is rotated to another vehicle, it gets logged on that vehicle record and crossed off this one.
- **The Retread Record** does just that. It keeps track of the fleet's tires as they are sent out for retreading. The Retread Record is reserved for the fleet retreads. If you purchase retreads, they are

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listed on the Tire Inventory Record as “new” tires because they need fleet ID numbers to get logged into the system. You may want to add any warranty to this sheet.

The Tire Mounting/Dismounting Record has a category that you will want to describe in detail if you aren’t already doing so. The “Reason” column asks for tire-repair details, rotation for tread wear, flat tire, etc. As we have mentioned previously, these records only need to be coded prior to use in a computerized tire program. If you are planning to computerize in the future, begin now to standardize the information. The kinds of monthly records that you could expect from a software program designed especially for tires would include a “new tires-in-service” report, a tire-age summary for the entire fleet, tires scrapped, etc.

Comparisons can be made of manufacturers, tire types, mileages and tread depths, and reasons for scrapping. With pull-points established, based on tread depth, you can also cross-reference to inspection records and project the inventory you’ll need. In fact, you’ll be able to determine average mileage for each $\frac{1}{32}$ inch of tread depth in the fleet and develop rotation and retread plans. These kinds of records are also invaluable for warranty claims. Tires that have failed may still be under manufacturer or retreader warranty. Any kind of failure trend is easily spotted with good records. Perhaps the fleet plans to trade some units and you’d like to mount the older tires in the fleet, good records can identify these for you.

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RETREAD RECORD

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Tire cpm

Another benefit of good records is cost control. Even though tire costs are a major portion of a vehicle's variable costs, many fleets are not yet able to track them accurately. The best measurement of tire cost is cost-per-mile. It is calculated just like vehicle cpm:

Add:

- purchase price,
- repair costs, and
- retread costs.

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Subtract from this total the casing price if you sell it and any warranty pay back you received for the tire. Then divide this total by the total number of miles traveled. It may take a while for the information to accumulate, but once you can track a tire's history and costs in this way, you'll be able to make better purchase, retread, and discard decisions.

Also remember to adjust costs for any warranty adjustments. This can be a critical factor when you are studying costs (did the manufacturer or dealer stand behind their product?).

Failure analysis

Some Maintenance Pros believe that the place to begin effective tire maintenance is the scrap heap. All the fleet's tire mistakes (and successes) will end up here sooner or later. Scrap analysis helps to judge tire performance and your own maintenance practices. In fact, if you would like to try a new brand or type of tire, find a fleet using that tire and ask to see their scrap pile. You'll learn a lot about that tire!

Tire scrap analysis

Look at scrap to determine why a tire failed. Can you spot trends — the same manufacturer, the same tread type, the same retread, etc.? If the same tire type fails consistently, there may be a defect in the tire. It may not be the proper tire for your operation. If too many tires from the same retreader are on the pile, you may need to change dealers.

Tires ruined by objects on the road often can't be helped, but too many instances might point to the driver or to the yard. You just don't find the highways littered with that much debris. And it's surprising how dirty some terminal areas can become when regular cleanup is neglected.

Your tire records (the Tire Mounting/Dismounting Record) should have detailed the reasons why tires were discarded. Be specific and train mechanics to describe failures on ROs accurately. Can you add more symptoms to the following list?

Tread:

- abraded surface,
- bulge on tread,
- stones in tread,
- deteriorating tread,
- tread separation,
- ply separation,
- tread crack,
- diagonal tread wear,
- puncture,
- uneven wear,
- chain damage, and

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- excessive wear exposing belts.

Sidewall:

- abrasion,
- soft rubber condition,
- tear,
- cut,
- snag,
- separation,
- flow cracks,
- tiny surface cracks,
- stress cracks from improper branding,
- exposed wire,
- bulge, and
- bead rubber cut, burned, or chafed.

The next step is to determine the cause of the failure. What caused the tread separation? What caused the uneven wear pattern? Driver abuse? Improper mounting procedures? Only by getting together once a month or so at the scrap pile can you and your mechanics make recommendations for changes.

While you're at the pile, it pays to stack the tires neatly out of the rain. Orderly classification of tires within the garage (tires needing repair near the repair area, repaired tires and new retreads near the mounting area) or outside under protection (tires to be scrapped) shows organization. You need to keep scrap tires dry for failure analysis. Orderly storing means you can keep an eye from month-to-month on whether the scrap pile is increasing or decreasing.

A second virtue of tire scrap analysis is identification and pulling out any tire that could possibly take a recap. Every casing that is rescued can delay a new tire purchase, so you want to be sure that good money isn't being thrown away. If you spot a tire that isn't good enough for recapping but will still hold air, could it be used as a spare?

Finally, looking at the scrap tells you how your tire maintenance program is doing. If too much tread wear and ensuing belt damage means that you've lost out on a recap possibility, you need to monitor tread depth more carefully during the tire's service life. Any time a tire is pulled for rotation or repair, the tread should be checked and recorded. Punctures that weren't repaired until they were large holes point to lazy inspections.

Also, look at your tire records for the tires on the scrap pile. Can you track the tire back to birth? Did the tire meet expectations? How many recap cycles did the casing go through? If you cannot answer these questions, review your recordkeeping. If you can answer them, but do not like the

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answers, you will need to adjust either your purchasing practices or your maintenance.

Wear pattern analysis

Another failure analysis tool the maintenance manager can use to try to improve tire performance is wear pattern analysis. Wear pattern analysis can come into play in two areas, as part of vehicle inspections as well as part of tire failure analysis. It is ideal to spot the wear pattern during a vehicle inspection, so the cause can be corrected before the tire is too severely damaged and must be removed.

If the tire did not wear evenly, there was a problem with either the tire or the vehicle. Tire wear patterns can be directly related to a cause of the wear pattern. Here are typical wear patterns and their causes:

Center wear is typically a result of either overinflation or constant underloading. This wear pattern is a result of the tire tread not being “flattened out” on the roadway, and only having solid contact with the roadway with the center portion of the tread. The solution to eliminate center wear is to lower the air pressure in the tire.

“Edge” or “shoulder” wear is excessive wear on both edges, or the shoulders, of the tread. This is typically caused by underinflation or overloading. The wear is caused by the center of the tire tread “folding up” due to not being able to hold shape. This wear pattern indicates the need to run the tire at a higher pressure, or the need for a tire with a higher weight rating.

Side wear is wear on only one edge of the tread. This is typically a result of an alignment problem, most commonly with the camber adjustment. If the camber adjustment is not correct, the weight is not being distributed across the tire tread, and the inside or outside (depending on which way the camber is off) will be wearing excessively because of the extra weight.

“Toe” or “feathering” wear is an uneven side wear pattern typically caused by an alignment problem, most commonly a poor toe-in adjustment. The excessive toe-in or toe-out causes the one tire to constantly try to turn the vehicle, while the other tires are trying to make the vehicle go straight. The extra side friction on the one tire (or set in the case of duals) will cause the tire to slide sideways slightly as it goes down the road, leading to the wear. In both side and toe wear, the solution is to perform an alignment on the vehicle.

Cupping is normally caused by tire balance issues or suspension problems, such as poor shocks. If the tires are out of balance or the suspension is not functioning correctly, a certain part of the tire will be “impacting” the ground, rather than rolling smoothly, which is what causes this wear. If the cause of the cupping is not repaired, the cupping will enlarge to the point where it will reach from edge to edge on the tread. Checking and repairing the suspension (if necessary) and rebalancing the tire is the solution to cupping.

Flat spotting is different than cupping. Flat spotting is when a large section of tread is missing, creating a flat spot in the tread. Flat spotting is typically caused by drivers either skidding the vehicle at high speed,

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or trying to drive the vehicle with a wheel, or set of wheels, not turning (park brake applied, wheel “frozen” in place, etc.).

Don’t forget the trailers! When performing inspections on trailers, remember to check wear patterns. In many maintenance issues, including tires, trailers are sometimes forgotten!

Summary

Make sure you are purchasing tires that match the job they are intended to perform. Also remember that tires contribute directly to operating costs in two ways: the cost to purchase and replace them, and in fuel mileage. Determine your fleet pull-points for rotating to other vehicle positions, recapping, and finally discarding, and stick to that standard. Your regular inspections — driver and shop PM — should record tread depth, tread wear patterns, and tire inflation. Pull tires when the vehicle is in the shop for a PM service if the tire is questionable for any reason. Tire problems are best dealt with on a preventive basis, rather than a breakdown basis.

You need to look at the pile of removed tires often enough to see why tires are failing and wearing, and to see if any tires can be salvaged or sent for recapping. There’s also the chance that a scrap tire may still be covered by warranty. Your tire records should quickly identify these at the time the tire is logged on the dismount record.

The sure thing about tire maintenance is that you cannot continue operating as you did in the past. Too much is going on in the field right now and only the informed maintenance manager will be successful in controlling tire costs. The time spent in setting up inspection and maintenance standards and keeping detailed records will result in extending tire life. That’s money that goes to the bottom line.

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Electronic components	
Electronic engines Nearly all engines manufactured today are electronically controlled to one degree or another. Some of the older engines have only a small fuel/air management system, while most of the heavy-duty engines are fully computerized (fuel injection and air-flow sensing and performance is tracked and recorded). In heavy duty engines, when the driver operates the throttle the engine control module (ECM) adjusts the fuel and air flow to most-efficiently achieve the performance the driver has requested. Along with controlling the management of the fuel system, the electronic engines all have a memory. The memory is intended to shorten the diagnostic cycle in case of engine problems. The engine electronics on some vehicles can be programmed to shut down the engine to protect it from damage. Should the oil pressure or level go too low, or the coolant level go too low or temperature too high, the engine will warn the driver and then turn off. Some optional packages allow the diagnostic system to display trouble codes to the driver if a check engine or shut down warning light has come on. By activating the system the driver can get the trouble codes displayed on the dash. Example: with the key turned on and the check engine button pushed down and held, the check engine light flashes a pattern of one flash, followed by six flashes (trouble code of 16). By looking in the troubleshooting guide the mechanic can tell the driver what to do to correct the problem. Part of the programming on some electronic engine systems allows supervisory personnel to set the vehicle to go no faster, or generate more power, than a pre-set limit. Once the speed, RPM, or power limit is reached, the computer will limit the amount of fuel to only what is required to maintain the desired speed, RPM, or power. Finally, the memory on these systems can become useful in case of a performance problem or an accident. All that is required to retrieve the data is usually a laptop computer or similar device and specific software. It is highly recommended for liability, maintenance, and warranty tracking reasons that you regularly download these systems (and save the data). These systems are very data-intensive, and require coordination between many sending units, sensors, processors, and actuators (injectors, etc.). The diagnostics built into the system are designed to save time and money. Rather than trying to sort through the system and locate a	

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fault, the system can tell you what components it is not communicating with or are not working correctly. If you are not going to get the training and equipment required to download and work with this data, you will need quick access to OEM service.

Electronic transmissions

Automatic transmissions are now available in both hydraulic and gear-drive configurations, both of which are electronically controlled. The hydro-drive transmissions use sensors and controls to shift the transmission at optimum shift points based on load, demand, and engine speed. Automatically shifted gear-drive transmissions use electronic sensors and controls to shift the gears at specific RPMs. This transmission offers the best of both worlds. It maximizes efficiency and fuel mileage by not losing power to the hydro-drive system and does not require the driver to have a high level of skill to shift the transmission.

ABS and traction control

The antilock braking system, and the associated traction control system, are a combination electronic/air (or hydraulic) system. The electronic sensors and processor make decisions, and then influence the operation of the air or hydraulic system, if necessary. As well as being data-intensive (the wheel sensors are constantly checking and reporting wheel speed to the processor), the system also has an active portion (the modulator valve that releases/applies the brakes and the throttle control) that works off commands from the data system.

One problem with ABS/traction control systems is that portions of the data system (the wheel sensors and the associated wiring) are in less than ideal positions (at the wheel ends). This location leaves them exposed to environmental hazards. While the components that are in these locations are designed to be there, they will still require extra attention during vehicle inspections.

One misconception about ABS is that it is not required. This is not true. If the vehicle was required to have ABS when it was built, the ABS is required to be in working order. It is not an out-of-service violation if the ABS is not functioning correctly, however, it is still a violation of the regulations (§393.55).

Instrumentation

Anyone who has been involved in maintenance for any length of time can tell you the improvements that have been made by changing from an electric instrumentation system to an electronic system. By using sensors and electronics, rather than sending units and wires, instrumentation wiring and troubleshooting has been simplified. Also, placing the instrumentation information on the data system has made many of the other systems possible. Because of the integration of the instrument information into the data system, a Maintenance Pro needs to remember that removal of instrumentation (or not repairing faulty instrumentation) can lead to other systems not functioning (or not functioning correctly). An example would be a faulty speedometer system.

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When this fails the cruise control, ICCS, and other systems cannot operate correctly. Without the speedometer data, the engine may not even operate correctly.

On-board diagnostics

Earlier we discussed the engine diagnostics. While this is typically the largest diagnostic system on the vehicle, it may not be the only one. Many of the components on the vehicle may have independent diagnostics that are connected into the vehicle electronics. Some systems (such as emissions systems) are fairly easy to diagnose, and the diagnostics simply use a tell-tale to notify the operator of a problem. Other systems (such as transmissions) may have a diagnostic memory that can be accessed to troubleshoot problems (or check the status). As with engines, being able to access the diagnostics in such components is critical.



Electronic safety systems

There are presently several electronic safety systems available. Here is a list of what is available, along with a short description of each. One key point to these systems is the vehicle needs to have the ability to support them. These systems will increase the demand on both the electrical system and the electronic communications network on the vehicle.

Collision warning systems

Collision warning systems (CWS) use radar, sonar, infrared, or laser technology to warn the driver when the vehicle is getting “too close” to another vehicle or an object.

These systems require mounting of hardware (the sending unit, the processor, and the display), electrical connections, and calibration on

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installation. Some vehicle OEMs are now offering these systems as an option. This is preferred to aftermarket installation, for integration reasons, but may not be preferred for cost reasons (aftermarket installation may be cheaper in some cases). These units are mostly self-contained, and do not require anything from the vehicle except electrical power.

Roll stability systems

Roll stability systems (RSS) use yaw and roll sensors to sense if the vehicle is approaching the edge of its stability envelope. If the vehicle becomes unstable, the system communicates with the engine, telling it to reduce power to avoid a rollover. In some vehicles the system will even make intelligent braking decisions to stabilize the vehicle.

These systems are data intensive. The sensor will constantly be sampling the environment and reporting to the processor, which will be constantly making stability decisions. If an intervention is called for, the RSS unit must initiate communications with the engine through the vehicle's electronic system. This is true even if the RSS system uses its own wiring for sensor-to-processor communications (or is one integrated unit). Another issue with these units is the establishment of parameters. Different settings than those provided by the factory may be required depending on the stability of the fleet vehicles. These systems are also available as an aftermarket product as well as being offered by some OEMs as an option.

The next generation systems, referred to as electronic stability control (ESC) systems are now becoming readily available. These systems, as well as preventing rollover as the RSS systems do, also watch for over- or under-steer situations that could lead to loss of control. They use basically the same sensor packages, as well as power control and intelligent braking to help the driver maintain control of the vehicle.

The National Highway Traffic Safety Administration (NHTSA) has proposed requiring ESC systems on large commercial vehicles in the future (they are already required in certain new light-duty vehicles). As a Maintenance Pro, you need to begin the process of getting familiar with these RSS/ESC systems. The use of them is going to be increasing, and if in the future they become mandatory all new commercial vehicles will be equipped with them.

Lane departure warning systems

Lane departure warning systems (LDWS) use video technology to alert the driver if the vehicle is departing its lane without the turn signal active. The system is designed to help the driver avoid "wandering" into other traffic lanes or leaving the roadway.

These systems require the installation and calibration of the sensor system, the processor, and the display. They may also require recalibration over time. While this is a data-intensive system, it is normally self-contained and requires only electrical power from the vehicle.

Intelligent cruise control systems

Intelligent cruise control systems (ICCS) is another data intensive system that communicates with the engine computer to slow or accelerate the vehicle by adjusting fuel flow to the engine, based on input from other onboard systems. Normal cruise control only maintains vehicle speed based on the driver selected speed. The ICCS works with other safety systems (normally CWS, RSS, and/or LDWS) to accelerate or decelerate the vehicle based on a threat. Some of the ICCS systems are active even when the driver has the cruise control switch in the off position. Experimental versions under development would even apply the brakes to prevent or minimize the effects of a collision. This is accomplished by using the additional brake system components, or electronic brakes, to apply the brakes.

Because of the level of integration that is necessary, ICCS is best installed as an OEM option. Aftermarket installation is possible, but can be difficult.

Electronic tire pressure monitoring system

A tire pressure monitoring system (TPMS) is an electronic system that monitors the tire air pressures on the vehicle. The TPMS reports real-time tire-pressure information to a panel or warning light on the dashboard. Some systems will simply warn the driver that he/she has a low tire, while other systems will report the pressure in each tire to the driver and/or alert the driver which specific tire is low on air. These systems are available through OEMs (either installed at the factory or as an aftermarket product) and or through TPMS manufacturers as an aftermarket add-on. These systems vary widely in complexity, integration, and installation difficulty.

A related system is the automatic tire inflation system. These systems not only have sensors that determine the air pressure in the tires, but will automatically inflate low tires. These systems typically have extensive installation requirements. However, in certain applications (such as using super single tires), the cost and installation labor time may be offset by the savings the system will generate.

Electronic on-board recorders and automatic on-board recording devices

Electronic on-board recorders and automatic on-board recording devices (EOBRs and AOBRDs, which are now collectively known as “electronic logging devices,” or ELDs) are devices intended to record a driver’s duty status. These systems take the place of the driver’s paper log. They presently rely on the vehicle for data and power to function legally and correctly. Data on engine performance is integrated into the system to determine when the driver is actually driving, how far he/she has driven, and when the vehicle was parked. These systems require a driver input panel so the driver can enter non-driving duty correctly.

Most ELDs are aftermarket add-ons, requiring integration with the vehicle data system when installed. Many of these devices will simply connect

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into the J-bus or OBD (depending on the vehicle's electronic system) using a diagnostic port and one wiring harness. However, some of the systems have extensive installation requirements. Also, older vehicles may require the installation of speedometer and tachometer sensors to make them compatible with the newer devices.

The next generation of these devices (based on a proposal released in March of 2014) would have to be connected to the J-bus of the vehicle and capture specific data sets from the ECM. Speed, mileage, engine hours, and RPMs are examples of what the ELD would need to be capturing off of the ECM on a regular schedule (a minimum of once per hour during operation, as well as any time the driver stops the vehicle or changes duty status).

Many of the ELD systems available are not only logging devices, but also include a communications system. This has the advantage that only one installation is required to end up with both an electronic log and communications system on the vehicle.

This is another system Maintenance Pros need to begin the process of getting familiar with, even if your company is not using one. These systems are gaining in popularity, and there are proposed regulations that would make them mandatory in the next few years.

Communications systems

Communications systems can be as simple as a cell-based, talk-only system or as complicated as a combination cell/satellite system that checks its location using GPS and reports the vehicle status and present and past activity on a predetermined schedule.

Because of the wide variety of these systems, their varying complexity, and their differing specifications, you will need to decide what you want to use the system for. That will determine which products you should be looking at, and then you can determine what integration will be required with the vehicle. The larger, more complex systems can take 8 to 16 hours to install in certain circumstances, and have extensive integration requirements (integrating into the engine data system, speed sensor, GPS receiver, etc.). Others install in as little as an hour or two (bolt on and plug in).

You will need to be aware of two regulations when looking at the various communications systems. The FMCSA has regulations prohibiting texting while driving and using a hand-held mobile telephone (cell phone) while driving.

The texting rule (§392.80) prohibits the use of any communications device that involves the reading or entering of letters or numbers while driving a commercial vehicle. Fleet communications systems that require reading or entering letters or numbers are covered by this rule. "Driving" is defined in this rule as driving on a public roadway, including momentary stops due to a traffic situation or a traffic control device (a driver cannot text while stopped in traffic). To assist in compliance with this rule many communications systems that use text have a "shut down while in motion" option. This turns the display for the system off once the vehicle reaches a certain speed. If this option is used, the maintenance department will

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need to know how to activate it and how to verify that it is still working correctly.

The regulation prohibiting the use of cell phones while driving commercial vehicles (§392.82) may also influence the decision on what communication system is used (and subsequently, what work may be required of the maintenance department). The regulation prohibits the driver of a commercial vehicle from leaving the normal driving position to reach for a cell phone, holding a cell phone, and dialing a cell phone while driving. If the driver can initiate and answer calls using either voice commands or a single touch (without holding the cell phone), then use of the cell phone is allowed. This regulation may lead to Maintenance Pros dealing with requests for the installation of docking stations, remote control buttons, or Bluetooth compatible devices if the carrier chooses cell phones for the company communications system.



Event data recorders

Event data recorders are intended to track the driver's and vehicle's activities, and provide a means to improve the performance of both. They are also known as "black boxes." These recorders can track vehicle speed (minute-by-minute and average), brake applications (times when the brakes were applied, number of times the brakes were applied, and brake force applied for each braking), engine RPMs (minute-by-minute and average), the driver's engine demands and the engine's performance, along with many other parameters. These systems can be part of the existing electronics on the vehicle that only needs to be accessed and activated, or they can be a separate system installed to track the driver and vehicle performance.

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System interoperability

Interoperability is a word borrowed from the information technology people. It has to do with how well various pieces of hardware and software will work together. Where problems arise is when there is too much traffic on the system, when the system cannot coordinate the traffic coming through it, or the components on the system are not speaking the same language.

While this has traditionally not been a concern in heavy-duty vehicles, it is becoming one as we continue to add systems and subsystems onto the on-board electronic system. To illustrate this point, just consider how many data collection points are trying to communicate with, or report to, the engine control module. Now consider how many of these data points are also trying to communicate with other components on the vehicle (speed sensor to the engine and the speedometer, as an example).

The spinal cord of a heavy vehicle's electronic system is the J1939 data bus/system. All electronic systems on the vehicle communicate through, and are coordinated by, this data bus. The engineering of this system has prevented most data communications problems.

Case in point. The National Transportation Highway Safety Administration (NHTSA) conducted extensive testing on the J1939 system. The tests were done to determine the realistic capacity of the system. Once that was determined, they also wanted to discover what stresses are being placed on the system and what happens as more systems and sensors are added to the system. What they discovered was that J1939 systems are extremely robust.

According to the NHTSA tests, the data system on a heavy-duty vehicle going down the road normally operates at 20 percent of capacity. Each additional system that is added to the vehicle (electronic transmission, LDWS, ICSS, etc.) will increase the workload 5 percent. Because of data trying to enter and exit the system, and priorities assigned to the data, they saw system performance begin to suffer when 50 percent of capacity was reached. Please note, the performance suffered by small fractions of a second at 50 percent of capacity. It was not as if the system stopped working. Certain nonpriority data was delayed entering or exiting the system by fractions of a second. There was no drop in vehicle performance.

As part of the test, the engineers wanted to see how much data it would take to overload the system to the point that vehicle performance suffered. To accomplish this they had to use six ECMs (the biggest data user, sender, and receiver on the system is the ECM) and have them all trying to send large, priority messages at the same time to overload the system. In the real world, this is just not feasible.

The typical J1939 system assigns priority to the TSC-1 traffic. TSC-1 are the torque and speed commands from the driver to the engine (also referred to as throttle commands). As other systems were added, they were assigned a priority either by design or by "fate" (added systems get lower priority). The bottom line to this is that no matter how much they loaded the system, the throttle commands always made it through without delay.

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The testing did turn up one item the Maintenance Pro needs to be aware of. If there is a communications problem caused by the J1939 system, the vehicle may not show a fault to the driver, or store a fault in a diagnostic system. This is because the J1939 system does not have its own diagnostic system or diagnostic memory. It relies on the components that use the system to identify, display, and store problems.

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Having addressed the shop operations and the vehicle systems and specifications, we are ready to move to the third area of operations — the people. You can reorganize the layout and equipment of the shop much more easily than the persons who work there! So we'll begin this discussion with the person over whom you have the most control — you. The maintenance manager/supervisor The number of supervisory personnel depends, naturally, on the size of the shop. A large fleet employs a director of maintenance, who may have a corporate staff position. That individual will have a shop supervisor who reports to him. The structure is two-tier: the managerial level where policies and standards are developed and the supervisory level where the policies are translated into day-to-day activities. The manager in the large fleet is further away from the shop activities; in fact, since he has a shop supervisor, he really isn't required to have a strong maintenance background. This can cause problems, though, because he is required to set maintenance standards. If your operation is smaller, you, as maintenance director, probably also supervise the technicians. Yours is a trickier position! A strong maintenance background is highly desirable because you need to answer questions from technicians, parts people, etc. Your challenge is to avoid getting so involved in specific problems on the floor that you no longer have the time to manage. As supervisor, you are being paid to do more than solve a problem on a particular vehicle. You aren't supposed to pitch in during crunch situations, either. What exactly are the management responsibilities, not supervisory responsibilities, that fall to you? • The shop safety program is an important responsibility that is all yours. In a large fleet, you would consult with the shop supervisor in developing the safety standards but you would define the program and direct the shop supervisor in how to enforce it (he's responsible to see that the shop employees carry it out). In the small fleet, this important duty is a top priority for you. You will need to be involved with drivers so that any maintenance measures taken to improve vehicle safety aren't spoiled by uninformed drivers. You may also need to justify equipment purchases made for improved shop safety to fleet management. Safety is a subject that involves vehicle, driver, technician, and management. It is one area where you must be aware of the needs of all three "parties". • You will need to be involved in spec'ing of new equipment if maintenance costs down the road are to be contained. A poor judgment in specs can also mean increased driver discontent, i.e. a fuel-economy engine that they only see as cutting down available power.	

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- As a manager, you must hire the right number of people to service the vehicles and the right kind of people to support your maintenance standards.
- Finally, it is your responsibility to set up the maintenance standard. This includes the PM inspection/service schedule and items to be handled, *and* the repair standard. The repair standard is the length of time that a particular repair job should take in your shop. It is based on fleet experience, and your own personal experience as a technician, together with some published rates as guides if needed. A time rate comparison is really the only way that you can judge a technician's performance on the job.

Only by having a maintenance standard can you improve the shop's productivity, or the output of the shop. The standards must be realistic: if you set them too high, technicians will become discouraged and leave. Set them too low, and employees won't try to improve. Finding the right balance is a delicate undertaking which requires an empathy with people combined with a realistic attitude toward the bottom line.

We have already discussed shop safety procedures and participation in vehicle specifications planning as part of your job as Maintenance Pro. Staffing is also a top job priority, but not just hiring and firing — let's think more in terms of personnel planning. When a Maintenance Pro puts together the right number of people in the right place at the right time, i.e. puts the right number of technicians in the right facility to service the vehicles at the lowest cost, we can say that his personnel planning has been successful. Because all shops employ technicians, we will limit our discussion to that employee.

The technician

Shortage of technicians

The numbers seem to indicate a tight labor market for skilled technicians. Statistics show that there are fewer new, young technicians entering the field. Through attrition and retirement, some of the most prized technicians have left the field. Many employers are finding it difficult to fill vacancies due to the unusual schedules that the industry requires, and the constantly changing technology continues to raise the bar on who can actually work on the equipment. Many individuals with the electronic skills to work on more sophisticated vehicles have opted to enter other fields. Turnover rates show that one in three technicians switched jobs each year among motor carriers. The industry is finding that the quality of applicants wishing to fill vacancies often lack the skills or qualities needed to perform the job description.

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According to the Bureau of Labor Statistics, people employed as truck, bus, and diesel technicians will be approximately 280,000 by 2008. However, the Technology & Maintenance Council stated that the automotive and trucking industry will need over 600,000 new maintenance personnel by this same timeframe.

Even with such a bleak outlook for the labor market, you cannot compromise safety to fill a position with a warm body. Standards should be set and a complete job description created with full expectations that a highly-skilled candidate will fill it.

Formulating a job description

The hiring process is weighted with many variables. To get the best results, you'll need to have a clear picture of the position you plan to fill — its demands, requirements, and expectations. For this reason, the importance of a job description cannot be overstated. A comprehensive, itemized description of the position to be filled will not only help you clarify your own needs, but will also provide the employee with a written list of your expectations and any health or physical risks that may be associated with the job. You'll know just what you're looking for and your technician will know just what he/she is getting into — and whether he/she is qualified. Completing the description is the first step in any successful employee search.

Assessing the needs of the position

Every shop is unique, with different equipment, services, objectives, and hazards. It stands to reason, then, that every shop will have its own unique priorities when it comes to hiring a technician. So, if you're planning on filling a position in your shop — whether you're creating a new opening or hiring to fill an old one — begin by assessing your personal needs. What do you expect in a technician and what do you hope for? What kinds of equipment will your technician be required to operate and maintain on a daily basis? What kinds of services must he or she be able to provide? How much physical activity will be involved in his/her duties? Are oral or written communication skills valuable to you or necessary to the position? How much experience would you like your employee to have? These are just a few of the questions you must ask in order to define your hiring priorities.

At a minimum, a comprehensive job description should include:

- **Job purpose** — Begin your job description with a concise, direct statement of the goal of the position e.g. "To repair company equipment in a safe, timely, cost-effective, and practical manner." This will give both you and your employee a precise idea of what the job will entail.

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- **Duties** — In this section, list the specific tasks and duties that make up the job. This is perhaps the most important part of your description, so be thorough and try not to take any essentials for granted. For instance, don't forget to stipulate that your technician should know how to operate your various technical instruments, and should be able to build, maintain, and repair the components of your fleets.
- **Accountabilities** — This is a detailed section in which you list the skills, abilities, and areas of knowledge that your technician will need to possess in order to do his job efficiently and competently. Professional conduct, familiarity with safety procedures and hazardous materials, and timely completion of paper work are examples of accountabilities.
- **Eligibility requirements** — Here you'll want to list the necessary prerequisites to the job. This section should not only include the legal requirements, such as a CDL and knowledge of government safety regulations, but also your own demands. List the number of years of experience you're requiring, along with level of education, etc.

Once you've covered all of your skill requirements for your technician position, it's time to address some of the issues your employee should know about before taking the job. This includes descriptions of the physical requirements and work environment, along with a list of the hazards associated with them. These sections are added not only for the sake of liability, but also to keep your employee informed about the dangers inherent to the position. It's always a good idea to be completely honest with your employees, especially at the time of hire. It will help to build a rapport with your employees and establish your shop as a place of honesty and integrity.

Remember to include:

- Physical requirements
- Work environment
- What tasks unrelated to vehicle repair will be required of the technician, i.e. vehicle washing, parts chasing, shop equipment repairing, vehicle fueling, and shop cleaning. This is important to productivity because you are paying a skilled technician for unskilled work and many technicians want to know up-front, how you value their time and expertise.

Personnel

The following is a sample job description for the position of technician. Use it to develop or revise your own:

Position Description	
ABC TRUCKING CO., INC.	
JOB TITLE: Mechanic	DATE:
DEPT. OR DIVISION:	STATUS:
REPORTS TO:	JOB CODE:
WRITTEN BY:	
APPROVED BY:	

JOB SUMMARY OR PURPOSE:
To repair company equipment in a safe, timely, cost effective and practical manner.

Depending upon the level of experience and the degree of supervision involved, this position description may apply to the following job titles: Apprentice Mechanic, Mechanic's Helper, Mechanic, Lead Mechanic, and Journeyman Mechanic. Specialized jobs might include bodyman, fenderman, and painter.

JOB DUTIES:

- Build, rebuild, and repair all parts of automotive equipment as may be required in the department to which they are assigned.
- Diagnose any mechanical, electrical or other breakdown or failure to a motor truck or related equipment.
- Read precision instruments such as micrometers, dial indicators, bore gauges, voltmeters, digital multimeters, calibrators and other electronic diagnostic tools.
- Troubleshoot and perform failure analysis of the component parts and systems on the truck or truck tractor; or the component parts and systems of the trailer or convertor dolly. (This requirement may not apply to body and frame specialists.)
- When applicable use welding skills and knowledge of metals to complete truck repairs. Individuals who work on convertor dollies must be able to weld horizontally and vertically without air pockets in the bead.
- Apply knowledge of DOT, EPA, and OSHA rules and regulations.

ACCOUNTABILITIES:

- Knowledge, understanding, and application of the safety practices related to this position.
- Knowledge and understanding of the proper handling of hazardous material.

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- Completion of all paper work and records in an accurate and timely manner.
- Knowledge and understanding of DOT, EPA, and OSHA rules and regulations.
- Professional representation of the company and the trucking industry.
- Maintenance of an adequate amount of hand tools to accomplish daily work.

JOB SPECIFICATIONS:

Eligibility requirements:

- Must be able to read and write and have the mental capacity to complete required paperwork and records.
- Must possess a valid Commercial Driver's License.
- Must have at least ____ years of truck repair experience, body and frame repair experience. (School may account for part, but not all of this experience.)
- Must have working knowledge of most of the systems located on a truck or truck tractor, a semi-trailer or convertor dolly.
- Must be able to read precision instruments such as micrometers, dial indicators, bore gauges, voltmeters, digital multimeters, calibrators and other electronic diagnostic tools.
- Must be able to troubleshoot and do failure analysis of some of the component parts and systems on the truck or truck tractor; or the component parts and systems of the trailer or convertor dolly. (This requirement may not apply to body and frame specialists.)
- Must have welding skills and knowledge of metals—individuals who work on convertor dollies must be able to weld horizontally and vertically without air pockets in the bead.
- Must have training and working knowledge of DOT, EPA, and OSHA rules and regulations.
- Must be willing to participate in training classes that are given by the company or requested by the company.
- Must be willing to move into different departments to keep the company running in an efficient operating manner. (This may include a shift change.)
- Must be willing to take tests to provide management with information to be used for management and classification. (These tests may be written and/or oral.)
- Consistent with company policies, individuals are expected to maintain superior customer relations; be involved and committed to the quality process; be willing to train and give aid to fellow employees; work in an efficient and economical manner; receive constructive criticism and praise in a business-like fashion; and maintain a positive attitude.
- Must be willing to work on any piece of rolling stock and associated equipment owned by the company.

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Post Offer:

- Must meet or exceed the medical standards of the U.S. Dept. of Transportation.
- Must satisfactorily pass a drug test.

Physical requirements:

- Must be able to move, operate, lift, and store specialized equipment that includes, but is not limited to welding equipment, hand tools, shop machines, and power tools.
- Must be able to complete repairs that may require bending, twisting, climbing, squatting, crouching, and balancing.
- Must have the ability to accomplish specialized detail work required in some repair and diagnostic assignments.
- Must have the ability to accurately read gauges and dials.
- Must be able to exit and enter the vehicle's cab. Cab floor level is generally from 36 to 66 inches from ground level, with exit and entry achieved with the assistance of various configurations of steps and handholds.
- Must be able to spend ____% of the day standing and ____% of the day walking on surfaces such as concrete, wood, and metal.

Work Environment:

- Mechanics may spend ____% of time exposed to heat, cold, dust, irritants etc.
- Mechanics may work with, and be exposed to hazardous materials.

Statements included in this job description do not necessarily represent an exhaustive list of all responsibilities, skills, duties, requirements, efforts or working conditions associated with the job. While this is intended to be an accurate reflection of the current job, management reserves the right to revise the job or to require that other or different tasks be performed as circumstances change.

Applying the regulations

Many operations are unaware that their technicians are actually *drivers* for DOT purposes, if the driver operates commercial vehicles on the highway. This means that all the necessary paperwork that would be kept for actual drivers must be kept for technicians. To determine if your technicians fall under the driver regulations found in Parts 382 and 383, and 390 through 396, you need to consider the following factors:

- Do your technicians test-run vehicles defined as a commercial motor vehicle (CMV) as found in Sec. 390.5?

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- Are these vehicles taken onto a public highway as defined in Sec. 390.5? This can include a private driveway or parking lot which allows public access. Even pulling a CMV out of the shop and parking it a parking lot that the public has access to would make your technicians into drivers by these definitions.
- Are you involved in interstate commerce as defined in Sec. 390.5? If not, you would need to contact your individual state agency to see which of the federal regulations have been adopted for intrastate commerce, and if any exceptions exist or definitions differ.

If you meet the criteria, your technicians are subject to the following regulatory requirements: driver qualification, hours of service, and vehicle inspections, and possibly the CDL and drug and alcohol testing requirements. These requirements are discussed in the Compliance Management section.

Specialized training and certification

Training is a part of the management picture in any company interested in the bottom line — “it increases profit by decreasing losses,” according to one transportation industry safety director. Some specialized training and certification requirements are currently in place which come out of one or the other sets of federal regulations. If you are responsible for training as part of your job duties, you need to be aware of these special requirements. Some are quite easily met, often right on the job, but you do need to recognize them and do the proper certification, etc. for them.

Several sorts of specialized training need to be taken into account:

- OSHA right to know training,
- OSHA tire mounting and dismounting training,
- FMCSA periodic (annual) inspector training,
- FMCSA brake inspection training,
- DOT hazmat employee training, and
- EPA air conditioning technician training and certification.

These requirements are also covered in the Compliance Management section of this manual.

There are other specialized training and certifications that you may consider for your technicians. These can include:

- Original equipment manufacturer training and certification programs.
- Automotive Service Excellence (ASE) training and certification programs.
- Trade association training.
- Continuing education through technical training centers.
- In-house or outsourced programs developed to improve technical skills, supervisory skills, leadership abilities, knowledge, teamwork, and efficiency.

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A key point to remember when it comes to retention: If the technician feels that he/she cannot grow within your operation, the technician may start looking for somewhere else that will allow him/her to grow. The bottom line to this is either provide an outlet for your good technicians who wish to grow and develop, or watch them go somewhere else.

As the technician gains skill and knowledge, the technician becomes more valuable for the operation (less time on tasks, less rework, more efficient use of time, etc.), laying the foundation for justifying pay increases (do not discount the value of pay raises in developing and retaining good technicians!).

The relationship of developmental training to retention is such that some major players in the maintenance area (major motor carriers, leasing companies, OEMs, etc.) are now budgeting time each year dedicated strictly to technician development. It is not unusual in such cases to see the company dedicating as much as 40 hours per year of the technician's paid time to training. It is also not unusual to see these employers providing a tuition reimbursement program. If the technician takes a class on his/her own time that is related to the job's core responsibilities, the company reimburses the cost of the course after successful completion (in some cases even providing a bonus for exceptional grades).

As we discuss the remaining topics in the chapter, remember this: Most employees do not leave their present employer over pay. As long as the pay is competitive, the employee will leave for a "better job." Therefore, to retain your technicians, you need to be the employer that offers the better job. Typically, a better job is one that has better hours, more room for advancement, and/or better working conditions. Better working conditions can include providing:

- a safe, comfortable, and clean working environment;
- an atmosphere where employees feel that are being kept well informed rather than kept in dark;
- an atmosphere of teamwork rather than subservience;
- room for development and growth;
- employees more input into the job; etc.

Building the team

You're already familiar with the shop paperwork: driver reports, repair orders are the big carriers of information, plus PM inspection/service sheets. These forms are common to most fleets. In addition to forms, fleets may circulate manufacturers' bulletins, fleet policy handbook updates, or the fleet's own service bulletins or letters. We have mentioned how important standardized reporting is, i.e. drivers and technicians both understand exactly what is meant by a description of a vehicle problem. A detailed RO with a check-off repair code makes communication from technician to supervisor much more efficient — and ready for computer data entry. So improving paper communication is often a matter of standardizing and improving forms so that everyone is "talking" about the same thing. And everybody knows just what is expected of him or her.

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Knowing the reason why or being able to see results (a decrease in road failures, for example) can convince technicians that the shop PM is on the right track and that they are helping that effort. But how about the more personal “paper” communication from you, as a representative of the fleet. A birthday card for the technician, an appreciation card (with a bonus!), or a holiday can go a long way in making an employee feel that his or her efforts are appreciated. Too many managers forget these personal touches, but the big fleets with many employees to keep track of don’t forget. They know that their success depends on keeping the employees that they have trained.

Talking to people isn’t so easy. Or should we say, talking is easy for most of us — it’s listening that’s tough! Even after you’ve refined your “paper” communication, you’re only half done. You need to be able to tell your technicians and other shop employees about the shop safety and productivity goals and then enlist their cooperation in that team effort. That requires some listening on your part.

Reward technicians that do well. If a technician is consistently on time with repairs and has little or no rework, find some way to reward him/her. Jackets, certificates, belt buckles, and gift certificates are examples of incentive awards that are not very expensive, but very much appreciated. Wouldn’t it be great to “have” to give all your technicians a new jacket every fall because they all are consistently on time with repairs and have a low rework rate?

Consider helping technicians further their qualifications by offering outside training at company expense. Updating or adding to SAE qualifications and attending manufacturers’ training classes would be examples. Remember also to reward these efforts. A technician who is willing to attend extra training and be more efficient in the shop should be worth a little extra pay.

Communication: Up-the-ladder/Down-the-ladder

If you (as a representative of fleet management) write up a policy and distribute it to shop employees, that’s sending the word down the ladder. If a technician drops a note into the shop suggestion box, he’s sending a message up the ladder. We can see very quickly that much more down-the-ladder communication exists in any business than the other way around (most of us don’t have many opportunities to tell the boss what’s on our minds).

Your job as shop supervisor is to keep the lines of communication open to you from the shop floor (up the ladder) and to send the right kind of communication down that same ladder. Your attitude is critical. If you hide away in your office and don’t respond to technicians’ complaints or suggestions for improvement, you won’t get any after a while. Then just try to find out what’s going on. If you rush to defend yourself about some less-than-perfect decision in the shop, technicians will see that you don’t like to take that responsibility and they’ll keep “unpleasant” news from you.

Many executives brag about their “open-door” policy, (an employee can walk in at any time to air a problem). But first you need to visit the

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shopfloor, circulate around and catch problems where they're easier to handle. By the time they get to your office, the whole problem may be out of control.

Shop meetings

Many managers prefer to establish a regular time and place where planning and discussion can take place between the manager and the staff. Such staff meetings, or shop meetings if you will, should take place as often as is practical — once a month is a useful interval to begin with. If the fleet employs drivers, they should get together with you and the technicians several times a year — especially if a PM program or any other action affecting both parties is just being put into practice.

Here are some hints for the Shop Meeting:

- **Be sure that you understand both sides of an issue, the view from management and that of the employees.** Both of these groups look to you to represent their interests. Whenever possible, show employees that their goals are often the same as those of management (especially in the areas of safety and productivity).
- **Pause to think whether an order or policy can best be communicated via paper or via a face-to-face meeting.** Writing a letter to drivers and technicians about a vehicle complaint that isn't getting solved isn't such a hot way to handle the problem. Similarly, only talking about the safe way to inspect a radiator without a demonstration or illustrated safety bulletin may go in one ear and out the other. A talk can be followed up by something written for an effective presentation that will be remembered.
- **Plan an agenda for the meeting.** Every meeting should have some regular topics: failure analysis of some part, a persistent mechanical problem, an evaluation of new equipment or a safety feature. If there is any hint of driver discontent with the way vehicles are maintained, here's the place to start defusing the situation.
- **Whether commendation for good work or special effort (like exceeding a performance standard) should be made public is up to you.** Be aware though, that some of the best run fleets today are posting merit raises and cash-bonus awards openly, contrary to long-accepted business practices of keeping any pay information strictly secret. Remember that once employee performance is quantified or measured in some way, you have a real basis for offering incentives and rewards. No more will you have to guess who your best technician is — you'll know. And by giving training assistance to less productive technicians, you're telling them that you're confident they can set and reach the same goals. Verbal appreciation for a job well done is always good management policy, but nothing creates enthusiasm for safety or productivity like extra cash. When your recordkeeping backs up claims of increased productivity, you'll find it easier to justify technician incentives to fleet management and so reward those who have contributed most.

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Quality circles

You've probably heard of this term, which originated in Japan as a means of getting workers involved. From five to fifteen people, all members of one work group (the manager is usually included) meet regularly on a volunteer basis. The purpose of the "quality circle" is to discuss specific problems relating to quality that are brought up by management, members of the circle, or other employees. Have you ever thought of using this idea to solve problems in the shop?

Too time-consuming, you say. Yes, you're right. Studies show that at the beginning, things do move slowly, sometimes chaotically. But that speed is more than made up for later in the time it takes for an idea to be accepted by the employees. It's a fact that employees are more likely to support a policy that they have helped to create. So try asking if any technicians would like to form a "quality circle" for shop safety, for example. You might be surprised at how quickly things can get organized. And at how high their standards can be!

Having discussed facilities and labor, we come to the final point of the operations triangle: materials. For the maintenance shop, this means replacement parts — finding them, keeping track of warranties, and stocking them in the shop.

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Performance Evaluation	
The basics	
Performance evaluations supply information that can be very useful in fostering good employee relations and achieving high performance. Few managers or supervisors enjoy doing performance evaluations, however. They take time, they can be uncomfortable, and can lead to poor morale if not done correctly.	
Some companies have formal performance evaluation programs, and others have little more than a policy of open communication used to cover any performance issues. Since evaluations are not required, some companies choose not to conduct them at all. There is no set process for what is right for all companies. Company policy and culture need to be considered in determining which strategy works best.	
Performance evaluations let employees know how they're doing, what they can do to improve or move up, and provide an opportunity for recognizing good performance. The evaluations are also communication tools used to identify employee strengths and weaknesses. And they are tools to communicate goals and achievements. The information can help the organization be more productive.	
Other benefits of performance evaluations include the following:	
• They provide opportunities to identify new ideas and improved methods. • They help avoid potential legal issues. • They allow employees to see how their work fits into the company goals, and why their work is important. • They provide opportunities for employees to convey personal conflicts that adversely affect their work performance.	
Poorly run performance evaluations may have a negative impact. They may:	
• Lead employees to feel that the evaluations are adversarial and are used to place blame for overall company performance. • Inhibit open communication between the managers and the employees. • Be used as an opportunity for managers to promote their biased opinions of certain employees.	
Performance evaluations should be designed to gather facts, identify potential problems before they arise, and provide for open communication. The evaluator needs to be objective, and needs to be familiar with	

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the evaluation process, along with how the information gathered is or can be used.

Evaluation should reflect actual performance

It is crucial that performance evaluations accurately reflect the employee's actual work performance. If this is not the case, employers are opening themselves up to discrimination claims, if an employee is discharged for actual "poor performance," even though the employee's performance evaluation reflected "good performance." In other words, an employer would have a hard time justifying its actions against an employee, if those actions were contrary to what the performance evaluation said.



Establish goals for performance

One of the first things to establish is what the goals of the company are and how employee tasks and performance fit into those goals. From there, the goals of the employees' position can be formulated and geared to mesh with the departmental goals. These need to be communicated to the employee. Knowing where they fit into the big picture provides them with a feeling of value, that the work they do has a place of importance in the company's overall goals.

To help establish goals, the evaluator may want to review each employee's training, experience, skills, and qualifications, along with his or her job performance since the last evaluation. This should be done prior to the evaluation. The evaluator may want to consider this information in regard to the employee's career opportunities in the company, or any obstacles that may exist.

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Delivering negative feedback

Delivering negative feedback to an employee can be challenging, however it's one of the most important parts of a good performance evaluation. If an individual isn't aware of areas that need improvement, he or she will have a difficult time improving and meeting goals and expectations.

As with most feedback, it's important that negative feedback be given in a constructive way. To help with this, you may want to consider giving the employee specific examples of how to improve in specific areas. For instance, providing an employee with additional training or certification opportunities may help if the employee is subpar in their work level.

By providing improvement suggestions, employees are more apt to feel optimistic about future success.

Ensure consistency

Some organizations perform the same type of evaluation for all employees, while others have different types for different levels of employees. Evaluations for management level employees, for example, may have more qualitative information than line employees. This may be because management level employees do not engage in activities that are easily quantifiable; i.e., they do not do ten oil changes a day, but they may put in place a process that increases the department's output of quality work. If you have lower level maintenance managers under you, you would want to use a different evaluation for them then you would use for the actual mechanics.

Performance evaluation criteria

There is no set-in-stone list of aspects that need to be addressed during a performance evaluation. The performance criteria used in an evaluation is usually rated on a scale, to allow for quantitative measurement. The scale will vary from company to company and will depend on such things as type of position, corporate culture, and many other factors.

Following is one example of a performance evaluation form, listing performance and measurement criteria.

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Sample Performance Evaluation Form

Name _____

Title _____

Date of evaluation _____

Your performance during _____ is evaluated on this form.

Every effort is made to present a fair and impartial review of your performance and how you are doing as an employee at this company. Your strong points, contributions, and accomplishments are noted, as well as areas needing improvement.

Performance Evaluation Criteria			
Performance factor	Exceeds requirements	Meets requirements	Unacceptable
Accuracy			
Thoroughness of work			
Job knowledge			
Quantity of work			
Initiative			
Attitude			
Flexibility			
Resourcefulness			
Dependability			
Working relationships			
Adaptability			
Safety			
Attendance			

Overall performance rating:

If all or a majority of ratings fall in the same category, then the overall rating would be that category. If there is no obvious overall rating, it is the responsibility of the evaluator to determine the weighting factor of each rating to determine the overall rating.

- ☐ Exceeds requirements — Performance exceeds requirements for most major accountabilities. Results are consistently at this level.
- ☐ Meets requirements — Performance meets requirements for all major accountabilities. Results fully meet expectations of job performance.
- ☐ Unacceptable — Performance does not meet minimum requirements for the job. Significant improvement is needed for results to be acceptable.

Major Accomplishments:

Significant Changes in Performance Noted Since Last Evaluation:

Key Areas for Performance Improvement:

Prepared by: _____ Date: _____

Manager approval: _____ Date: _____

HR approval: _____ Date: _____

This evaluation has been discussed with me:

Associate name/signature: _____ Date: _____

Training for performance evaluations

Those who need to perform employee performance evaluations may benefit from learning some of the pitfalls to avoid and how to handle certain situations. It may help them to know about rater biases and what to do if an employee refuses to accept responsibility for his or her performance.

At the very least, those who are to perform evaluations will need to know the process for doing them — who they are to evaluate, what forms to use, what information to gather, when to conduct the evaluation, and why they are doing them in the first place.

From there they can be taught how to rate employees, what to evaluate, and how to score. Additional training can include the following:

- Maintaining open communication;
- Documentation — not only of the evaluation, but of the employee's ongoing performance;
- Appropriate places to hold the evaluation;
- Listening skills, and
- Coaching.

As indicated earlier, employee performance evaluations can run the gamut from basic open communication between management and employees, to formal processes. Whichever one is used, it should be objective and based on facts. Information should be documented, but such documentation should not include information that involves age, race, gender, or any other protected class.

How to conduct a performance evaluation

A performance evaluation is a means to:

- Review and measure an employee's performance.
- Determine individual strengths and weaknesses.
- Set individual objectives in line with corporate objectives.
- Identify any training needs.

Appraisals are meant to be two-way communication tools. Employee feedback can be instrumental in determining business-related decisions.

You may find yourself communicating to some employees more than others about performance issues. If you have employees whose job performance is borderline, a performance appraisal is a good place to encourage and guide them.

Performance evaluations for technicians

The performance evaluation of technicians is based mainly on time (scheduled & unscheduled), materials used, and level of knowledge in the area in which they work.

The amount of "scheduled" maintenance done in a shop has improved dramatically since the mid-1970s. Then, if a fleet could report 45 or 50%

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of maintenance as “scheduled”, it was assumed that the figure was extraordinary. In 1980 it took superior effort to make 60% scheduled repairs. Today, the shops designated as “model shops” are handling up to 70% of repair on a scheduled basis. Although this high percentage is only achieved by the best of shops, it is worth noting because of the great amount of standardization and control that goes into the maintenance procedures of these shops.

Let’s review our terms:

- **Scheduled repair** means that the work was planned; the vehicle was brought into the shop at a scheduled time, the technicians knew it was coming, and therefore did not have to leave other work to service it.
- **Unscheduled repair** means that the assigned work in the shop was interrupted to service the vehicle, i.e. a technician was taken off another job to take care of it.
- **Emergency** is unscheduled repair in which the fleet’s schedule is interrupted in addition to the shop’s; often the driver is forced to wait around until the repair is taken care of. (Driver complaints, flat tires, cold-weather jumpstarts, etc. are usually defined as emergency work.)

What are your definitions for these terms as used in your shop’s ROs? Did you make a rapid calculation of what percentage of ROs were scheduled and unscheduled for the past several months in your facility? How did your percentage compare?

The maintenance standard, which you should have already determined, is a PM inspection/service standard. In a perfect world, that standard would be all that is needed; with good PM, vehicles would never break down, all components would be replaced before they failed, and tractors would be traded just before the engine needed an overhaul. Unscheduled repair will always be with us, however. The goal of PM is to minimize unscheduled repair. A standard simply makes sure that procedures are consistent. Repair standards do exactly the same thing: they outline the steps to be taken in diagnosis and repair.

A repair standard is used primarily for measuring technician performance. It is related to time and quality control. A repair standard means setting a time for each type of repair. The time control, or expected-completion time can come from different sources:

- **a flat-rate guide such as the automobile-repair industry uses** (a truck dealership maintenance shop might have a similar guide)
- **a review of your own ROs** (provided that you have enough spaces for specific in-out times on the form and that recordkeeping is detailed and consistent)
- **discussions with your own technicians or other experts in component repair or general repair services.**

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Time control

Since your own ROs are the easiest documents to obtain, reviewing them is the quickest way to set up an expected-completion time; just be aware that your shop inefficiencies may be built into those repair times. Begin with some of the most common repair tasks in the shop and note the total time that the technician spent on the repair — from diagnosis to picking up the parts to completion of any testing. Make comparisons for just one technician. How consistent are the times? Then make comparisons for another technician, using the same job. Who has the best time? Who has the worst? What is the average time?

Don't forget to note whether there were any rework occurrences (how many?) for this repair. Remember that at this point we are not evaluating an individual technician, nor should you be deciding who your top technician is; we are only trying to find a shop average for the repair.

This may be a place where you can make use of computer reports, if you have a maintenance program sophisticated enough to give you technician productivity and time information easily, especially broken out by specific tasks. If you don't have access to this kind of software, don't despair though, it is possible to come up with comparative information manually as well.

Once you have the average time, set your standard time, based on your own training and experience if you wish (keeping in mind that yours is a subjective measure), or by simply cutting the time by a percentage. This final time standard becomes your expected-completion time. You're always able to change it later if it doesn't work out, but you have to start somewhere!

Allowing technicians to take time to check out other things that they may spot on the vehicle is always encouraged. More often than not they perform work not itemized on the RO. This is fine as long as the work is described in the "remarks" section and time-in/time-out is clarified.

Quality control

The "quality control" part of your repair standard ensures that the test/check/action procedure is performed in the same way every time. When a problem comes into the shop, the technician starts by performing diagnostic testing to determine the cause of the problem. Troubleshooting charts provide suggestions for diagnosis; most likely, the experienced technician has over the years developed a set of personal mental "check-lists" to get to the source of a problem. Your objective is to standardize that procedure for each repair so it becomes the most efficient checklist for every technician in the shop.

Rework tracking

As part of your quality control program be sure to track "rework." Rework is a term used for work that has to be repeated because of misdiagnosis or improper preventive maintenance or repairs. Remember, some rework is unavoidable due to complicated systems that are prone to misdiagnosis and supervisory decisions. What a maintenancemanager or supervisor

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needs to watch for is repeated rework or rework that is required on fairly simple repairs. If a technician is seen to have a high rate of rework, consider retraining the technician in troubleshooting or repair procedures.

Sound like a tough order? Your technicians are too independent for that kind of interference? Or perhaps they are already performing in a superior way? (Your ROs will tell you if they are; then improving efficiency may simply mean better scheduling.) Well and good. But tightening up on repair completion time is being used by the big fleets to boost efficiency and you should at least determine if you need to use some of their methods. Some methods for improving repair-completion time and quality include:

- **having one skilled, experienced person, familiar with the fleet's maintenance operations (shop supervisor, lead technician, etc.), prepare all ROs before they go to the line technician.** This is the first step to standardizing the procedure. The preparer will also eventually be responsible for adding an expected-completion time to the work order
- **sending along a diagnostic checklist with the RO,** the checklist outlines precisely the steps to be taken by the technician to find the problem and repair it
- **computerizing the diagnostic procedure.** The technician plugs in the problem on the terminal and the microcomputer presents a selection of solutions to that problem. After completing the work, the technician records time, parts, etc.

Improving technician productivity after the evaluation

Once you have your time standards for a particular job, measured your technicians' performances against them, and set the new standard to shoot for, you are faced with the challenge of bringing underachieving technicians up to standard and motivating productive employees to improve performance even more. Remember that it is your responsibility to set the standard. It is up to your shop supervisor (or yourself) to monitor how well the standard is being met and to take steps to bring performance in line. Here are some suggestions for doing so.

- **First, ask whether any equipment aids could help.** A new tool or piece of diagnostic equipment can be a powerful motivator and training aid when standardizing procedures. And of course any tool improvements should cut down on time.
- **Investigate whether pre-packaged repair kits from a manufacturer might speed up a job.** These kits range from PM kits (oil and fuel filter, with bottle for fluids analysis) to in-frame overhaul kits (all instructions, special tools, parts, warranty, etc.) One fleet which is increasing its kit use, reports that it's much easier to track repair time with them. In the manager's experience, an injector replacement presently takes three shop hours, a bearing roll-in takes eight hours, and a complete in-frame overhaul takes 24 hours. He adds that not having the right part or tool can waste a tremendous

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amount of time for the technician. The kit also guarantees that nothing is overlooked, i.e. a gasket or filter.

- **Ask the technicians themselves where they're getting bogged down on a particular job and what suggestions they have for making it more efficient.** Ask for their suggestions on speeding up parts distribution within the shop.

One shop supervisor reports that time spent in personal discussions with technicians after major repair jobs has really resulted in improved productivity for that job when it is performed the next time.

- **Then, begin training for any weak techniques.** If completion times differ a great deal for a brake adjustment, (or even a chassis lube), establish the standard and then conduct a training session on the right way to perform the procedure. You can also do this for a PM inspection or any job that needs tightening up.

One large fleet developed a slide program for training with hundreds of truck closeups, demonstrating the right way to do a PM inspection. Not only did the "class" go through the steps but the technicians were told why a particular action was important.

The program is used to train new people and to "refresh" experienced technicians. As new vehicles are added to the fleet, changes or additions can be added. Participation by everyone is encouraged; often technicians make suggestions on how to improve a procedure or what to watch for when checking a component.

Are you smiling to yourself, sure that such an in-depth program is fine for a big fleet but you'd never have the time to take on something of that size? That may be true, but is there just one job where you seem to be showing the procedure over and over? Or something that just isn't being done right? Or consider that PM inspection. If you develop it right just once, and then repeat the program (or have the lead technician do it), this saves money by saving your time. The most expensive training is the kind of "show me" training that a supervisor does more than once.

- **Teaming a new technician with an experienced employee is another way to train on a smaller scale.** The "master" technician will have refined his techniques over the years (no wasted movement, organized techniques) to the point where he should be one of the faster technicians and he'll also have hints to pass along to the newcomer. Such a short-term team effort helps the two individuals get to know each other better and makes the newcomer feel part of the total operation.
- **Factory schools or seminars at your shop, staffed by technicians from component manufacturers, are always a source of new information and training.** You and your technicians can't afford not to take advantage of this expert training.

For maximum use of the out-of-house instructor's expertise if the training is to be held at the shop, collect "problem parts" pertaining to the training well before the appointed date. Try to have any "live"

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demonstrations performed on your own vehicles. You want the instruction to be as practical as possible and directly related to your vehicles. A lively session on why certain parts failed always sparks good discussion and starts your technicians thinking “why” as well as “what”.

Do your technicians accept training? The average age of technicians is getting younger and the idea of continual training is often more easily accepted by this group of people. (Older technicians may feel they know everything they need to know and may resist the idea.) Remember, too, that it isn’t enough to simply provide training. Fleet management often wants to see concrete results. Evaluate the training by testing if possible (ask if evaluations are part of an instructor’s program) and by following up to see if the new techniques are being used. Allow enough practice. And use refresher materials later on. Follow-up means getting your money’s worth. And if you send a technician to a factory school, let him know in advance that he’ll be responsible for shop demonstrations when he returns.

- **A library of shop manuals, bulletins, and similar materials should be part of every shop.** Every vehicle model should have a complete set of service manuals. Dealers also have service bulletins that can pertain to your vehicle repair procedures. Special “engine” binder notebooks should be maintained. Manuals relating to shop equipment should be available apart from the vehicle materials. Regulatory material relating to vehicles should also be kept in the maintenance shop. Encourage employees to use the materials — not only for troubleshooting — but also to keep up on what’s happening in maintenance.

Keep information up to date: weed out the old junk, organize materials into binders, maintain manufacturers’ files. And while you’re at it, subscribe to some maintenance/industry magazines and check on whether they’re read. If you are scheduling or plan to schedule staff meetings, ask a technician occasionally to check out and research a problem and report to the group. You shouldn’t always be doing this kind of problem-solving yourself.

Large fleets — especially those which operate in many locations — often issue a prepared procedures manual to each maintenance shop. The manual is used to keep technicians informed about all kinds of maintenance operations. One fleet’s manual contains over 250 bulletins covering 35 general topics; these are updated as new

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information comes out from the manufacturers of their equipment or problems develop with a particular component. This kind of information also standardizes procedures since they are placed directly in shop areas as well as the maintenance supervisor's office (the former have plastic-laminated pages, which is an indication of how much they're used).

Eight sure ways to fail at performance evaluations

Performance evaluations are usually done at the employee's anniversary. It is up to you to decide what is the best way to perform these evaluations for your managers and technicians. The following are eight areas that can cause a performance evaluation to take a wrong turn. These should be avoided in order to make the performance evaluation experience a positive one for all.

"This is the first I've heard of it"

While there are many supervisors who provide feedback throughout the year, there are unfortunately many who do not. Regularly discussing an employee's performance allows the employee to make improvements over the course of the year. A supervisor should be careful not to keep a record of mistakes to bring up at the evaluation. Instead, the problem should have been addressed when it was apparent. An employee cannot work on or correct areas of weakness if they are unaware of your expectations. Performance management is a year-round event.

All this negativity

Beginning the evaluation with sub-par performance rather than positive accomplishments sets a tone. An evaluation should have some focus on the things that went well or were done properly. Even though a performance evaluation is a time to address problem areas, a supervisor must also leave the employee with a reason to want to remain at the employer.

Winging it

A performance evaluation should not be done off the cuff. The person who is assigned to evaluate the employee needs to have an understanding of the projects the employee is working on now and how he or she performed on last year's evaluation. This will give a foundation for completing the human resource paperwork. It's more than checking boxes on a form and writing a few comments. You want to focus on continued improvement from year to year.

Postponed until further notice

Employees expect their evaluations by a specific date, usually linked somehow to an anniversary date, job transfer date, or promotion. In many instances, the review is a basis for a merit raise, and a supervisor who is late on presenting the information is viewed as indifferent toward the employee. This feedback is seen as the last thing the supervisor wants to deal with, which the employee may project on him/herself.

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Monologue

A performance evaluation is not supposed to be a monologue. It should be a dialogue between management and the employee. The individual performing the evaluation should ask open-ended questions to draw out feedback from the employee.

Defensiveness

This performance evaluation is a time for employees to offer suggestions to the organization on how they can do their jobs better. When an employee does this, it sometimes is viewed as a criticism of the supervisor who is evaluating. If the supervisor becomes defensive, the dialogue will end and any ideas to better the organization will be stifled.

Failure to communicate

Not everyone is a natural-born communicator, including supervisors who conduct performance evaluations. They may know their “stuff” and what the motor carrier employees are supposed to be doing. But if the one conducting the evaluation does not clearly layout the information he or she wants to convey, the employee may leave the evaluation without a clear understanding on how to improve his or her performance and what expectations are being placed on him or her.

Sparing feelings

It's hard being the “bad guy.” Many bosses are reluctant to offer constructive criticism or correction to their employees even when it is warranted. Motives often include people-pleasing or a concern that it will appear on someone's permanent record, affecting his or her career path. This is especially true if the supervisor conducting the evaluation sees the employee as a peer. This may occur if the supervisor has worked his or her way up through the ranks. If concerns are not addressed, especially those that affect safety, it could result in a catastrophe.

Although it may be very difficult to do, conducting performance evaluations is an important part of any business, and plays directly to the productivity of the entire company. This is a time when personal feelings must be set aside and discussions of performance and areas of improvement must be brought to light, backed by solid observation and documentation.

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Part 393 — Parts and Accessories Part 393 regulations enumerate the various parts and accessories which must be included on a properly-equipped motor vehicle being operated in interstate and foreign commerce. In addition, the regulations may permit or restrict the use of other types of vehicle accessory equipment. However, the Federal Motor Carrier Safety Regulations (FMCSR) do not cover the manufacturing specifications for these parts and accessories, but rather indicate only the general type(s) which must be used for safe operation. In many instances, the rules also specify placement on the vehicle. Specific motor vehicle parts and accessories manufacturing safety specifications are found in Part 571. The requirements in Part 393 are applicable to all employers, employees, and commercial motor vehicles which transport property or passengers in interstate commerce. A <i>commercial motor vehicle</i> is defined as having a gross vehicle weight rating of 10,001 pounds or more, designed to transport more than 8 or 15 people (including the driver, depending on compensation), or transporting hazardous materials in quantities requiring the vehicle to be placarded. The requirements of Part 571 — specifically, the Federal Motor Vehicle Safety Standards — are applicable to all motor vehicles or items (parts and accessories) of the motor vehicle equipment that the manufacturer has completed. In general, any person whose duties involve the equipment of a carrier's transport motor vehicles, whether it be decision making, procurement, installation, maintenance, or other aspects, must share responsibility for compliance with the equipment requirements of Part 393. "Every employer and employee shall comply and be conversant with the requirements and specifications of this part..." (§393.1) Furthermore, a carrier is prohibited from operating or permitting to be operated, a motor vehicle unless it is properly equipped in accordance with these regulations. "No employer shall operate a commercial motor vehicle, or cause or permit it to be operated, unless it is equipped in accordance with the requirements and specifications of this part." (§393.1) With regard to Part 571, the responsibility for meeting the Federal Motor Vehicle Safety Standards (FMVSS) generally lies with the manufacturers of motor vehicles. However, in some cases where the effective date of individual standards is after the vehicles' manufacture date, the motor carrier or operator of the motor vehicle may be responsible (through retrofitting or other means) for ensuring that required safety standards are met. In general, vehicle owners and operators are required to make sure	

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the vehicle continues to meet the FMVSS that were in effect at the time of vehicle manufacture.

In many cases, Part 393 will refer directly to Part 571 for technical compliance information. An example of this is the relationship between Subpart C of Part 393 (brakes) and §121 in Part 571 (also referred to as FMVSS 121). Part 393 requires that vehicles built with air-brake systems complying with §571.121 must continue to comply with §571.121 (you cannot modify the vehicle in such a way that it no longer complies with §571.121, or operate it in a condition that is not in compliance with §571.121).

Part 393 is rather technical and lengthy. For the sake of this section of the manual we will only summarize the subpart topics. The detailed regulations are available in the regulations portion of this manual.

Subpart A, General, provides the scope, applicability, and definitions used in the part.

Subpart B, Lighting devices, reflectors, and electrical equipment

This subpart provides the regulations for lights and reflectors, and the related equipment.

The first areas we will cover are roadway illumination and vehicle conspicuity (how noticeable the vehicle is). The purpose of the roadway illumination and vehicle conspicuity requirements are quite simple — to reduce traffic accidents, injuries, and death by providing adequate illumination of the roadway, and enhancing the visibility or attention-getting ability of motor vehicles on the road so that their presence is perceived and their signals are clearly understood by other motorists and pedestrians, in both daylight and darkness (or any other conditions that might reduce visibility).

Both Parts 393 and 571 address this area. In general, Part 393 specifies the quantity, color, location, and position of lighting and reflective devices on motor vehicles, while Part 571 lists the manufacturing specifications for original and replacement lamps (including bulbs), reflective devices, and all associated equipment. Part 571 also provides some technical data related to the location of some lights and reflectors. This is done by §393.11 referencing §571.108, using the statement that the vehicle must meet the applicable §571.108 standard that was in place at time of manufacture.

In general, all lamps must be securely attached and capable of being operated at all times (§393.9).

In addition, all lighting devices must meet the requirements of Part 571 and the associated Society of Automotive Engineers (SAE) standards (when referenced). The following is a list of the various lighting devices required by §393.11 and their specifications as described in §571.108.

Headlamps — Each truck and bus must be equipped with a headlighting system which conforms to the following requirements:

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Required motor vehicle headlighting systems						Notes
Headlamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard	
Buses & Trucks Less Than 80" Wide	2 white (minimum) with an equal number on each side.	Front of vehicle.	On the front at the same height, an equal number at each side of the vertical centerline as far apart as possible.	Not less than 22" nor more than 54".	S10, Headlight system requirements	
Buses & Trucks 80" or More Wide					S10, Headlight system requirements	
Note 1: Headlamp beams must be adjustable both vertically and horizontally, and must provide for upper and lower distribution of light at the driver's will. Note 2: Fog and auxiliary lighting may be used in lieu of headlight system under conditions that make their use advisable, however, they cannot be considered as replacing the headlights. Turn signal lamps — Unless turn signals are so constructed (double-faced) and located as to be visible to passing motorists, two turn signals are required on the rear of a truck tractor — one at each side as far apart as practicable. In all cases, turn signal lamps must meet the following requirements:						
Required motor vehicle turn signal lamps						
Turn Signal Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard	
Buses and Trucks Less Than 80" Wide	2 red or amber; 2 amber.	At or near front and rear of vehicle.	At or near the front — one amber on each side of the vertical centerline, at the same height, and as far apart as practicable.	Not less than 15" nor more than 83".	S7, Signal lamp requirements	
Buses and Trucks 80" or More Wide			On the rear — one red or amber on each side of the vertical centerline, at the same height, and as far apart as practicable.		S7, Signal lamp requirements	

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Turn Signal Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Trailers Less Than 80" Wide	2 red or amber.	Rear of vehicle.	On the rear — one red or amber on each side of the vertical centerline, at the same height, and as far apart as practicable.		S7, Signal lamp requirements
Trailers 80" or More Wide					S7, Signal lamp requirements

Note 1: Turn signal lamps must not be connected optically with either headlamps or other lighting devices that produce a greater intensity of light than the turn signal lamps.

Note 2: Turn signal lamps must not be combined with stop lamps unless the stop light function is deactivated when the turn signal function is activated.

Identification lamps — Identification lamps (ID markers) must meet the following requirements:

Required motor vehicle identification lamps

Identification Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses and Trucks 80" or More Wide	3 amber.3 red.	Front and rear of vehicle.	On the front and rear — 3 lamps, amber in front, red in rear, as close as practicable to the top of the vehicle, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6" or more than 12" apart. The front lamps may be located as close as practicable to the top of the cab.	No requirement.	S7.5, Clearance and identification lamps

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Identification Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Trailers 80" or More Wide	3 red.	Rear of vehicle.	On the rear — 3 lamps, amber in front, red in rear, as close as practicable to the top of the vehicle, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6" or more than 12" apart.		

Note: Identification lamps for vehicles over 80" in overall width may be mounted on the vertical centerline of the truck cab where different from the centerline of the vehicle, except where the cab is not more than 42 inches wide at the front roofline, then a single lamp at the center of the cab shall be deemed to comply with the requirements for identification lamps (see Footnote 1 to the table at §393.11). No part of the identification lamps or their mounting may extend below the top of the vehicle's windshield. Identification lamps are not required on vehicles under 80" wide.

Also, the regulations (§571.108) do not allow the placement of any other lamps in such a manner as to interfere with the purpose of the ID marker lamps. Any other lamps must be twice the distance from the outside ID lamps as the distance between the ID lamps. Example: If the ID markers are 6" apart, the other lamps must be at least 12" away from the outside ID markers.

Clearance lamps — Clearance lamps for vehicles 80" in overall width must meet the following requirements:

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Required motor vehicle clearance lamps

Clearance Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses, Trucks, and Trailers Less Than 80" Wide, and Buses, Trucks, and Trailers 80" or More Wide	2 amber.2 red.	Front and rear of vehicle.	On the front and rear — 3 lamps, amber in front, red in rear, to indicate overall width of the vehicle, one on each side of the vertical centerline, at the same height, and as near the top as practicable.	No requirement.	S7.5, Clearance and identification lamps

Note 1: In cases where the rear identification lamps are mounted at the extreme height of a vehicle, rear clearance lamps need not meet the requirements that they be located as close as practicable to the top of the vehicle.

Note 2: Clearance lamps must not combine optically with tail lamps or identification lamps.

Tail lamps — Tail lamps shall be activated when the headlamps are activated in a full intensity, steady-burning state and must meet the following requirements:

Required motor vehicle tail lamps

Tail Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses, Trucks, and Trailers Less Than 80" Wide and Buses, Trucks, and Trailers 80" or More Wide	2 red.	Rear of vehicle.	On the rear, one lamp on each side of the vertical centerline, at the same height, and as far apart as practicable.	Both on the same level between 15" and 72".	S7.2, Taillamps

Stop lamps — Stop lamps shall activate upon application of the vehicle's service brakes and must meet the following requirements:

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Required motor vehicle stop lamps						Notes
Stop Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard	
Buses, Trucks, and Trailers Less Than 80" Wide and Buses, Trucks, and Trailers 80" or More Wide	2 red.	Rear of vehicle.	On the rear, one lamp on each side of the vertical centerline, at the same height, and as far apart as practicable.	Both on the same level between 15" and 72".	S7.3, Stop lamps	

Side marker lamps — Side marker lamps must meet the following requirements:

Required motor vehicle side marker lamps					
Side Marker Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses, Trucks, and Trailers Less Than 80" Wide	2 red.2 amber.	Side of vehicle.	On the side — One red as far to the rear as practicable, and one amber as far to the front as practicable.	Not less than 15". Rear marker on trailer: Not less than 15" and not more than 60".	S7.4, Side marker lamps
Buses, Trucks, and Trailers 80" or More Wide				Not less than 15". Rear marker on trailer: Not less than 15" and not more than 60". Rear side markers are not required on truck tractors.	

Note: If vehicle is 30' or more in length, one additional side marker lamp is required on each side, amber in color, located at or near the midpoint between front and rear side markers, not less than 15" above the road surface.

License plate lamps — License plate lamps must activate when the vehicle's headlamps are activated and must meet the following requirements:

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Required motor vehicle license plate lamps

License Plate Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses, Trucks, and Trailers Less Than 80" Wide and Buses, Trucks, and Trailers 80" or More Wide	1 white.	Rear of vehicle.	At rear license plate, so that the plate is illuminated from either the top or sides.	No requirement.	S7.7, License plate lamps

Note: Multiple license plate lamps and backup lamps may be used to fulfill the requirements of the SAE Standards applicable to same.

Hazard warning flasher lamps — Every bus, truck, and truck tractor is required to be equipped with a signaling system that, in addition to signaling turning movements, shall have a switch or combination of switches that will cause the two front turn signals and the two rear signals to flash simultaneously as a vehicular traffic signal warning. This warning system must be capable of flashing simultaneously with the ignition of the vehicle on or off and must meet the following requirements:

Required motor vehicle hazard warning flasher lamps

Hazard Warning Flasher Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses and Trucks Less Than 80" Wide	2 amber.	At or near front and rear of vehicle.	At or near the front — one amber on each side of the vertical centerline, at the same height, and as far apart as practicable.	Not less than 15" nor more than 83".	S9.6, Vehicular hazard warning signal operating unit
Buses and Trucks 80" or More Wide			On the rear — one red or amber on each side of the vertical center-line, at the same height, and as far apart as practicable.		S9.6, Vehicular hazard warning signal operating unit

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Hazard Warning Flasher Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Trailers Less Than 80" Wide	2 red or amber.	Rear of vehicle.	On the rear — one red or amber on each side of the vertical center line, at the same height, and as far apart as practicable.	Not less than 15" or more than 83".	S9.6, Vehicular hazard warning signal operating unit
Trailers 80" or More Wide					S9.6, Vehicular hazard warning signal operating unit

Backup lamps— Backup lamps are required to operate when the vehicle (bus, truck, or truck tractor) is in reverse and must meet the following requirements:

Required motor vehicle backup lamps

Backup Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses and Trucks Less Than 80" Wide	1 white.	Rear of vehicle.	On the rear of vehicle.	No requirements.	S7.6, Backup lamps

Note 1: Backup lamps are not required on trailers.

Note 2: Multiple license plate lamps and backup lamps may be used to fulfill the requirements of the SAE Standards applicable to same.

Parking lamps — Parking lamps are for vehicles less than 80 inches in overall width and must meet the following requirements:

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Required motor vehicle parking lamps

Parking Lamps for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses and Trucks Less Than 80" Wide	2 amber or white.	Front of vehicle.	On the front - one on each side of the vertical centerline, at the same height, and as far apart as practicable.	Not less than 15", nor more than 83".	S7.8, Parking lamps

Conspicuity systems — The conspicuity system requirements were implemented to reduce traffic accidents, injuries, and death by enhancing vehicle visibility through the combined use of reflectors and retroreflective sheeting.

In general, these requirements apply to:

- Trailers of 80 inches or more in overall width, and with a gross vehicle weight rating (GVWR) over 10,000 lbs., manufactured on or after **December 1, 1993**;
- Trailers of 80 inches or more in overall width, and with a gross vehicle weight rating (GVWR) over 10,000 lbs., manufactured prior to **December 1, 1993**; and
- Truck tractors manufactured on or after **July 1, 1997**.

Retroreflective sheeting — Retroreflective sheeting consists of a smooth, flat, transparent exterior film covering a retroreflective element so as to form a non-exposed retroreflective optical system.

Retroreflective sheeting must conform to a specific pattern of red and white colors. This pattern must consist of:

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- alternating red and white segments with each being 300 mm $\pm$ 150 mm (12 inches $\pm$ 6 inches) in length;
- neither red nor white sheeting segments can represent more than two-thirds of the cumulative total of any continuous strip marking the width of a trailer, or any continuous or broken strip marking its length.

Exception: This pattern applies except when a segment must be trimmed to clear obstructions, or lengthened to provide red sheeting near red lamps.

Although retroreflective sheeting must conform to a specific pattern of alternating red and white colors, the width of the sheeting can vary (allowing for different equipment design and specifications). The three acceptable widths, or grades, of retroreflective sheeting are:

- Grade DOT-C2 shall be not less than 50 mm (2 inches) wide;
- Grade DOT-C3 shall be not less than 75 mm (3 inches) wide; and
- Grade DOT-C4 shall be not less than 100 mm (4 inches) wide.

Required motor vehicle retroreflective sheeting

Retro-reflective Sheeting for ↓	Color	Dimensions	Location	Height above road measured (in mm) from center of strip
Truck Tractors	Each sheet (strip) shall consist of an alternating pattern of red and white color segments.	Each color segment shall be 300 mm $\pm$ 150 mm (12 inches $\pm$ 6 inches) in length, and either 50 mm (2 inches), 75 mm (3 inches), or 100 mm (4 inches) wide.	Rear of vehicle as close to outer edge as practicable (see below).	Above the top of tires and not more than 1,525 mm (60 inches) at truck tractor unladen vehicle height.
Trailers 80" or More Wide and Weighing 10,000 lbs or More			Rear and sides of vehicle as close to outer edges as practicable (see below).	Not less than 375 mm (15 inches) and not more than 1,525 mm (60 inches) at trailer curb weight.

Location of retroreflective sheeting — Rear of truck tractor—There are 2 requirements, or **elements**, for applying retroreflective sheeting to the rear of a truck tractor. They are as follows:

Requirements of **Element 1** include:

- Two strips of retroreflective sheeting of not less than 600 mm (24 inches) in length, shall be applied (as close to the edges as practicable) to the rear fenders, mudflaps, or mudflap support brackets to mark the width of the truck tractor.

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- These two retroreflective strips being applied as horizontally as practicable, in a vertical plane facing the rear of the vehicle on:
- The rear fender.
- The mudflap support brackets. On truck tractors fitted with temporary mudflap support brackets, the retroreflective strips shall be applied on the mudflaps or on plates that are transferable to permanent mudflap support brackets.
- The plates attached to the mudflap support brackets; or
- The mudflaps. Retroreflective strips applied on mudflaps shall be applied so that they are not lower than 300 mm (12 inches) below the upper horizontal edge of the mudflap.
- For truck tractors without mudflaps, the retroreflective strips may be applied outboard of the frame on brackets behind the rear axle or on brackets ahead of the rear axle and above the top of the tires (such as mounted to the back of the cab). If they are mounted directly or indirectly to the back of the cab, the elements must be as close to the outer edge as practicable, within 1,525 mm (60 inches) of the ground, and 75 percent of the strips must be visible (not blocked by other equipment parts or components).

Requirements of **Element 2** include:

- Two pairs of white retroreflective sheeting strips, with each pair consisting of strips 300 mm (12 inches) in length, shall be applied accordingly. One pair shall be applied horizontally and the other vertically to the right and left upper corners of the truck tractor cab, as close to the top of the cab and as far apart as practicable.
- These two pairs of white retroreflective sheeting strips shall be applied so that a minimum of 75 percent of their area may be seen.
- If the rear window of the cab is so large as to occupy all the space, the strips may be applied directly to the edge of the window.

Location of retroreflective sheeting — Rear of trailer — There are 3 requirements, or **elements**, for applying retroreflective sheeting to the rear of a trailer. They are as follows:

Requirements of **Element 1** include: a single strip of retroreflective sheeting (in alternating red and white colors) shall be applied horizontally to the full width of the trailer, and as close as possible to the extreme edges. This strip shall be not less than 375 mm (15 inches) and no more than 1,525 mm (60 inches) above the road surface at the strip's centerline with the trailer at curb weight.

Requirements of **Element 2** include: two pairs of white retroreflective sheeting strips, with each pair consisting of strips 300 mm (12 inches) in length, shall be applied accordingly. One pair shall be applied horizontally and the other vertically to the right and left upper contours of the trailer and as far apart as practicable.

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If the perimeter of the trailer is not rectangular, the retroreflective strips may be applied along the perimeter, as close as possible to the uppermost and outermost edges on the left and right sides (as viewed from the rear).

Requirements of **Element 3** include: a single strip of retroreflective sheeting (in alternating red and white colors) shall be applied to the full width of the horizontal member of the rear underride protection device.

Location of retroreflective sheeting — Sides of trailer — Retroreflective sheeting applied to sides of trailers must conform to the following requirements. It must:

- Be applied as horizontally as possible in alternating red and white colors;
- Start and end as close to the front and rear of the trailer as possible. Retroreflective sheeting applied to sides of trailers need not be in a continuous strip, as long as 50 percent or more of the length of the trailer is covered and the spaces are distributed as evenly as possible.
- Be not less than 375 mm (15 inches) and not more than 1,525 mm (60 inches) above the road surface at the strip's centerline with the trailer at curb weight.
- Be applied in such a way (if necessary) to clear rivet heads or other obstructions, as long as any separation of stripping is of the same color and no more than 25 mm (1 inch) apart.
- The retroreflective strip shall be in a location on the sides of trailers so that it shall not be obscured in whole or in part by any part of the motor vehicle equipment or trailer cargo.

On **March 31, 1999** the Federal Highway Administration (FHWA, the agency that handled the motor carrier regulations before FMCSA) published a final rule amending Part 393 of the Federal Motor Carrier Safety Regulations (FMCSR) — creating Sec. 393.13; **Retroreflective sheeting and reflex reflectors, requirements for semitrailers and trailers manufactured before December 1, 1993.**

This amendment requires interstate motor carriers to retrofit the sides and rear of all semitrailers and trailers manufactured prior to December 1, 1993, with either retroreflective sheeting (conspicuity tape) or reflex reflectors.

Sec. 393.13 applies to semitrailers and trailers that have an overall width of 80 inches (2,032 mm), and a gross vehicle weight rating (GVWR) of 10,001 pounds (4,536 kg) or more, and was effective as of June 1, 1999.

The retroreflective sheeting must conform to the same requirements as trailers manufactured on or after December 1, 1993 (see **Retroreflective Sheeting** and **Location of Retroreflective Sheeting — Rear & Sides of Trailer** above).

The amendment required interstate motor carriers to retrofit trailers within 2 years of the June 1, 1999 effective date (**June 1, 2001**) if the semitrailers and trailers **did not have** a retroreflective sheeting or reflex reflector system, and within 10 years of the June 1 effective date (**June 1, 2009**) if the semitrailers and trailers had a conspicuity treatments that

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did not conform to the requirements of the final rule (the red and white conspicuity systems).

The reason for the extended period was that some motor carriers had been voluntarily using conspicuity treatments on their trailers built before December 1, 1993, that differed in color schemes and area coverage, as well as levels of sheeting reflectivity, from the requirements for trailers manufactured on or after December 1, 1993 (see Federal Motor Vehicle Safety Standard No. 108, 49 CFR 571.108, S5.7).

Making these carriers conform to the requirements within the 2-year phase-in period would penalize them for being proactive in their safety efforts. Therefore, carriers that demonstrated an extra level of safety consciousness by voluntarily fitting their trailers with retroreflective sheeting in advance of the rule, were given 10 years to replace the alternative conspicuity treatments with ones complying to the new rule.

As June 1, 2009 has since passed, all trailers in operation that require the conspicuity systems (including ones built previous to December 1, 1993) should now be equipped with the standard retroreflective sheeting/reflectors.

Reflex reflectors

Reflex reflectors must meet the following requirements:

Required motor vehicle reflex reflectors

Reflex Reflectors for	Quantity & Color	Location	Position	Height above road measured (in inches) from center of lamp at curb weight	Applicable §571.108 standard
Buses, Trucks, and Trailers Less Than 80" Wide	4 red, 2 amber.	Rear and each side of vehicle.	On the rear - one on each side of the vertical centerline, at the same height, and as far apart as practicable.	Not less than 15" and not more than 60".	S8.1, Reflex reflectors
Buses, Trucks, and Trailers 80" or More Wide			On the side - One red as far to the rear as practicable, and one amber as far to the front as practicable.		

Note 1: A trailer that is less than 30 inches in overall length, including the trailer tongue, need not be equipped with front side reflex reflectors.

Note 2: If trailer is 30' or more in length, one on each side, located at or near the midpoint between front and rear side markers.

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Associated equipment — In general, the requirements for equipment associated with vehicle lighting and electrical systems all concern safety and the prevention of accidents and fires caused by lighting or electrical system failures.

The electrical requirements, other than for lighting requirements discussed above, are primarily protective in nature. They are protective against failure and disruption of electrical service, and protective against accidents. The following examples illustrate these requirements, and are given here as reminders to those with responsibility for proper equipping of motor vehicles.

Wiring should be grouped and protected against abrasion by coverings like nonmetallic tape, braid, metal sheathing or tubing. When passing through holes, the holes should be rolled or bushed with a suitable material. In addition, wiring should be properly supported and protected against overheating and becoming enmeshed in moving parts.

Unless storage batteries are located in the engine compartment, they must be covered by a fixed part of the vehicle or a removable cover or enclosure. It is especially important when the battery and a fuel tank are located in a common compartment or area, that they be partitioned from each other and that each compartment have an independent cover, ventilation and drainage.

Current to all low tension circuits must pass through overload protection devices, except battery to starter or battery to generator, horn, and electrically-operated fuel pump and brake circuits. Headlight circuits must not be affected by short circuits in other lighting circuits or they must be protected by an automatic reset overload circuit breaker.

Passenger-carrying vehicles have stricter roadside inspection requirements when it comes to “electrical cables” (high wattage power lines that are normally not overload protected). This requirement is in place to reduce the risk of vehicle fires in the passenger-carrying vehicles. Therefore, your maintenance inspections should be more detailed when it comes to these electrical cables. Any chafing, rubbing, missing grommet, broken or unsecure connection, or loose electrical cable should immediately be repaired (this is a good policy to have no matter what type of commercial vehicle you operate!).

All electrical wiring between towing and towed vehicles shall be contained in substantially constructed protective devices, and shall have suitable detachable connections so as to afford reasonable assurance against incorrect connection or accidental disconnection.

This discussion of lighting, reflectors and other associated equipment is intended only to serve as an overview of the regulations. For complete details, the regulations in the regulations portion of this manual should be consulted.

Subpart C, Brakes

Subpart C, Brakes, provides the requirements for brakes. The first regulations of interest are §393.42 and .48, which require work brakes on all wheels that meet the standards set down in FMCSA Part 393 and

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FMVSS Part 571. There are a few exceptions (lift axles that are not contacting the ground, very old vehicles, specialized vehicles, trailers weighing less than 3,000 pounds, etc.), but basically all wheels that are on the ground must have working brakes.

In §393.43 the regulations require that any towed vehicle have brakes that will automatically engage in the event of a breakaway. This regulation applies to all towed units that must have brakes. In §393.47 the FMCSA provides the freeplay limits for brake adjusters (sometimes referred to as the “readjustment limits”).

The design and condition of brake components are also covered in Subpart B. If a brake component does not comply with the requirements in Subpart B, the vehicle is in violation. Here are a few key regulations that seem to generate a lot of discussion.

Automatic slack adjusters — As of October 1993 for hydraulic brake systems and October 1994 for air brake systems, brakes on new vehicles are required to be equipped with slack adjusters that automatically adjust as the brake linings and drums wear. If the vehicle was built with automatic slack adjusters, they cannot be removed and replaced with manual slack adjusters.

Antilock braking systems — In March 1995, NHTSA issued rules requiring antilock brake systems (ABS) for heavy trucks, tractors, trailers, and buses. Specifically these rules require:

- All new truck tractors manufactured on or after March 1, 1997, must be equipped with ABS;
- All new air-braked trailers and single-unit trucks and buses manufactured on or after March 1, 1998, must be equipped with ABS; and
- All new single-unit trucks and buses with hydraulic brakes manufactured on or after March 1, 1999, must be equipped with ABS.

The standard for air-brake equipped tractors requires antilock control on the front axle and at least one rear axle. On at least one of the tractor axles, each wheel must be independently controlled by an antilock modulator. This ensures that a wheel provides shorter stopping distances and optimal braking force on all surfaces, especially on road surfaces where one side is more slippery than the other.

For air-brake equipped semi trailers, at least one axle must have ABS. Full trailers must have ABS for at least one front and one rear axle. All air-brake equipped trailers manufactured after March 1, 1998, must be equipped with an ABS malfunction warning light, and all trailers manufactured after March 1, 2001, must be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer’s antilock brake system to the towing vehicle.

Well-maintained, operational ABS is vital to a motor carrier. Consider the following facts:

- In tests, it took larger trucks 47 percent farther to stop on a dry surface as compared to a passenger car.
- On surfaces which were wet or slippery, the comparison between larger trucks and passenger cars was even greater.

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- Tractor-trailer combinations have the potential for loss of control and jackknifing in both dry and wet conditions.

Finally, if the vehicle was built with ABS, the regulations require that the ABS be maintained.

Brake distance reduction — Due to an update to the FMVSS 121 standards (§571.121) passed in 2009, the vast majority of new heavy truck tractors will have to achieve a 30 percent reduction in stopping distance compared to the truck-tractors currently in service at that time. New truck-tractors traveling at 60 miles per hour will be required to stop in 250 feet or less, when pulling a test trailer and loaded to their gross vehicle weight rating. For a small number of very heavy-duty tractors (severe-service tractors), the stopping distance requirement will be 310 feet or less under the same conditions. In addition, this new standard requires that all truck-tractors must stop within 235 feet when at their “lightly loaded vehicle weight” (bobtail).

When this new standard goes into effect, it will affect approximately 99 percent of the truck-tractors sold in the United States.

According to the DOT there are a number of simple and effective manufacturing solutions that vehicle manufacturers can use to meet the requirements of this new standard. These solutions include the installation of enhanced drum brakes, air disc brakes, or hybrid disc/drum systems. The DOT noted that a number of vehicles being built when the rule was passed were already meeting the performance requirements of the new standard.

This new standard went into effect on November 24, 2009. However, truck manufacturers had until August 1, 2011, to come into compliance with the regulations when building three-axle tractors with a GVWR of 59,600 pounds or less. Two-axle tractors and tractors with a GVWR above 59,600 pounds had until August 1, 2013, to meet the new standards.

The goal with updating this standard is to reduce the number of fatalities and injuries by reducing the number of crashes involving tractor-trailers and other vehicles. In addition, the DOT believes that this new standard will reduce the severity of injuries and significantly reduce the amount of property damage in crashes involving truck-tractors (better braking should result in lower accident speeds when an accident does happen).

Maintenance Pros need to be prepared to retrain technicians and develop the parts management practices necessary to support these newer brake systems when they begin arriving on the new vehicles purchased by the fleet. Also, be aware of the “tie-in” between FMVSS 121 and Part 393. According to Part 393, the vehicle must be maintained such that it continues to comply with the §571.121 standards that were in effect when the vehicle was manufactured (this prohibits “modifying” the vehicle to an “older, but easier to maintain” brake system after purchase).

The rest of Part 393

Subpart D, Glazing and window construction provides the requirements for windshield and other windows. This section also discusses what is allowed as far as tinting, damage, and obstructions when it comes to

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the windshield. The bottom line is that nothing is allowed to be in the “critical area” of the windshield, which extends from the top of the steering wheel to a border two inches from the top of the windshield, and side to side from a border one inch from the windshield post to a border one inch from the windshield post. The only exceptions are government issued transponders and stickers (and they must be correctly placed), and minor damage meeting the exceptions provided in the regulations (damage that can be covered by a ¾ inch disk, provided it is not two intersecting cracks).

Section 393.62 of this subpart contains the requirements for emergency exits on buses. This is another section that references the FMVSS requirements. This section requires that the vehicle continue to meet the FMVSS 217 standards (§571.217) that were in place when the vehicle was manufactured, if the bus was manufactured after September 1, 1994. These standards establish the operating forces, opening dimensions, and markings for bus emergency exits.

Subpart E, Fuel system lists the regulations for all types of fuel systems including liquid, compressed natural gas, and compressed petroleum gas. This part includes a reference to §571.304, which has additional requirements on vehicles using compressed or liquified natural gas (CNG or LNG) fuels. These requirements include making sure the tank area is marked with a decal informing the vehicle owner and operator of the 36,000 mile or annual (whichever comes first) tank inspection requirement.

There are common requirements for all fuel systems, including:

- The fuel tank must be securely mounted to the vehicle and the cap must be in place and secure.
- The fuel lines and fittings must be adequate, long enough to allow for vehicle flexing, secured, not rubbing, protected if routed below the vehicle, and tight.
- The fuel tank, lines, and fittings cannot be leaking fuel.

If you are considering switching to an alternate fuel vehicle, there are several considerations. First, you will need to get at least some of your technicians trained to inspect and maintain the fuel system (some OEM and parts suppliers provide the training). Second, you will need to begin stocking parts for the systems. Finally, you will need to establish a preventive maintenance inspection schedule for the fuel system. Discussing the specifications and maintenance requirements with the system provider (OEM or parts supplier) can provide insight into the inspection and parts requirements. Also, do not forget that your technicians (and drivers!) will need to be trained on safely fueling these vehicles and how to handle any fuel-related incidents.

Subpart F, Coupling devices provides the regulations on systems used to connect (couple) commercial vehicles together. It is broken into two sections, one for “driveaway/towaway” vehicles (which involves piggybacking and tow-bar towing other vehicles) and one for vehicles using standard coupling devices to pull trailers (fifth-wheels, pintle hooks, bumper hitches, etc.).

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Subpart G, Miscellaneous parts and accessories covers a wide range of vehicle components (tires, wipers, speedometer, exhaust, bus drive shaft protections, bus seating and standing location prohibitions, etc.) that are not covered elsewhere in Part 393. Section 393.75, the tire requirements, is a section that should be read carefully. Many recommended and best practices have been confused with the regulations over the years. Make sure to read the actual regulation to know which is which.

Also in this subpart (at §393.86) are the rear end protection requirements (the rear bumper requirements). These requirements vary based on vehicle type and year of manufacture, so this is another section that should be read carefully.

Subpart H, Emergency equipment specifies what emergency equipment a commercial motor vehicle must carry (three warning devices, a 5 B:C or 10 B:C extinguisher, spare fuses for any circuit that uses fuses and powers a required accessory).

Subpart I, Protection against shifting and falling cargo is a rather lengthy subpart, providing both the general cargo securement requirements as well as specific commodity securement requirements for “high risk” commodities such as metal coils, concrete pipe, and large rolls of paper.

The Maintenance Pro will only become directly concerned with this subpart when conducting FMCSA-required periodic inspections, as cargo securement is a portion of the periodic (annual) inspection.

Subpart J is the last subpart and contains the regulations pertaining to frames, cabs, wheels, steering, and suspensions.

Speed limiting

While not part of the FMCSA regulations on parts and accessories, speed limiters are a compliance issue Maintenance Pros need to become familiar with. Presently, two Canadian provinces (Ontario and Quebec) have speed limiter regulations. In the United States several major trucking associations and motor carriers, and several safety organizations have petitioned the United States Department of Transportation to consider similar regulations.

The regulations in Ontario and Quebec require all heavy trucks (defined as a truck over 11,000 kilograms, or roughly 24,250 pounds) built after 1995 be limited to a maximum speed of 105 kilometers per hour (roughly 65 miles per hour). The regulations also require that as much as is practical the speed limiter be tamperproof. Once it is set at the appropriate speed, the driver is not to have the ability to alter it.

Carriers are responsible for compliance with these regulations. Carriers that have the technical know-how and correct equipment (hardware and software) should be able to do the programming themselves. If the carrier does not have the know-how or equipment, the programming will need to be done at a dealer or repair facility that has the correct capabilities.

Compliance is primarily verified through speeding citations. If a driver is operating in excess of 105 kilometers per hour, the carrier can be cited for violating the speed limiting law. Note: If the driver was operating over

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the posted speed limit on the roadway, the driver will receive a speeding ticket in addition to the company being cited for violating the speed limiting regulation. However, some officers will be provided systems that can allow the viewing of the vehicle's electronic settings (including checking if the vehicle component settings have been tampered with, changing the actual versus vehicle reported speed, as well as the speed limiter settings).

One key point Maintenance Pros need to be aware of is these regulations apply to every heavy truck (built after 1995) operating in Ontario and Quebec, **regardless of where the vehicle is registered**. Trucks entering Ontario and Quebec from other provinces or the United States must comply with these regulations upon entering these provinces.

Part 396 — Inspection, Repair, and Maintenance

Part 396 concerns itself directly with the safety of your commercial motor vehicles. Part 396 is relatively small, containing only 13 sections and no subparts.

However, as the Maintenance Pro you need to:

- Develop a thorough understanding of the important requirements of Part 396; and
- Incorporate adequate management controls to ensure compliance and the safety of your vehicles.

§396.3 Inspection, repair, and maintenance, states that you must have in place a *systematic* method of inspecting, repairing, and maintaining your CMVs, and that all safety-related parts and accessories must be in safe and proper operating condition at all times. It also requires that the pushout windows, emergency doors, and emergency exit marking and lighting on buses be inspected by the company at least every 90 days.

§396.3 also lists the maintenance record retention requirements. For each CMV you control (operate) for 30 consecutive days or more, you must create a file that contains the following:

- An identification of the vehicle including:
 - Your company-assigned vehicle number (if so marked),
 - Owner of the vehicle if not company owned,
 - Make,
 - Serial number,
 - Year, and
 - Tire size.
- A means to indicate the nature and due date of the various inspection and maintenance operations to be performed (the preventive maintenance schedule for the vehicle); and
- A record of inspections, repairs, and maintenance indicating their date and nature (work orders generated for the vehicle), including

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records of all emergency exit inspections (for passenger-carrying vehicles).

The records of inspections, repairs, and maintenance generally must be retained where the vehicle is either housed or maintained for a period of 1 year, and for 6 months after the motor vehicle leaves your control. The exceptions to this are:

- Records relating to an engine change. Appendix A to Part 379 requires records pertaining to an engine change be maintained by the carrier for three years after disposal of the equipment.
- Records relating to a roadside inspection. These must be kept for 12 months.
- DVIR forms. These must be kept for three months.
- Records of periodic (annual) inspections. These reports must be kept for 14 months.

Many carriers retain some or all of these records for the entire time the vehicle is in service, and then for the additional six months. In the Determining Maintenance Schedules and Recordkeeping sections we discussed the value of having long-term records available for review, as well as the process for establishing your maintenance schedules. During an audit you will be judged on how well you have followed the maintenance schedule you have established (based on these records) and the results of roadside inspections your vehicles have undergone over the last year.

The retention of all repair/work orders and receipts from vendor repairs (provided the receipts detail the repairs) is all that is needed to comply

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with this regulation. If you are retaining records for operational purposes, chances are you will far exceed the regulatory requirements. Simply check that the records you are generating and retaining in the course of operating the maintenance shop contain the required information.

As of December 2008 (effective December 2009), intermodal equipment providers will also be subject to these regulations. This regulatory change will require drivers at carriers that use intermodal chassis to inspect and report on any safety problems to the provider. If defects are found, the driver cannot operate the chassis until it is repaired when taking custody of it. When returning it, the driver must provide a written report reporting the condition of the chassis to the provider, if there is a defect. Intermodal equipment providers must also have a systematic inspection and maintenance program for all chassis, and be maintaining records of all inspections and maintenance (including driver inspections).

§396.9 Inspection of motor vehicles in operation, is the regulation that provides agents of the FMCSA with the authority to perform inspections of your vehicles while in operation — being driven on a *highway*. As you may recall from our earlier discussion, a highway is any place to which the motoring public has unrestricted access.

This regulation also authorizes these same agents to declare a vehicle *out of service* if they believe continued operation of the vehicle is likely to cause an accident or breakdown due to a safety-related defect or deficiency.

If placed out of service, the vehicle cannot be operated again until all out-of-service defects and deficiencies have been repaired.

The inspections are generally performed by state troopers or motor carrier enforcement officers who work for the states. Upon completion of the inspection, one copy of the report is presented to the driver and another is sent to the FMCSA and placed on file. There are six basic inspections the officers will perform on a driver and/or vehicle. They are:

Level I — This is the most comprehensive inspection. It includes an inspection of all vehicle components and the driver's credentials and condition.

Level II — This is basically the same as a Level I inspection, with the exception that the officer does not check anything that requires going under the vehicle. It is referred to as a "walk-around" inspection (not to be confused with a driver's walk-around inspection).

Level III — The Level III inspection consists of a check of the driver's credentials and condition only.

Level IV — This inspection is referred to as a "special inspection." These are either done as part of a larger program to verify or refute specific trends at the national level or as part of a local or regional "crack-down" on specific problems. A brake-only inspection done as part of Operation Brake Check, which is conducted annually to check the status of truck brake systems on the road, would be an example of a Level IV inspection.

Level V — A Level V inspection is a vehicle-only inspection consisting of the same vehicle components as a Level I inspection. This is normally done either at a carrier's facility or on the road in situations where the

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driver is not available. An example of this would be an inspection following a crash where the driver was injured.

Level VI — Level VI inspections are done only on vehicles transporting certain radioactive materials. It is an in-depth Level I inspection with tougher criteria for passing.

Roadside inspections are conducted at scales, inspection sites, or literally on the roadside to determine if drivers and vehicles are in compliance with the regulations. The inspector is verifying that the vehicle meets the requirements established in Part 393. If the driver or vehicle is in a condition that could be deemed unsafe (likely to cause an accident or breakdown) the driver and/or vehicle can be placed out of service. The decision on whether the vehicle is likely to cause an accident or breakdown is based on the Commercial Vehicle Safety Alliance (CVSA) North American Out-of-Service Criteria, which is updated every April.

If the vehicle is placed out of service, the vehicle cannot be operated on the highway until it is back into compliance. The officer issuing the out-of-service order will normally review the vehicle before lifting the out-of-service order to assure compliance has been met. If the driver is placed out of service, the driver may not operate any commercial vehicle until he/she is back into compliance.

The bottom line is if the vehicle was placed out of service it must be repaired *before being operated on the roadway*. The vehicle cannot even be driven to a repair facility. This will require road service being sent to the vehicle to make the necessary repairs. The only other option is to have the vehicle towed to a repair facility by a vehicle that is designed to tow other vehicles and is equipped with a crane or hoist.

If an out-of-service driver operates a commercial motor vehicle, or a vehicle that is out of service is moved before it is repaired, it is considered a violation of an out-of-service order, which is a very serious violation.

Note: Fines for violating an out-of-service order range from **\$1,100-\$2,750** for drivers, and **\$2,750-\$16,000** for employers and equipment providers, and can lead to a driver being disqualified. ***Do not allow anyone to operate the vehicle until the repairs are completed, and you have documentation proving that the repairs were done!*** In some cases the driver may be able to perform the repairs. If so, have the driver document the repairs and have the inspecting officer sign off on the inspection report before the vehicle leaves the inspection site.

In cases where violations are noted on the inspection form, but the driver or equipment were not placed out of service, corrective action must be taken as soon as possible, but the vehicle can be operated by the driver.

Generally, when one of your drivers undergoes a roadside inspection, the inspecting officer will complete an inspection report known as an ASPEN report or a MCS-63.

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To sum it up, federal regulations, specifically 49 CFR Part 396.9(d), require the driver to submit the inspection report to the carrier. This must be done even if the inspection is passed with no violations. The carrier must then review it, sign it, indicate that all violations listed have been corrected, and return it to the issuing agency within 15 days. A copy of the report must be kept at the carrier's place of business for one year following the inspection. Here is a step-by-step summary of the inspection process:

- The driver is not to operate a vehicle that has been placed out of service until it is repaired and back into compliance, and you have documentation that proves the repairs took place.
- The driver shall deliver the report to the company upon arrival at the next terminal or facility.
- If the driver is not scheduled to arrive at a terminal or facility within 24 hours, he or she shall immediately mail the report to the company.
- The company shall correct any unresolved violations noted. Repairs should be done before the vehicle is dispatched on to its next run. If the inspection report included a chassis provided by an intermodal equipment provider, the carrier is to forward a copy of the inspection to the intermodal equipment provider.
- A motor carrier official (or an official at the intermodal equipment provider if a violation noted involved an intermodal chassis provided to the carrier) is to certify on the form that violations have been corrected and mail the completed form to the address shown. This must be done within 15 days following the date of the inspection. Documentation proving the repair of out-of-service violations should be kept in the vehicle maintenance records (carriers and providers are required under §396.3 to either keep records, or see that the records are kept and available at time of audit).

Many times this function is handled by operations or safety personnel. The Maintenance Pro needs to be included in this process. As the Maintenance Pro it will be up to you to track the vehicle violations and out-of-service orders to make sure required repairs are being performed. Also, you will want to keep an eye on trends. If a certain type of vehicle is repeatedly receiving violations for brakes out of adjustment, you may want to see if there is a systemic problem with that type of brake and/or change the preventive maintenance scheduling for the vehicles equipped with those brakes.

Presently, there are more than 3,500,000 roadside inspections conducted annually by state and federal inspectors. Federal grants through the Motor Carrier Safety Assistance Program (MCSAP) have increased funding to the states for safety inspection purposes over the years. States have banded together to form the CVSA, the organization that oversees the out-of-service standards and sees to the uniformity and reciprocity of inspections conducted by state and federal inspectors.

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CSA

CSA and roadside inspections. When the FMCSA receives its copy of the inspection report, the information on it is entered into the MCMIS (Motor Carrier Management Information System) database. The data is then used by the CSA (Compliance, Safety, Accountability) carrier tracking system, the Safety Measurement System, or SMS, to measure carrier performance in seven key areas, referred to as “Behavior Analysis and Safety Improvement Categories” or BASICS.

Data from the CSA SMS also feeds the Inspection Selection System (ISS). The ISS is a decision-making aid for officers on the road. It is used as part of the selection criteria when deciding who to inspect. If a carrier has a high score in one of the BASICS, it will also have a high ISS score. This will result in the carrier being “flagged” as “Optional” or “Inspect” in the ISS. If an officer enters the carrier’s DOT number into the ISS, the officer will see the inspect recommendation. This will lead to the carrier seeing significantly more roadside inspections.

Other inspection selection criteria includes drivers and/or vehicles with obvious violations, driver committing a traffic violation while driving, and random selection.

One critical difference between CSA and its predecessor systems is that DRIVERS are now tracked, measured, and evaluated by the system. In the CSA system there is a Driver Safety Measurement System that tracks drivers independent of the carriers. The system is nearly identical to the carrier systems, with the only major difference being what is done with drivers that do not score well (carrier and driver “evaluations” and “interventions” are different).

Safety Measurement

In CSA, all safety-related violations noted on roadside inspection reports count against a carrier’s and driver’s score in the Safety Measurement Systems. In the past the FMCSA has only looked at out-of-service violations when evaluating carriers (and they did not evaluate drivers).

Carrier and driver data is viewed and judged in seven narrow BASICS. Here are the seven BASICS and the associated regulations areas:

- Unsafe Driving (Parts 392, 397, and local traffic laws)
- Hours-of-Service (HOS) Compliance (Parts 392 and 395)
- Driver Fitness (Parts 383 and 391)
- Controlled Substances/Alcohol (Part 382 and 392)
- Vehicle Maintenance (Parts 393 and 396)
- Hazardous Materials (HM) Compliance (the hazardous materials regulations in Parts 171 to 180, and 397)
- Crash Indicator

Just an FYI: The Vehicle Maintenance BASIC includes all vehicle-related issues, including cargo securement.

Compliance Management

The way the BASICS function is that whenever an inspection, violation, or crash is entered into the FMCSA data system, CSA's SMS assigns the event to the correct BASIC. This assignment is done based on the type of inspection (driver and/or vehicle), regulation number that was violated (if there was a violation), and whether or not the event was a crash.

Driver inspections (Level 1, 2, 3, and 6 inspections) are placed in the HOS Compliance, Driver Fitness, and Controlled Substances and Alcohol BASICS. Vehicle inspections (Level 1, 2, 5, and 6 inspections) are placed in the Vehicle Maintenance BASIC. HM inspections are placed in the HM Compliance BASIC.

For CSA purposes, a "HM inspection" in the HM Compliance BASIC is one in which the vehicle was or should have been placarded at the time of the inspection. The CSA system methodology also refers to these as "placardable inspections."

The Unsafe Driving BASIC is slightly different (it does not use all driver inspections). Inspections that include an Unsafe Driving violation are placed in the Unsafe Driving BASIC, along with the violation.

The DOT-recordable crashes reported to the FMCSA by law enforcement are what are placed into the Crash BASIC. Fault or preventability are not considered. All crashes reported to the FMCSA by law enforcement are simply placed into the Crash BASIC for scoring.

Just an FYI, the reason Unsafe Driving and Crash BASICS are different is that they use a different measuring and scoring methodology. These BASIC use the number of power units a carrier operates multiplied by a utilization factor that considers the carrier's mileage per power unit when calculating the carrier measures and scores (the other BASICS use the relevant inspections in the measuring and scoring processes).

As far as placing violations into the correct BASIC, this is done by the specific regulations involved. If a roadside inspection report notes a violation of "\$393.11 Required Light inoperable," the system will place the violation into the Vehicle Maintenance BASIC.

ONE KEY POINT HERE: Violations noted on roadside inspection reports and violations discovered during auditing are what are tracked and used in the CSA Safety Measurement System. This has nothing to do with whether the driver or company received a "citation" or "ticket," or if the driver or vehicle were placed out of service. If an officer conducts an inspection, the officer will note any violations of the regulations that are discovered during the inspection on the roadside inspection report. These violations are what end up in the CSA Safety Measurement Systems. Once the inspection is complete, the officer will then decide if the violations that were discovered are serious enough to warrant issuing a formal warning or citation (ticket), and/or placing the vehicle or driver out-of-service.

No matter what the officer decided to do as far as issuing a formal warning or citation, or placing the vehicle out of service, the violations that were noted on the roadside inspection report will show up in the CSA Safety Measurement System.

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When the violations from roadside inspection reports and crashes enter the system, they are “severity and time weighted.” The severity weighting for each violation is based on the violation’s relationship to crashes. Violations that have a close relationship to crashes have a higher value (as high as 10), while violations that have a lower association to crashes are given a low severity weight (as low as 1). If the violation was in the HOS Compliance, Driver Fitness, Vehicle Maintenance, or HM Compliance BASIC and resulted in the driver or vehicle being placed out of service, the severity is automatically increased by 2. Here are the severity weighting tables used by the FMCSA in the Vehicle Maintenance BASIC:

Vehicle maintenance BASIC violation severity table

Section	Description	Group	Severity*	Affects Driver Score?
385.103(c)	Fail to display current CVSA decal — Provisional Authority	Inspection Reports	4	N
392.2WC	Wheel (mud) flaps missing or defective	Windshield/Glass/Markings	1	Y
392.7	No pre-trip inspection	Inspection Reports	4	Y
392.7(a)	Driver failing to conduct pre-trip inspection	Inspection Reports	4	Y
392.7(b)	Driver failing to conduct a pre-trip inspection of intermodal equipment	Inspection Reports	4	Y
392.8	Failing to inspect/use emergency equipment	Emergency Equipment	2	Y
392.9	Failing to secure load	General Securement	1	Y
392.9(a)	Failing to secure load	General Securement	1	Y
392.9(a)(1)	Failing to secure cargo	General Securement	1	Y
392.9(a)(2)	Failing to secure vehicle equipment	General Securement	1	Y
392.9(a)(3)	Driver’s view/movement is obstructed	General Securement	1	Y
392.22(b)	Failing/improper placement of warning devices	Cab, Body, Frame	2	Y
392.33	Operating CMV with lamps/reflectors obscured	Lighting	6	Y
392.62(c)(1)	Bus — baggage/freight restricts driver operation	General Securement	1	Y
392.62(c)(2)	Bus — exit(s) obstructed by baggage/freight	General Securement	1	Y
392.62(c)(3)	Passengers not protected from falling baggage	General Securement	1	Y
392.63	Pushing/towing a loaded bus	Towing Loaded Bus	10	Y
393.9	Inoperative required lamps	Clearance Identification Lamps/Other	2	Y
393.9H	Inoperative head lamps	Lighting	6	Y
393.9T	Inoperative tail lamp	Lighting	6	Y
393.9TS	Inoperative turn signal	Lighting	6	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.9(a)	Inoperative required lamps	Clearance Identification Lamps/Other	2	Y
393.11	No/defective lighting devices/reflective devices/projected	Reflective Sheeting	3	Y
393.11LR	Lower retroreflective sheeting/reflex reflectors — trailer manufactured on or after 12/1/1993	Reflective Sheeting	3	Y
393.11N	No retroreflective sheeting/reflex reflectors — trailer manufactured on or after 12/1/1993	Reflective Sheeting	3	Y
393.11RT	Retroreflective sheeting not affixed as required — trailer manufactured on or after 12/1/1993	Reflective Sheeting	3	Y
393.11S	Side retroreflective sheeting or reflex reflector requirements for vehicles manufactured after December 1993	Reflective Sheeting	3	Y
393.11TL	No retroreflective sheeting or reflex reflectors on mud flaps — truck tractor manufactured on or after 7/1/1997	Reflective Sheeting	3	Y
393.11TT	No retroreflective sheeting/reflex reflectors — truck tractor manufactured on or after 7/1/1997	Reflective Sheeting	3	Y
393.11TU	No upper body corners retroreflective sheeting/reflex reflectors — truck tractor manufactured on or after 7/1/1997	Reflective Sheeting	3	Y
393.11UR	No upper reflex reflectors retroreflective sheeting/reflex reflectors — trailer manufactured on or after 12/1/1993	Reflective Sheeting	3	Y
393.13(a)	Retroreflective tape not affixed as required for trailers manufactured after 12/1/1993	Reflective Sheeting	3	Y
393.13(b)	No retroreflective sheeting or reflex reflective material as required for vehicles manufactured before December 1993	Reflective Sheeting	3	Y
393.13(c)(1)	No side retroreflective sheeting or reflex reflective material as required for vehicles manufactured before 12/1/1993	Reflective Sheeting	3	Y
393.13(c)(2)	No lower rear retroreflective sheeting or reflex reflective material as required for vehicles manufactured before 12/1/1993	Reflective Sheeting	3	Y
393.13(c)(3)	No upper rear retroreflective sheeting or reflex reflective material as required for vehicles manufactured before 12/1/1993	Reflective Sheeting	3	Y
393.13(d)(1)	Improper Side Placement of retroreflective sheeting or reflex reflective material as required for vehicles manufactured before December 1993	Reflective Sheeting	3	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.13(d)(2)	Improper lower rear placement of retroreflective sheeting or reflex reflective material requirements for vehicles manufactured before 12/1/1993	Reflective Sheeting	3	Y
393.13(d)(3)	Upper rear retroreflective sheeting or reflex reflective material as required for vehicles manufactured before December 1993	Reflective Sheeting	3	Y
393.17	No/defective lamp/reflector — tow-away operation	Lighting	6	Y
393.17(a)	No/defective lamps — towing unit — tow-away operation	Lighting	6	Y
393.17(b)	No/defective tow-away lamps on rear unit	Lighting	6	Y
393.19	Inoperative/defective hazard warning lamp	Lighting	6	Y
393.23	Required lamp not powered by vehicle electricity	Clearance Identification Lamps/Other	2	Y
393.24(a)	Noncompliance with headlamp requirements	Lighting	6	Y
393.24(b)	Noncompliant fog/driving lamps	Lighting	6	Y
393.24BR	Noncompliant fog or driving lamps	Lighting	6	Y
393.24(c)	Improper headlamp mounting	Lighting	6	N
393.24(d)	Improper head/auxiliary/fog lamp aiming	Lighting	6	N
393.25(a)	Improper lamp mounting	Lighting	6	N
393.25(b)	Lamps are not visible as required	Lighting	6	Y
393.25(e)	Lamp not steady burning	Lighting	6	Y
393.25(f)	Stop lamp violations	Lighting	6	Y
393.26	Requirements for reflectors	Reflective Sheeting	3	Y
393.28	Improper or no wiring protection as required	Other Vehicle Defect	3	Y
393.30	Improper battery installation	Other Vehicle Defect	3	Y
393.40	Inadequate brake system on a CMV	Brakes, All Others	4	Y
393.41	No or defective parking brake system on CMV	Brakes, All Others	4	Y
393.42	No brakes as required	Brakes, All Others	4	Y
393.42A-BM	Brake — missing required brake	Brakes, All Others	4	Y
393.42A-BMAW	Brake — all wheels not equipped with brakes as required	Brakes, All Others	4	Y
393.42A-BM-TSA	Brake — missing on a trailer steering axle	Brakes, All Others	4	Y
393.43	No/improper breakaway or emergency braking	Brakes, All Others	4	Y
393.43(a)	No/improper tractor protection valve	Brakes, All Others	4	Y
393.43(d)	No or defective automatic trailer brake	Brakes, All Others	4	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.44	No/defective bus front brake line protection	Brakes, All Others	4	Y
393.45	Brake tubing and hose adequacy	Brakes, All Others	4	N
393.45PC	Brake tubing and hose adequacy — connections to power unit	Brakes, All Others	4	N
393.45UV	Brake tubing and hose adequacy under vehicle	Brakes, All Others	4	N
393.45(a)(4)	Failing to secure brake hose/tubing against mechanical damage	Brakes, All Others	4	N
393.45(b)(2)	Failing to secure brake hose/tubing against mechanical damage	Brakes, All Others	4	Y
393.45B2PC	Brake hose or tubing chafing and/or kinking — connection to power unit	Brakes, All Others	4	Y
393.45B2UV	Brake hose or tubing chafing and/or kinking under vehicle	Brakes, All Others	4	N
393.45(b)(3)	Failing to secure brake hose/tubing against high temperatures	Brakes, All Others	4	N
393.45(d)	Brake connections with leaks/constrictions	Brakes, All Others	4	N
393.45DCPC	Brake connections with constrictions — connection to power unit	Brakes, All Others	4	Y
393.45DCUV	Brake connections with constrictions under vehicle	Brakes, All Others	4	N
393.45DLPC	Brake connections with leaks — connection to power unit	Brakes, All Others	4	Y
393.45DLUV	Brake connections with leaks under vehicle	Brakes, All Others	4	Y
393.47	Inadequate/contaminated brake linings	Brakes, All Others	4	Y
393.47(a)	Inadequate brakes for safe stopping	Brakes, All Others	4	Y
393.47(b)	Mismatched brake chambers on same axle	Brakes, All Others	4	Y
393.47(c)	Mismatched slack adjuster effective length	Brakes, All Others	4	Y
393.47(d)	Insufficient brake linings	Brakes, All Others	4	Y
393.47(e)	Clamp/roto-chamber type brake(s) out of adjustment	Brakes Out of Adjustment	4	Y
393.47(f)	Wedge type brake(s) out of adjustment	Brakes Out of Adjustment	4	Y
393.47(g)	Insufficient drum/rotor thickness	Brakes, All Others	4	Y
393.48(a)	Inoperative/defective brakes	Brakes, All Others	4	Y
393.48A-BCM	Brakes — hydraulic brake caliper movement exceeds 1/8" (0.125") (3.175 mm)	Brakes, All Others	4	N
393.48A-BMBC	Brakes — Missing or Broken Components including Pad Retaining Components	Brakes, All Others	4	N
393.48A-BRMMC	Brakes — rotor (disc) metal-to-metal contact	Brakes, All Others	4	N

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Section	Description	Group	Severity*	Affects Driver Score?
393.48A-BSRFS	Brakes — severe rusting of brake rotor (disc)	Brakes, All Others	4	N
393.48(b)(1)	Defective brake limiting device	Brakes, All Others	4	Y
393.50	Inadequate reservoir for air/vacuum brakes	Brakes, All Others	4	N
393.50(a)	Failing to have sufficient air/vacuum reserve	Brakes, All Others	4	N
393.50(b)	Failing to equip vehicle air brake system with adequate reserve capacity or reservoir	Brakes, All Others	4	N
393.50(c)	No means to ensure operable check valve	Brakes, All Others	4	N
393.50(d)	No or defective air reservoir drain valve	Brakes, All Others	4	Y
393.51	No or defective brake warning device	Brakes, All Others	4	Y
393.52(a)(1)	Insufficient braking force as percent of GVW or GCW	Brakes, All Others	4	Y
393.53(a)	Automatic brake adjuster CMV manufactured on or after 10/20/1993 — hydraulic brake	Brakes, All Others	4	Y
393.53(b)	Automatic brake adjuster CMV manufactured on or after 10/20/1994 — air brake	Brakes, All Others	4	Y
393.53(c)	Brake adjustment indicator CMV manufactured on or after 10/20/1994 — external automatic adjustment	Brakes, All Others	4	Y
393.55(a)	ABS — all CMVs manufactured on or after 3/1/1999 with hydraulic brakes	Brakes, All Others	4	N
393.55(b)	ABS — malfunction indicators for hydraulic brake system	Brakes, All Others	4	N
393.55(c)(1)	ABS — all tractors manufactured on or after 3/1/1997 air brake system	Brakes, All Others	4	N
393.55(c)(2)	ABS — all other CMVs manufactured on or after 3/1/1998 air brake system	Brakes, All Others	4	N
393.55(d)(1)	ABS — malfunctioning circuit/signal — truck tractor manufactured on or after 3/1/1997, single-unit CMV manufactured on or after 3/1/1998	Brakes, All Others	4	N
393.55(d)(2)	ABS — malfunctioning indicator to cab of towing CMV manufactured on or after 3/1/2001	Brakes, All Others	4	N
393.55(d)(3)	No or defective ABS malfunction indicator for towed vehicles on vehicles manufactured after February 2001	Brakes, All Others	4	N
393.55(e)	ABS — malfunctioning lamps towed CMV manufactured on or after 3/1/1998	Brakes, All Others	4	Y
393.60EWS	Windshield — obstructed	Windshield/Glass/Markings	1	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.60(b)	Windshields required	Windshield/ Glass/Markings	1	Y
393.60(c)	Damaged or discolored windshield	Windshield/ Glass/Markings	1	Y
393.60(d)	Glazing permits less than 70 percent of light	Windshield/ Glass/Markings	1	Y
393.61	Inadequate or missing truck side windows	Windshield/ Glass/Markings	1	Y
393.61(a)	Inadequate or missing truck side windows	Windshield/ Glass/Markings	1	Y
393.62(a)	No or defective bus emergency exits — bus manufactured on or after 9/1/1994	Windshield/ Glass/Markings	1	Y
393.62(b)	No or defective bus emergency exits — bus manufactured on or after 9/1/1973 but before 9/1/1994	Windshield/ Glass/Markings	1	Y
393.62(c)	No or defective bus emergency exit windows — bus manufactured before 9/1/1973	Windshield/ Glass/Markings	1	Y
393.62(d)	No/defective safety glass/push-out window — bus manufactured before 9/1/1973	Windshield/ Glass/Markings	1	Y
393.62(e)	No or inadequate bus emergency exit marking — bus manufactured on or after 9/1/1973	Windshield/ Glass/Markings	1	Y
393.65	Fuel system requirements	Fuel Systems	1	N
393.65(b)	Improper location of fuel system	Fuel Systems	1	Y
393.65(c)	Improper securement of fuel tank	Fuel Systems	1	Y
393.65(f)	Improper fuel line protection	Fuel Systems	1	Y
393.67	Fuel tank requirement violations	Fuel Systems	1	N
393.67(c)(7)	Fuel tank fill pipe cap missing	Fuel Systems	1	Y
393.67(c)(8)	Improper fuel tank safety vent	Fuel Systems	1	N
393.68	Compressed Natural Gas (CNG) fuel container does not conform to regulations	Other Vehicle Defect	3	Y
393.70	Fifth wheel	Coupling Devices	3	N
393.70(a)	Defective coupling device — improper tracking	Coupling Devices	3	N
393.70(b)	Defective/improper fifth wheel assemblies	Coupling Devices	3	Y
393.70B1II	Defective/improper fifth wheel assembly upper half	Coupling Devices	3	Y
393.70(b)(2)	Defective fifth wheel locking mechanism	Coupling Devices	3	Y
393.70(c)	Defective coupling devices for full trailer	Coupling Devices	3	Y
393.70(d)	No/improper safety chains/cables for full trailer	Coupling Devices	3	Y
393.70(d)(8)	Improper safety chain attachment	Coupling Devices	3	Y
393.71	Improper coupling driveaway/tow-away operation	Coupling Devices	3	Y
393.71(g)	Prohibited towing connection/device	Coupling Devices	3	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.71(h)	Towbar requirement violations	Coupling Devices	3	Y
393.71(h)(10)	No/improper safety chains/cables for towbar	Coupling Devices	3	Y
393.75	Tires/tubes (general)	Tires	8	Y
393.75(a)	Flat tire or fabric exposed	Tires	8	Y
393.75(a)(1)	Tire — ply or belt material exposed	Tires	8	Y
393.75(a)(2)	Tire — tread and/or sidewall separation	Tires	8	Y
393.75(a)(3)	Tire — flat and/or audible air leak	Tires	8	Y
393.75(a)(4)	Tire — cut exposing ply and/or belt material	Tires	8	Y
393.75(b)	Tire — front tread depth less than 4/32 of inch	Tires	8	Y
393.75(c)	Tire — other tread depth less than 2/32 of inch	Tires	8	Y
393.75(d)	Tire — bus regrooved/recap on front wheel	Tires	8	Y
393.75(e)	Tire — regrooved on front wheel of truck/truck-tractor	Tire vs. Load	3	Y
393.75(f)	Tire — exceeding weight rating of tire	Tire vs. Load	3	Y
393.75(f)(1)	Weight carried exceeds tire load limit †	Tire vs. Load	3	Y
393.75(f)(2)	Tire underinflated †	Tire vs. Load	3	Y
393.75(h)	Tire underinflated	Tire vs. Load	3	Y
393.76	Sleeper berth requirement violations	Other Vehicle Defect	3	Y
393.77	Defective and/or prohibited heaters	Other Vehicle Defect	3	Y
393.77(b)(11)	Bus heater fuel tank location	Other Vehicle Defect	3	Y
393.77(b)(5)	Protection of operating controls from tampering	Other Vehicle Defect	3	Y
393.78	Windshield wipers inoperative/defective	Windshield/Glass/Markings	1	Y
393.79	Defroster/defogger inoperative	Windshield/Glass/Markings	1	Y
393.80	Failing to equip vehicle with two rear vision mirrors	Other Vehicle Defect	3	Y
393.81	Horn inoperative	Other Vehicle Defect	3	Y
393.82	Speedometer inoperative/inadequate	Other Vehicle Defect	3	Y
393.83(a)	Exhaust system location	Exhaust Discharge	1	Y
393.83(b)	Exhaust discharge fuel tank/filler tube	Exhaust Discharge	1	Y
393.83(c)	Improper exhaust — bus (gasoline)	Exhaust Discharge	1	Y
393.83(d)	Improper exhaust — bus (diesel)	Exhaust Discharge	1	Y
393.83(e)	Improper exhaust discharge (not rear of cab)	Exhaust Discharge	1	Y

Compliance Management

Section	Description	Group	Severity*	Affects Driver Score?
393.83(f)	Improper exhaust system repair (patch/wrap)	Exhaust Discharge	1	Y
393.83(g)	Exhaust leak under truck cab and/or sleeper	Exhaust Discharge	1	Y
393.83(h)	Exhaust system not securely fastened	Exhaust Discharge	1	Y
393.84	Inadequate floor condition	Cab, Body, Frame	2	Y
393.86	No or improper rearend protection	Cab, Body, Frame	2	Y
393.86(a)(1)	Rear impact guards — all trailers/ semitrailers manufactured on or after 1/26/98	Cab, Body, Frame	2	N
393.86(a)(2)	Impact guard width — all trailers/ semitrailers manufactured on or after 1/26/98	Cab, Body, Frame	2	N
393.86(a)(3)	Impact guard height — all trailers/ semitrailers manufactured on or after 1/26/98	Cab, Body, Frame	2	N
393.86(a)(4)	Impact guard rear — all trailers/ semitrailers manufactured on or after 1/26/98	Cab, Body, Frame	2	N
393.86(a)(5)	Rear Impact Guard Cross-section vertical height insufficient for trailer manufactured on or after January 26, 1998	Cab, Body, Frame	2	N
393.86(b)(1)	Rear impact guards — motor vehicles manufactured on or after 12/31/52, see exceptions	Cab, Body, Frame	2	Y
393.87	Warning flag required on projecting load	Warning Flags	1	Y
393.87(a)	Warning flag required on projecting load	Warning Flags	1	Y
393.87(b)	Improper warning flag placement	Warning Flags	1	Y
393.88	Improperly located television receiver	Cab, Body, Frame	2	Y
393.89	Bus driveshaft not properly protected	Cab, Body, Frame	2	Y
393.90	Bus — no or obscure standee line	Cab, Body, Frame	2	Y
393.91	Bus — improper aisle seats	Cab, Body, Frame	2	Y
393.93(a)	Bus — not equipped with seatbelt	Cab, Body, Frame	2	Y
393.93(a)(3)	Seats not secured in conformance with FMVSS	Cab, Body, Frame	2	N
393.93(b)	Truck not equipped with seatbelt	Cab, Body, Frame	2	Y
393.95(a)	No/discharged/unsecured fire extinguisher	Emergency Equipment	2	Y
393.95(a)(1)(i)	No/discharged/unsecured fire extinguisher	Emergency Equipment	2	Y
393.95(b)	No spare fuses as required	Emergency Equipment	2	Y
393.95(c)	No spare fuses as required	Emergency Equipment	2	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.95(f)	No/insufficient warning devices	Emergency Equipment	2	Y
393.95(g)	HM — restricted emergency warning device	Emergency Equipment	2	Y
393.100	Failure to prevent cargo shifting	General Securement	1	Y
393.100(a)	Failure to prevent cargo shifting	General Securement	1	Y
393.100(b)	Leaking/spilling/blowing/falling cargo	Improper Load Securement	7	Y
393.100(c)	Failure to prevent cargo shifting	General Securement	1	Y
393.102(a)	Improper securement system (tiedown assemblies)	Tiedown	3	Y
393.102(a)(1)	Insufficient means to prevent forward movement	Failure to Prevent Movement	3	Y
393.102(a)(1)(i)	Insufficient means to prevent forward movement	Failure to Prevent Movement	3	Y
393.102(a)(1)(ii)	Insufficient means to prevent rearward movement	Failure to Prevent Movement	3	Y
393.102(a)(1)(iii)	Insufficient means to prevent lateral movement	Failure to Prevent Movement	3	Y
393.102(a)(2)	Tiedown assembly with inadequate working load limit	Tiedown	3	Y
393.102(b)	Insufficient means to prevent vertical movement	Failure to Prevent Movement	3	Y
393.102(c)	No equivalent means of securement	Improper Load Securement	7	Y
393.104(a)	Inadequate/damaged securement device/system	Securement Device	1	Y
393.104(b)	Damaged securement system/tiedowns	Securement Device	1	Y
393.104(c)	Damaged vehicle structures/anchor points	Securement Device	1	Y
393.104(d)	Damaged dunnage/bars/blocking-bracing	Securement Device	1	Y
393.104(f)(1)	Knotted tiedown	Tiedown	3	Y
393.104(f)(2)	Use of tiedown with improper repair	Tiedown	3	Y
393.104(f)(3)	Loose/unfastened tiedown	Tiedown	3	Y
393.104F4R	No edge protection for tiedowns	Tiedown	3	Y
393.106(a)	No/improper front end structure/headerboard	Securement Device	1	Y
393.106(b)	Cargo not immobilized or secured	Failure to Prevent Movement	3	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.106(c)(1)	No means to prevent cargo from rolling	Failure to Prevent Movement	3	Y
393.106(c)(2)	Cargo without direct contact/prevention from shifting	Failure to Prevent Movement	3	Y
393.106(d)	Insufficient aggregate working load limit	Tiedown	3	Y
393.110	Failing to meet minimum tiedown requirements	General Securement	1	Y
393.110(b)	Insufficient tiedowns; without headerboard/blocking	Tiedown	3	Y
393.110(c)	Insufficient tiedowns; with headerboard/blocking	Tiedown	3	Y
393.110(d)	Large/odd-shaped cargo not adequately secured	Failure to Prevent Movement	3	Y
393.112	Tiedown not adjustable by driver	Securement Device	1	Y
393.114	No/improper front end structure	General Securement	1	Y
393.114(b)(1)	Insufficient height for front-end structure	Securement Device	1	Y
393.114(b)(2)	Insufficient width for front-end structure	Securement Device	1	Y
393.114(d)	Front-end structure with large opening(s)	Securement Device	1	Y
393.116	No/improper securement of logs	General Securement	1	Y
393.116(d)(1)	Short, over 1/3 length past structure	Improper Load Securement	7	Y
393.116(d)(2)	Short, insufficient/no tiedowns	Improper Load Securement	7	Y
393.116(d)(3)	Short, tiedowns improperly positioned	Improper Load Securement	7	Y
393.116(d)(4)	Short, no center stakes/high log not secured	Improper Load Securement	7	Y
393.116(e)	Short, length; improper securement	Improper Load Securement	7	Y
393.118	No/improper lumber/building materials. securement	General Securement	1	Y
393.118(b)	Improper placement of bundles	Improper Load Securement	7	Y
393.118(d)	Insufficient protection against lateral movement	Failure to Prevent Movement	3	Y
393.118(d)(3)	Insufficient/improper arrangement of tiedowns	Tiedown	3	Y
393.120	No/improper securement of metal coils	General Securement	1	Y
393.120(b)(1)	Coil/vertical improper securement	Improper Load Securement	7	Y
393.120(b)(2)	Coils, rows, eyes vertical; improper secure.	Improper Load Securement	7	Y
393.120(c)(1)	Coil/eye crosswise improper securement	Improper Load Securement	7	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.120(c)(2)	X-pattern on coil(s) with eyes crosswise	Improper Load Securement	7	Y
393.120(d)(1)	Coil with eye lengthwise — improper securement	Improper Load Securement	7	Y
393.120(d)(4)	Coils, rows, eyes length — improper securement	Improper Load Securement	7	Y
393.120(e)	No protection against shifting/ tipping	Failure to Prevent Movement	3	Y
393.122	No/improper securement of paper rolls	General Securement	1	Y
393.122(b)	Rolls vertical — improper securement	Improper Load Securement	7	Y
393.122(c)	Rolls vertical/split — improper securement	Improper Load Securement	7	Y
393.122(d)	Rolls vertical/stacked — improper securement	Improper Load Securement	7	Y
393.122(e)	Rolls crosswise — improper securement	Improper Load Securement	7	Y
393.122(f)	Rolls crosswise/stacked load — improperly secured	Improper Securement	7	Y
393.122(g)	Rolls length — improper securement	Improper Load Securement	7	Y
393.122(h)	Rolls lengthwise/stacked — improper securement	Improper Load Securement	7	Y
393.122(i)	Improper securement — rolls on flatbed/curtain-side vehicle	Improper Load Securement	7	Y
393.124	No/improper securement of concrete pipe	General Securement	1	Y
393.124(b)	Insufficient working load limit — concrete pipes	Tiedown	3	Y
393.124(c)	Improper blocking of concrete pipe	Improper Load Securement	7	Y
393.124(d)	Improper arrangement of concrete pipe	Improper Load Securement	7	Y
393.124(e)	Improper securement, up to 45 in. diameter	Improper Load Securement	7	Y
393.124(f)	Improper securement, greater than 45 inch diameter	Improper Load Securement	7	Y
393.126	Fail to ensure intermodal container secured	General Securement	1	Y
393.126(b)	Damaged/missing tiedown/ securement device	Securement Device	1	Y
393.126(c)(1)	Lower corners of container not on vehicle/structure	Securement Device	1	Y
393.126(c)(2)	All corners of chassis not secured	Improper Load Securement	7	Y
393.126(c)(3)	Front and rear of container not secured independently	Improper Load Securement	7	Y
393.126(d)(1)	Empty container not properly positioned	Improper Securement	7	Y
393.126(d)(2)	Empty container, more than 5 foot overhang	Improper Load Securement	7	Y
393.126(d)(4)	Empty container — not properly secured	Improper Securement	7	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.128	No/improper securement of vehicles	General Securement	1	Y
393.128(b)(1)	Vehicle not secured — front and rear	Improper Load Securement	7	Y
393.128(b)(2)	Tiedown(s) not affixed to mounting points	Improper Load Securement	7	Y
393.128(b)(3)	Tiedown(s) not over/around wheels	Improper Load Securement	7	Y
393.130	No/improper heavy vehicle/machine securement	General Securement	1	Y
393.130(b)	Item not properly prepared for transport	Improper Load Securement	7	Y
393.130(c)	Improper restraint/securement of item	Improper Load Securement	7	Y
393.132	No/improper securement of crushed vehicles	General Securement	1	Y
393.132(b)	Prohibited use of synthetic webbing	Securement Device	1	Y
393.132(c)	Insufficient tiedowns per stack cars	Tiedown	3	Y
393.132(c)(5)	Insufficient means to retain loose parts	Improper Load Securement	7	Y
393.134	No/improper securement of roll/hook container	General Securement	1	Y
393.134(b)(1)	No blocking against forward movement	Failure to Prevent Movement	3	Y
393.134(b)(2)	Container not secured to front of vehicle	Improper Load Securement	7	Y
393.134(b)(3)	Rear of container not properly secured	Improper Securement	7	Y
393.136	No/improper securement of large boulders	General Securement	1	Y
393.136(b)	Improper placement/positioning for boulder	Improper Load Securement	7	Y
393.136(c)(1)	Boulder not secured with chain	Improper Load Securement	7	Y
393.136(d)	Improper securement — cubic boulder	Improper Load Securement	7	Y
393.136(e)	Improper securement — non-cubic boulder with stable base	Improper Load Securement	7	Y
393.136(f)	Improper securement — non-cubic boulder with unstable base	Improper Load Securement	7	Y
393.201(a)	Frame cracked/loose/sagging/broken	Cab, Body, Frame	2	Y
393.201(b)	Bolts securing cab broken/loose/missing	Cab, Body, Frame	2	N
393.201(c)	Frame rail flange improperly bent/cut/notched	Cab, Body, Frame	2	N
393.201(d)	Frame accessories improperly attached	Cab, Body, Frame	2	N
393.201(e)	Prohibited holes drilled in frame rail flange	Cab, Body, Frame	2	N
393.203	Cab/body parts requirements violations	Cab, Body, Frame	2	Y
393.203(a)	Cab door missing/broken	Cab, Body, Frame	2	Y

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Section	Description	Group	Severity*	Affects Driver Score?
393.203(b)	Cab/body improperly secured to frame	Cab, Body, Frame	2	Y
393.203(c)	Hood not securely fastened	Cab, Body, Frame	2	Y
393.203(d)	Cab seats not securely mounted	Cab, Body, Frame	2	Y
393.203(e)	Cab front bumper missing/unsecured/protruding	Cab, Body, Frame	2	Y
393.205(a)	Wheel/rim cracked or broken	Wheels, Studs, Clamps, Etc.	2	Y
393.205(b)	Stud/bolt holes elongated on wheels	Wheels, Studs, Clamps, Etc.	2	Y
393.205(c)	Wheel fasteners loose and/or missing	Wheels, Studs, Clamps, Etc.	2	Y
393.207(a)	Axle positioning parts defective/missing	Suspension	7	Y
393.207(b)	Adjustable axle locking pin missing/disengaged	Suspension	7	Y
393.207(c)	Leaf spring assembly defective/missing	Suspension	7	Y
393.207(d)	Coil spring cracked and/or broken	Suspension	7	Y
393.207(e)	Torsion bar cracked and/or broken	Suspension	7	Y
393.207(f)	Air suspension pressure loss	Suspension	7	Y
393.207(g)	No/defective air suspension exhaust control	Suspension	7	N
393.209(a)	Steering wheel not secured/broken	Steering Mechanism	6	Y
393.209(b)	Excessive steering wheel lash	Steering Mechanism	6	Y
393.209(c)	Loose steering column	Steering Mechanism	6	Y
393.209(d)	Steering system components worn, welded, or missing	Steering Mechanism	6	Y
393.209(e)	Power steering violations	Steering Mechanism	6	Y
396.1	Must have knowledge of and comply with regulations	Inspection Reports	4	Y
396.3(a)(1)	Inspection/repair and maintenance parts and accessories	Wheels, Studs, Clamps, Etc.	2	Y
396.3A1B	Brakes (general)	Brakes, All Others	4	Y
396.3A1BA	Brake out of adjustment	Brakes Out of Adjustment	4	N
396.3A1BC	Brake — air compressor violation	Brakes, All Others	4	N
396.3A1BD	Brake — defective brake drum	Brakes, All Others	4	N
396.3A1BL	Brake system pressure loss	Brakes, All Others	4	N
396.3A1DSCB	Center Bearing (Carrier Bearing) Cracked / Loose / Broken / Missing	Other Vehicle Defect	3	N
396.3A1DSDT	Drive Shaft Tube Cracked or Twisted	Other Vehicle Defect	3	N
396.3A1DSUJ	Universal Joint Loose / Broken / Missing Component	Other Vehicle Defect	3	N

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Section	Description	Group	Severity*	Affects Driver Score?
396.3A1DSYE	Drive Shaft Yoke Ends Cracked / Loose / Broken / Missing	Other Vehicle Defect	3	N
396.3A1T	Tires (general)	Tires	8	Y
396.5	Excessive oil leaks†	Other Vehicle Defect	3	N
396.5(a)	Failing to ensure that vehicle is properly lubricated	Other Vehicle Defect	3	N
396.5A-HNLIW	Hubs — no visible or measurable lubricant showing in the hub — inner wheel	Wheels, Studs, Clamps, Etc.	2	N
396.5A-HNLOW	Hubs — no visible or measurable lubricant showing in the hub — outer wheel	Wheels, Studs, Clamps, Etc.	2	Y
396.5(b)	Oil and/or grease leak	Other Vehicle Defect	3	N
396.5B-HLIW	Hubs — oil and/or grease leaking from hub — inner wheel	Wheels, Studs, Clamps, Etc.	2	N
396.5B-HLOW	Hubs — oil and/or grease leaking from hub — outer wheel	Wheels, Studs, Clamps, Etc.	2	Y
396.5B-HWSLIW	Hubs — wheel seal leaking — inner wheel	Wheels, Studs, Clamps, Etc.	2	N
396.5B-HWSLOW	Hubs — wheel seal leaking — outer wheel	Wheels, Studs, Clamps, Etc.	2	Y
396.7	Unsafe operations forbidden	Other Vehicle Defect	3	Y
396.9(c)(2)	Operating an OOS vehicle	Vehicle Jumping OOS	10	Y
396.9(d)(2)	Failure to correct defects noted on inspection report	Inspection Reports	4	N
396.11	No or inadequate driver vehicle inspection report	Inspection Reports	4	Y
396.13(c)	No reviewing driver's signature on Driver Vehicle Inspection Report (DVIR)	Inspection Reports	4	Y
396.17(c)	Operating a CMV without proof of a periodic inspection	Inspection Reports	4	N
398.5	Operating a motor vehicle not in compliance with parts and accessories regulations — migrant workers	Other Vehicle Defect	3	Y
398.7	Failure to inspect or maintain motor vehicle to ensure safe and proper operating condition — migrant workers	Inspection Reports	4	N
399.207	Vehicle access requirements violations	Cab, Body, Frame	2	N
399.211	Inadequate maintenance of driver access	Cab, Body, Frame	2	N

*Severity is increased by 2 if the violation results in an out-of-service order.

†This violation is expected to be removed from the scoring system at a later time based on regulatory changes.

There are two “safeties” built into the system. First, one inspection cannot put more than 30 “severity points” into a BASIC. Second, if a violation repeats on an inspection (such as brakes out of adjustment), the violation is only counted once. These are in place because the system is looking for

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carriers that have a history of violations, not a carrier that has one really bad inspection.

Crashes are also severity weighted, depending on the severity of the crash. If the crash involved an injury or fatality, the crash is given a severity weight of 2. If the crash involved no injuries or fatalities, but a vehicle had to be towed away from the scene, the crash is given a severity of 1. If any crash involved the release of a hazardous material (other than motor fuel), the severity is increased by 1. Here is a table that summarizes the crash severity weighting system:

Crash Type	Crash Severity Weight
Involves tow-away but no injury or fatality	1
Involves injury or fatality	2
Involves a hazmat release	Crash Severity Weight (from above) + 1

Once the severity weight has been determined for a violation, the next step is to “time weight” the violation or crash. Time weighting rewards or punishes carriers and drivers for more recent activity. Violations or crashes that took place in the last six months are given a time weighting of 3. If the violation or crash took place between 6 and 12 months ago, the time weighting is 2. If the violation or crash took place more than a year ago, the time weighting is one. Violations and crashes are used to calculate the carrier’s score for two years, and the driver’s for three years. Here is a table that shows the time weighting (driver time weighting is slightly different):

Event took place...	Time weight
Within the last 6 months	3
6 to 12 months ago	2
12 or more months ago	1

Violations that occurred more than 24 months ago are not used in the scoring.

To determine the full value of a violation simply multiply the total violation severity value (the severity value plus two for being placed out of service, if applicable) by the time weighting.

Once per month, carriers and drivers are scored in each BASIC. The BASIC scoring process involves first adding up all the severity and time weighted events in the BASIC.

To begin scoring carriers, this total is then divided by a “normalizing factor.” In the Unsafe Driving and Crash BASICs, the total is divided by the number of power units the carrier has reported on their recent MCS-150s multiplied by a utilization factor that is based on the number of miles per power unit. In the HOS Compliance, Controlled Substance and Alcohol, and Driver Fitness BASICs, the total is divided by the “time-weighted” driver inspections the carrier has undergone (inspections are time weighted the same as violations) in the previous two years. In the Vehicle Maintenance BASIC, the total is divided by the time-weighted vehicle inspections the carrier has undergone. In the HM BASIC, the severity and time weighted HM violations are divided by the time-weighted HM inspections.

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This “normalizing process” creates a “BASIC Measure” in each BASIC. This BASIC Measure is then compared to the BASIC Measures of other carriers in the carrier’s Safety Event Group. Carriers are assigned a Percentile Ranking within the Safety Event Group based on the carrier’s BASIC Measure. The carrier with the lowest (best) BASIC Measure is given a percentile rank (score) of 0, while the carrier with the highest (worst) BASIC Measure in the BASIC is given a percentile rank of 100. All other carriers in the Safety Event Group are assigned a percentile rank in between, based on their BASIC Measure. This percentile rank inside the Safety Event Group is the carrier’s BASIC Score.

To sum this process up, if a carrier has a BASIC Score of 70 this means that 69 percent of the carriers in the carrier’s Safety Event Group have a better BASIC Measure and only 29 percent of the carriers have a worse BASIC Measure.

The Safety Event Groups are based on the number of inspections with a violation in the BASIC, the number of driver inspections, the number of vehicle inspections, the number of HM inspections, or the number of crashes, depending on the BASIC. Here are the Safety Event Group Tables that the CSA SMS uses:

Safety Event Groups in the Unsafe Driving BASIC

Group	Number of inspections with Unsafe Driving violation: Combination Vehicle Fleet	Number of inspections with Unsafe Driving violation: Straight Vehicle Fleet
1	3-8	3-4
2	9-21	5-8
3	22-57	9-18
4	58-149	19-49
5	150 or more	50 or more

Safety Event Groups in the Driver Fitness, HOS Compliance, and Vehicle Maintenance BASICS

Group	Number of Relevant Inspections
1	3-10 (HOS); 5-10 (All others)
2	11-20
3	21-100
4	101-500
5	501+

A “relevant inspection” is a driver inspection in the driver-related BASICS and a vehicle inspection in the Vehicle Maintenance BASIC.

Safety Event Groups in the Controlled Substance and Alcohol BASIC

Group	Number of inspections with a Controlled Substance or Alcohol violation
1	1
2	2
3	3
4	4 or more

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Safety Event Groups in the HM Compliance BASIC

Group	Number of Relevant Inspections
1	5-10
2	11-15
3	16-40
4	41-100
5	101+

A “relevant inspection” in the HM Compliance BASIC is an inspection where the vehicle required placarding at the time of the inspection.

Safety Event Groups in the Crash BASIC

Group	Number of crashes: Combination Vehicle Fleet	Number of crashes: Straight Vehicle Fleet
1	2-3	2
2	4-6	3-4
3	7-16	5-8
4	17-45	9-26
5	46 or more	27 or more

Driver scores are arrived at using a similar process, except that in the Unsafe Driving, Controlled Substances and Alcohol, and Crash BASICS the driver’s BASIC Measure is not a “normalized number.” The driver’s BASIC Measures in these BASICS are simply the total of all severity and time-weighted events.

Also, there are no driver Safety Event Groups in the Unsafe Driving, Controlled Substances and Alcohol, and Crash BASICS. Drivers’ BASIC Measures are directly compared to all other drivers’ BASIC Measures to determine the drivers’ percentile ranks, and therefore BASIC Scores.

In the other BASICS, the driver system mirrors the carrier system. To arrive at the BASIC Measures in the HOS Compliance and Driver Fitness BASICS, the total is divided by the time-weighted driver inspections the driver has undergone (inspections are time weighted the same as violations). In the Vehicle Maintenance BASIC, the total is divided by the time-weighted vehicle inspections the driver has undergone. In the HM BASIC, the severity and time-weighted HM violations are divided by the time-weighted HM inspections.

In these BASICS, the driver’s BASIC Measure is then compared to other drivers in their Safety Event Group. The driver’s percentile rank within the Safety Event Group is the driver’s BASIC Score. The Safety Event Groups are based on the number of inspections (see tables below).

Driver Safety Event Groups in the HOS Compliance, Driver Fitness, Vehicle Maintenance, and HM Compliance BASICS

Group	Number of Relevant Inspections
1	3
2	4-6
3	7+

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Once again, a “relevant inspection” is a driver inspection in the driver-related BASICs, a vehicle inspection in the Vehicle Maintenance BASIC, and a HM inspection in the HM Compliance BASIC.

Evaluation

Once the CSA Safety Measurement System has scored all carriers the next step is to evaluate the carriers to determine what carriers need an intervention. To evaluate carriers the FMCSA has been using a three-step approach.

The three-step approach uses carrier “type” (passenger, hazmat, and regular property are the only three types), carrier BASIC Scores, and predetermined thresholds. Carriers are subject to interventions if the carrier has a BASIC Score over the threshold in any BASIC, and the threshold is based on the carrier type.

Passenger Carriers: Passenger carriers have the lowest intervention thresholds. Passenger carriers for the purposes of the CSA program are carriers that have indicated they operate passenger-carrying vehicles on their MCS-150, and the passenger-carrying vehicles comprise more than 2 percent of the fleet vehicles. If a passenger carrier has a BASIC Score above these thresholds, the carrier is subjected to an intervention. Passenger carriers have an intervention threshold of:

- **50** in the Unsafe Driving, HOS Compliance, and Crash BASICs,
- **65** in the Controlled Substance and Alcohol, Driver Fitness, and Vehicle Maintenance BASICs, and
- **80** in the HM Compliance BASIC.

Hazmat Carriers: The thresholds for hazmat carriers are not as low as for the passenger carriers, but they are lower than the regular property carriers. A hazmat carrier for the purposes of the CSA program is a carrier that has had two roadside inspections during which the vehicle was required to be placarded in the last two years (with one having taken place in the last 12 months). Also the HM inspections must make up more than 5 percent of the carrier’s inspections. Carriers that have applied for and been issued the FMCSA’s hazardous materials safety permit are also evaluated as a hazmat carrier. The hazmat carrier thresholds are:

- **60** in the Unsafe Driving, HOS Compliance, and Crash BASICs,
- **75** in the Controlled Substance and Alcohol, Driver Fitness, and Vehicle Maintenance BASICs, and
- **80** in the HM Compliance BASIC.

Regular Property Carriers: Regular property carriers have the highest Intervention Threshold as their operations are viewed as the “lowest risk.” Here are the regular property carrier intervention thresholds:

- **65** in the Unsafe Driving, HOS Compliance, and Crash BASICs, and
- **80** in the Controlled Substance and Alcohol, Driver Fitness, Vehicles, and HM Compliance BASICs.

One warning about these intervention threshold numbers: The FMCSA has said that these numbers are one of the things that may change over

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time (the other component that is likely to see more changes is the severity weighting table).

To be declared “Unfit” and ordered out of business, the carrier will need to be over a yet-to-be determined “Failing” threshold in one or more BASIC. However, no carrier (or driver) can be declared “Unfit” based on the BASIC Scores alone until the rule allowing such action is proposed, commented on, and made final. For the time being, carriers with high BASIC scores or multiple BASICs over the threshold are being subjected to the most severe intervention available to the FMCSA, a compliance review. If the carrier is rated as “Unsatisfactory” following the compliance review, the carrier can be subject to an out-of-service order. If the carrier fails to submit and follow a corrective action plan, the FMCSA can enforce the order effectively shutting the carrier down.

Two key points about driver evaluations and interventions: First, the driver BASIC Measures and Scores are confidential, and no one except officers, investigators, and auditors can see them (carriers can see the driver data, but not driver Measures and Scores by using the Driver Pre-employment Screening Program).

Second, there is no intervention threshold component to the Driver Safety Measurement System/Safety Evaluation (at this time). However, drivers are subject to interventions. The way the driver intervention system works for the moment (this is subject to change) is whenever a carrier undergoes an intervention, part of the intervention involves a check of all of the carrier’s drivers’ CSA BASIC Scores. Drivers with “high scores” (the FMCSA discussed using 90 at one time, but this has not been official adopted) have their violation records reviewed and may be intervened with directly at that point (given a formal warning letter called a Notice of Violation or a fine, called a Notice of Claim).

Interventions

Carriers that are below the threshold in all of the BASICs receive no intervention. They are allowed to continue to operate with no intervention. However, carriers could still receive a visit from an audit team if the carrier is involved in a serious crash, a series of crashes, or is the subject of a valid complaint.

Carriers that are above the threshold in any of the BASICs are considered in the “Alert” status, and may be subjected to an intervention. The exact intervention will depend on how high the BASIC score is, how many BASICs are over the threshold, and the carrier’s enforcement/intervention history with the FMCSA. The interventions include:

Warning letter: Warning letters inform the carrier that the FMCSA has seen a problem, and inform the carrier that they need to correct it, or further action will be forthcoming. There is no response required, only improvement.

Increased roadside enforcement: This intervention will result in the carrier being “flagged” as “optional” or “inspect” in the FMCSA data system that is visible to roadside officers (the ISS discussed earlier). This flagging will result in the carrier seeing an increased number of road inspections. To sum this intervention up, roadside inspectors will be “looking” for the carrier’s vehicles. Also, the officers on the road are able to see

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the BASIC or BASICs that have led to the ISS recommendation of “optional” or “inspect.”

Focused on and off site investigations: The “focused” interventions involve an auditor only checking the BASIC areas that the carrier is having trouble in. Example: the only BASIC a carrier is having trouble in is the HOS Compliance BASIC (too many drivers found not in compliance with the HOS regulations). The focused on or off site investigation will only involve compliance with the HOS regulations unless other problems are found or suspected.

Comprehensive (compliance) review: The Comprehensive Review is a full and complete review of the carrier’s safety program and all records related to it.

Cooperative Safety Plan: Cooperative safety plans can be used at any time, but can really be expected after another intervention did not go well. It involves submitting a plan to the FMCSA that explains how the carrier is going to address the problems that the intervention or SMS has pointed out.

Notice of Violation: A Notice of Violation is an official notice from the FMCSA that specific problems must be fixed, or else.

Notice of Claim/Settlement Agreement: This is the FMCSA’s method of fining a carrier.

Presently, the only interventions that are being used with drivers are Notice of Violation and Notice of Claim.

Scoring yourself in CSA

Of particular interest to the Maintenance Pro is the scoring in the Vehicle Maintenance BASIC. Here is a quick overview of the scoring in this BASIC:

Step 1

Locate all roadside inspections from the past two years that involved a vehicle inspection.

Step 2

Locate all roadside inspections that list a vehicle violation (the only exception is a vehicle violation listed on a driver-only inspection). Locate the severity weight in the table above for each vehicle violation on the inspection report.

Step 3

Add up the severity weights for all violations on each inspection. If the severity weights add up to more than 30, stop at 30. If the inspection had no violations, its severity weighting is 0.

Step 3

Time weight the severity weight total for each inspection. This is done by multiplying the severity weight by the appropriate time weight. The time weight is based on the date of inspection. The time weight for an inspection that took place in the last 6 months is 3, 6 to 12 months ago 2, and more than a year ago 1.

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Step 4

Add the severity and time weighted total for all inspections together.

Step 5

The next step is to time weight all the vehicle inspections and driver inspections that listed a vehicle violation, good and bad. An inspection that occurred in the last 6 months is given a time weight of 3, 6 to 12 months ago 2, and more than a year ago 1.

Step 6

Divide the total of all time and severity weighted violations by the time weighted inspections total.

This number is the BASIC Measure for the Vehicle Maintenance BASIC. This is what will be used to determine the carrier's BASIC Score in the Vehicle Maintenance BASIC. It is also the key benchmark that a Maintenance Pro needs to watch. To improve the carrier's score, the Maintenance Pro will need to make this number go down. How do you do that? By eliminating on-the-road violations, especially the "high severity" violations.

Keeping your score low

To keep your score low you will need to track roadside inspection reports, maintenance repair (work) orders, on-the-road repairs, and make adjustments to the maintenance program. Changes could include shortening the maintenance interval or increasing the items checked during preventive maintenance.

The other component to lowering this score (or keeping it low) is working with drivers and making sure they are doing complete inspections, communicating defects to the company immediately, that they understand the company policy in respect to on-road-the road repairs, and that they do not operate vehicles that are in need of repair.

Checking your data

Maintenance managers and supervisors should either ask for, or get for themselves, a download of all roadside inspections the FMCSA has on file for the company. Of particular interests to you are vehicle roadside inspections and all roadside inspections that include a vehicle violation. This can be done for now by going to the Safety Measurement System website at: <http://ai.fmcsa.dot.gov/SMS>. At this point, enter the USDOT number and PIN number assigned to your company by the FMCSA in the section that says "Motor Carrier Login." If you do not know your PIN, check with the safety and operations departments to see if they have the PIN. If you cannot locate the PIN, the login system will instruct you on how to acquire it online or you may contact the FMCSA.

Once logged into the site, enter your USDOT number in the search box and click "search." After your overview page is displayed, click on the "Vehicle Maintenance" tab to display the Vehicle Maintenance BASIC page. As you scroll down the page, you will find a violation summary (this is useful for locating your high frequency and high severity violations,

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which are the ones you want to deal with quickly) followed by the inspection details section. You have two display options in this section, all relevant inspections or inspections with a vehicle violation. By clicking on the report number (the left most column) you can see the complete inspection report, including all violations written during the inspection, not just the summary of violations that is shown for each inspection.

You will want to compare this data to what you know through the violation reports that you have reviewed from the drivers. If an inspection appears in the FMCSA data that you were not aware of, check to see that an inspection from another carrier was not accidentally assigned to your fleet. Verify that the plate number and driver are yours. If the vehicle and driver are yours, find the driver involved and discuss the situation with him or her. If the inspection belongs to another carrier, file a challenge using the DataQs system.

Also, if you do not agree that a violation was actually a violation you can challenge the violation in DataQs. The key with this is going to be supporting your argument. You will need to provide proof that the violation did not exist at the time of the inspection or that the officer made a mistake.

DataQs can be accessed from any page in the CSA SMS. Simply click on the “How do I correct my data” link. DataQs will ask you to input the inspection date and number and to explain (and support) why the inspection or violation should not be in your data.

§396.11 Driver vehicle inspection report(s) (DVIRs), is the next requirement we’ll address — and this is a big one. This is the regulation most commonly cited following a compliance review or safety investigation (audit).

Your drivers, operations, and maintenance personnel must have a thorough understanding of the DVIR process. Make sure it is adequately covered during any training.

What exactly is this process? To ensure vehicle safety, each of your drivers should be required to perform a *post-trip* inspection at the end of each workday on all vehicles operated. The driver is *required* to complete a DVIR at the end of each workday.

Whatever DVIR form you use, remember, at a minimum, it must include provisions for three signatures:

- The signature of the driver who actually prepared the report;
- The signature of the mechanic who certified the reported defects or deficiencies were repaired or corrected — or that no corrections were needed; and
- The signature of the next driver who reviews the DVIR as part of his or her pretrip inspection acknowledging the corrective action taken (or agreeing that repairs were not necessary).

Under the intermodal roadability regulations, drivers must provide the intermodal provider with a written report reporting the condition of intermodal equipment when the equipment is returned, if there is a defect. Much like the DVIR, the intermodal provider must review these reports,

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and a representative of the provider must sign that any reported defects were repaired, or that the defects listed did not require repair. This form is then kept by the provider for three months (unlike the carrier DVIR, the next driver does not have to sign that the repairs were completed or not necessary).

If you are operating intermodal chassis provided by an intermodal equipment provider, you and your driver are still subject to the regular carrier DVIR requirements (the chassis will show up on the driver's regular DVIR as a trailer). The additional reporting and retention requirement applies to the equipment provider, not the carrier. The only carrier requirement is the driver completing the intermodal equipment provider's inspection report and providing it to the equipment provider when returning the equipment, if there is a defect. These requirements are discussed in §396.11 and §396.12 (§396.12 only applies to intermodal equipment providers).

§396.13 Driver inspection, is the second *pretrip* inspection requirement found in the FMCSRs. Along with §392.7, it reinforces your drivers' responsibility to satisfy themselves that the CMV is in safe operating condition. This section also closes the loop on the DVIR process. It states your drivers must review the last DVIR and sign the report *only* if safety-related defects or deficiencies were noted and repairs were made.

As this failure of this process (pretrip/post trip/DVIR) is one of the most common reasons carriers are fined during compliance reviews, we will spend a little extra time on it.

This section (§396.13) mandates that the driver shall satisfy him or herself that basic parts and accessories are in *good working condition* before the vehicle is driven. There is no reporting requirement in the regulations for this inspection, which is referred to as a "pretrip inspection." Some carriers have created a "pretrip form" for use by the drivers, but this is not required by the regulations.

The pretrip requirement in Part 396 requires the driver to check the previous day's driver's DVIR (even if it is the same driver) as well as performing a pretrip inspection to assure that the vehicle is in safe working condition. The driver must then sign the previous day's DVIR below the "person performing repairs" signature if the previous DVIR noted any defects. This signature indicates that any necessary repairs were performed, or that the driver agrees that the repairs are not immediately necessary because the defect will not impact the safe operation of the vehicle.

Upon completion of the work day, the driver is to complete a DVIR reporting the condition of the vehicle to the carrier. Even if nothing is wrong with the vehicle, the driver must still complete the DVIR. As a convenience many carriers locate the DVIR on the back or lower half of the drivers' record of duty status (log). While this is convenient for the driver, it may create problems for the maintenance department as they may not normally receive the drivers' logs. If the drivers are marking defects on the DVIR form on the log, there needs to be a mechanism in place to get the DVIRs to the maintenance department, signed by the technicians

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performing the repairs, and signed by the next drivers to pretrip the vehicles.

Once the driver has completed the DVIR, it is the carrier's responsibility to act on the report. If the driver has noted any defects, the carrier must either repair them and sign the report, or mark that repairs are necessary, and then sign the report.

Drivers are allowed to sign as the person performing repairs for any repairs they perform. If a driver's post-trip inspection discovered a defective turn signal light, and the driver noted it on the DVIR, then repaired it, the driver would sign as the driver, the person completing the repair, and the next driver verifying the repair if he/she drove the vehicle the next day.

To sum it up, the driver inspection responsibility falls into two primary parts — the pretrip and post-trip inspections. After the post-trip, the driver is to complete a DVIR and submit it. If no defects are noted, no action is necessary (simply file the DVIR and retain it for three months). If the driver noted a defect, the carrier must act on the DVIR. The carrier must see to it the vehicle is repaired and then a representative of the carrier must sign the DVIR (or the driver or a mechanic from an outside shop if the vehicle is repaired on the road). The next driver must then sign that the repairs were completed (or that he/she agrees with the company representative that repairs were not necessary).

§396.17 and §396.19 Periodic inspection, are the regulations that require each of your CMVs to be inspected at least once every 12 months. This is the "annual" vehicle inspection regulation. These regulations also apply to intermodal equipment providers. They are required to see to it that the equipment they provide to motor carriers has been annually inspected.

The regulations require that all CMVs controlled by you and operated in interstate commerce pass an inspection at least annually. You are responsible to ensure all your vehicles are inspected (and that vehicles provided to you by others, such as intermodal equipment providers and leasing companies have been annually inspected).

If you do your own periodic inspections, they must be performed by a qualified inspector who meets the requirements found in §396.19.

If you are having an outside shop perform some or all of your periodic inspections, make sure that they are actually doing the inspections, and that the inspections are being done in accordance with the regulations. You, as a carrier, are still responsible for the inspection, even if it is done by another party.

There are cases (both criminal and civil) involving Maintenance Pros being held responsible for poor periodic inspections done by outside shops. The civil cases have involved Maintenance Pros not verifying that the outside shop was doing the periodic inspection correctly. The criminal cases involved Maintenance Pros knowing that the outside shops were not doing the inspections correctly. In one criminal case that led to jail time, the Maintenance Pro knew the shop was not even conducting the inspections, even though the carrier was receiving the required reports

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and decals (the vehicles were never in the outside shop that issued the reports and decals).

§396.21 Periodic inspection recordkeeping requirements, provides the documentation rules for your periodic inspections.

The qualified inspector performing your annual inspections must prepare a report for each inspection which identifies:

- The name of the individual performing the inspection;
- The motor carrier operating the vehicle;
- The date of the inspection;
- The vehicle inspected; and
- The components inspected.

All periodic inspection reports must be retained where your vehicles are housed or maintained for 14 months. A copy of the inspection report, or a decal containing minimal information about the inspection, must be on your vehicles.

The annual inspection requirement can actually be met in a number of ways. The vehicle can:

- Pass a state or other jurisdiction roadside vehicle inspection, such as a Commercial Vehicle Safety Alliance Level I or Level 5 Inspection, and be issued a report and decal.
- Be inspected by a qualified inspector (according to the provisions of Section 396.19) on-site at the motor carrier's location and pass.
- Be inspected by your shop using a technician that you have qualified to perform periodic inspections.
- Be inspected by a commercial shop of some kind (shop, garage, or other third party acting as an agent for the motor carrier).
- Be inspected in one of the state-mandated programs which are equivalent to the federal requirements. States that have mandatory inspection programs that have been determined to be equivalent include:
 - Alabama (LPG Board)
 - California
 - Connecticut (bus inspection program)
 - Hawaii
 - Illinois
 - Louisiana
 - Maine
 - Maryland
 - Massachusetts
 - Michigan (bus inspection program)

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- Minnesota
- New Hampshire
- New Jersey
- New York
- Ohio (church bus inspection program)
- Pennsylvania
- Rhode Island
- Texas
- Utah
- Vermont
- Virginia
- Washington, D.C.
- West Virginia
- Wisconsin (bus inspection program)

What are the requirements? The specific items to be inspected are stated in Appendix G to Subchapter B — Minimum Periodic Inspection Standards, which is listed in the Regulation area of this manual. Also, at the end of this chapter is a sample Periodic Inspection Form.

One key point, you are allowed to certify technicians to perform periodic inspections. However, you must document that the individual knows the requirements of the regulations, and the procedures involved in performing the periodic inspections. The documentation must include proof that the individual *either* successfully completed a State- or Federal-sponsored training program, or has a combination of training and/or experience totaling at least 1 year. Such training and/or experience may consist of:

- Participation in a vehicle manufacturer-sponsored training program or similar commercial training program designed to train students in vehicle operation and maintenance.
- Experience as a mechanic or inspector in a motor carrier maintenance program.
- Experience as a mechanic or inspector at a commercial garage, fleet leasing company, or similar facility.
- Experience as a commercial vehicle inspector for a State, Provincial or Federal Government.

The documentation must be retained for the entire time the technician is employed, and for one year after the person leaves the company.

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ANNUAL VEHICLE INSPECTION REPORT-LABEL

237-FS-E3 (Rev. 7/97)

USE A PERMANENT IMAGE MARKER OR PENCIL TO WRITE ON THE LABEL
TO COMPLETE THE FORM FOLLOW THE INSTRUCTIONS ON THE BACK OF THE SET

ANNUAL VEHICLE INSPECTION REPORT

DATE _____		INSPECTOR'S NAME (PRINT) _____	
MOTOR CARRIER OPERATOR _____		THIS INSPECTOR MEETS THE QUALIFICATION REQUIREMENTS IN SECTION 396.19 ☐ YES ☐ NO	
ADDRESS _____		VEHICLE IDENTIFICATION (CHECK AND COMPLETE ONE) ☐ Lic. Plate No./State ☐ Fleet Unit Number	
CITY, STATE, ZIP CODE _____		☐ Veh. ID No. ☐ Other _____	
VEHICLE COMPONENTS INSPECTED mark X Yes, ok; mark X No, not ok; — Does not apply			
OKAY YES NO		OKAY YES NO	
1. BRAKE SYSTEM a. Service brakes b. Parking brake system c. Brake drums or rotors d. Brake hose e. Brake tubing f. Low pressure warning device g. Tractor protection valve h. Air compressor i. Electric brakes j. Hydraulic brakes k. Vacuum systems		7. STEERING MECHANISM a. Steering wheel free play b. Steering column c. Front axle beam and all steering components other than steering column d. Steering gear box e. Pitman arm f. Power steering g. Ball and socket joints h. Tie rods and drag links i. Nuts j. Steering system	
2. COUPLING DEVICES a. Fifth wheels b. Pintle hooks c. Drawbar/towbar eye d. Drawbar/towbar tongue e. Safety devices f. Saddle-mounts		8. SUSPENSION a. Any U-bolt(s), spring hanger(s), or other axle positioning part(s) cracked, broken, loose or missing resulting in shifting of an axle from its normal position. b. Spring assembly c. Torque, radius or tracking components	
3. EXHAUST SYSTEM a. Any exhaust system determined to be leaking at a point forward of or directly below the driver/sleeper compartment. b. A bus exhaust system leaking or discharging to the atmosphere in violation of standards (1), (2) or (3). c. No part of the exhaust system of any motor vehicle shall be so located as would be likely to result in burning, charring, or damaging the electrical wiring, the fuel supply, or any combustible part of the motor vehicle.		9. FRAME a. Frame members b. Tire and wheel clearance c. Adjustable axle assemblies (Sliding subframes)	
4. FUEL SYSTEM a. Visible leak b. Fuel tank filler cap missing c. Fuel tank securely attached		10. TIRES a. Tires on any steering axle of a power unit b. All other tires	
5. LIGHTING DEVICES All lighting devices and reflectors required by Section 393 shall be operable		11. WHEELS AND RIMS a. Lock or side ring b. Wheels and rims c. Fasteners d. Welds	
6. SAFE LOADING a. Part(s) of vehicle or condition of loading such that the spare tire or any part of the load or dunnage can fall onto the roadway b. Protection against shifting cargo		12. WINDSHIELD GLAZING Requirements and exceptions as stated pertaining to any crack, discoloration or vision reducing matter (reference 393.60 for exceptions)	
		13. WINDSHIELD WIPERS Any power unit that has an inoperative wiper, or missing or damaged parts that render it ineffective.	

CERTIFICATION: This vehicle has passed all the inspection items for the Annual Vehicle Inspection Report in accordance with 49 CFR 396.
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APPLY TO VEHICLE

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Likewise, §396.25 Qualifications of brake inspectors, provides qualification requirements for anyone you may have inspect, repair, service, or maintain the brakes of your CMVs.

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A brake inspector is defined as a person who is an employee of a motor carrier responsible for ensuring that inspections, maintenance, repairs, or service to the brakes meet applicable safety standards.

To qualify as a brake inspector a technician must be knowledgeable of and have mastered the methods, procedures, tools and equipment used, and understands the brake service or inspection task to be accomplished. The technician must also be capable of performing the assigned brake service or inspection by reason of experience, training, or both as follows:

- Has successfully completed an apprenticeship program sponsored by a State, a Canadian Province, a Federal agency or a labor union.
- Has successfully completed a training program approved by a State, Provincial or Federal agency.
- Has a certificate from a State or Canadian Province which qualifies the person to perform the assigned brake service or inspection task.
- Has brake related-training or experience or a combination thereof totaling at least one year. Such training or experience may consist of participation in a training program sponsored by a brake or vehicle manufacturer or similar commercial training program, experience performing brake maintenance or inspection similar to the assigned brake service or inspection task in a motor carrier maintenance program, or experience performing brake maintenance or inspection similar to the assigned brake service or inspection task at a commercial garage, fleet leasing company, or similar facility.

| A driver without an *air brake restriction* on his or her CDL is qualified to inspect air brakes, but is *not* qualified to perform brake adjustments or other brake-related tasks unless the driver has the required training or experience to qualify as a brake inspector. A driver with an air-brake endorsement may only perform brake repairs (including adjustment) under the direct supervision of qualified brake inspector.

Finally, you are required to maintain evidence of brake inspector qualifications at your principal place of business or where the inspector is employed. The documentation must be retained for as long as the inspector is employed in that capacity and for one year thereafter for brake inspectors.

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BRAKE INSPECTOR CERTIFICATION

MOTOR CARRIER

DATE

LOCATION

NAME OF BRAKE INSPECTOR (PRINT)

§396.25 Qualifications of brake inspectors.

(a) The motor carrier shall ensure that all inspections, maintenance, repairs or service to the brakes of its commercial motor vehicles, are performed in compliance with the requirements of this section.

(b) For purposes of this section, "brake inspector" means any employee of a motor carrier who is responsible for ensuring all brake inspections, maintenance, service, or repairs to any commercial motor vehicle, subject to the motor carrier's control, meet the applicable Federal standards.

(c) No motor carrier shall require or permit any employee who does not meet the minimum brake inspector qualifications of §396.25(d) to be responsible for the inspection, maintenance, service or repairs of any brakes on its commercial motor vehicles.

(d) The motor carrier shall ensure that each brake inspector is qualified.

I AM A QUALIFIED BRAKE INSPECTOR BASED ON THE FOLLOWING:

- (1) I understand the brake service or inspection task to be accomplished and can perform that task; and
- (2) I am knowledgeable of and have mastered the methods, procedures, tools, and equipment used when performing an assigned brake service or inspection task; and
- (3) I am capable of performing the assigned brake service or inspection by reason of experience, training or both as follows:

- (i) I have successfully completed an apprenticeship program sponsored by a State, a Canadian Province, a Federal agency or a labor union, or a training program approved by a State, Provincial or Federal agency, or have a certificate from a State or Canadian Province which qualifies me to perform the assigned brake service or inspection task (including passage of Commercial Driver's License air brake tests in the case of a brake inspection):

Name of Program/Certificate

OR

- (ii) I have brake-related training or experience or a combination thereof totaling at least **one year**. Such training or experience shall consist of:

- (A) Participation in a training program sponsored by a brake or vehicle manufacturer or a similar commercial training program designed to train students in brake maintenance or inspection similar to the assigned brake service or inspection tasks:

Name of Program/Certificate _____ How Long? _____ Months

Years
(Circle One)

or

- (B) Experience performing brake maintenance or inspection similar to the assigned brake service or inspection task in a motor carrier maintenance program:

Name of Employer _____ How Long? _____ Months

Years
(Circle One)

Name of Employer _____ How Long? _____ Months

Years
(Circle One)

or

- (C) Experience performing brake maintenance or inspection similar to the assigned brake service or inspection task at a commercial garage, fleet leasing company, or similar facility:

Name of Employer _____ How Long? _____ Months

Years
(Circle One)

Name of Employer _____ How Long? _____ Months

Years
(Circle One)

NOTE: Combination of (A), (B), and (C) above must total at least one year.

SIGNATURE OF BRAKE INSPECTOR

DATE

SIGNATURE OF COMPANY REPRESENTATIVE

DATE

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BRAKE INSPECTOR CERTIFICATION	
	Company _____
	Location _____
§396.25 Qualifications of brake inspectors	
(b) For purposes of this section, "brake inspector" means any employee of a motor carrier who is responsible for ensuring all brake inspections, maintenance, service, or repairs to any commercial motor vehicle, subject to the motor carrier's control, meet the applicable Federal standards.	
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THIS CERTIFIES THAT:	
Name _____	
I am qualified under 396.25(d) to be responsible for the brake service and/or inspection tasks assigned. I:	
1) understand the brake service or inspection task to be accomplished and can perform that task; and	
2) am knowledgeable of and have mastered the methods, procedures, tools and equipment used when performing an assigned brake service or inspection task; and	
3) am capable of performing the assigned brake service or inspection by reason of experience, training or both.	
Employee Signature _____	Date _____
Company Representative Signature _____	Date _____
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Appendix G and the CVSA North American Standard Out-of-Service Criteria

Appendix G. Appendix G to the FMCSA regulations establishes the conditions a vehicle must meet to pass a FMCSA periodic (sometimes referred to as an "annual") inspection. If the vehicle does not meet the conditions established in Appendix G, the inspector (usually not a law enforcement officer in this case, simply the title given to the person conducting the inspection) cannot pass the vehicle. The requirements for the periodic inspection are also referenced in other locations in the regulations. If a driver reports a defect, the carrier cannot put a vehicle back on the road until it meets the requirements of Appendix G (see the interpretation to §396.11, specifically Question 6 and the associated guidance).

Appendix G breaks the inspection down into 13 inspection areas, again broken down by vehicle component. They include standards covering:

- **Brake system**, including service brakes, parking brakes, brake drum or rotors, and brake hoses and tubing. For air brake vehicles the appendix includes standards on low pressure warning devices, tractor protection valves, and air compressors. The appendix also includes standards for electric brakes, hydraulic brakes, and vacuum systems that support brakes.
- **Coupling devices**, including fifth wheels (upper and lower), pintle hooks, drawbars and tow eyes, drawbar and towbar tongues, safety devise (chains or cables), and saddle mounts.
- **Exhaust systems**, including leaks, location of the discharge point of the exhaust, and damage to other parts from contact with the exhaust system.
- **Fuel systems**, including leaks, caps, and securement of the tank(s).
- **Lighting devices**. Appendix G simply states that the lights and reflectors on the vehicle must meet all light and reflector requirements of Part 393.
- **Safe loading**, including securement devices for cargo and other equipment (spare tires, dunnage, etc.).

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- **Steering mechanism**, including steering wheel free play, steering column, front axle beam, steering gear box, pitman arm, power steering mechanism and hoses, ball and socket joints, tie rods and drag links, nuts, and the steering system overall.
- **Suspension**, including U-bolt(s), spring hanger(s), axle positioning part(s), spring assembly, and torque, radius, or tracking components.
- **Frame**, including frame members (rails, crossmembers, and fasteners), tire and wheel clearances, and sliding component subframes.
- **Tires**, including tread depth, condition, inflation, load rating, and position and type matching.
- **Wheels and rims**, including rims, wheels, fasteners, and welds.
- **Windshield**, including discoloration and/or anything (cracks, stickers, etc.) that is restricting the vision of the driver.
- **Windshield wipers**. These standards require that all wipers be fully functional.

North American Out-of-Service Criteria. The 13 areas listed in Appendix G are also the basis for the out-of-service criteria, with a few differences. Generally, if the vehicle has a defect that would cause it to not pass a periodic inspection, it may be placed out of service during a roadside inspection conducted under §396.9.

Any vehicle placed out of service must be repaired before it can resume operating on the roadway. This will require having the vehicle repaired at the location of the inspection, or having the vehicle towed to a repair facility. Documentation of the repairs (and towing if the vehicle was towed) will need to be handled and filed correctly to verify that the terms of the out-of-service order were complied with.

The actual out-of-service criteria is published by the Commercial Vehicle Safety Alliance (CVSA). Complete copies of the CVSA inspection procedures and criteria are available through the CVSA website at <http://www.cvsa.org/>.

As a general rule, the CVSA Out-of-Service Criteria follows Appendix G. The difference between the CVSA Out-of-Service Criteria and Appendix G is explained at the end of Appendix G. When there are differences, the out-of-service criteria is not as strict as Appendix G.

An example would be brakes. One defective brake (bad shoe, drum, or brake out-of-adjustment) would lead to a vehicle not passing a periodic inspection because of the Appendix G requirements. In the out-of-service criteria, the vehicle may be allowed to continue if only one brake has a defect. The vehicle is still in violation and the vehicle would not pass a periodic inspection, but the inspector may allow it to continue its trip and be repaired before its next dispatch, rather than placing it out of service.

Here is a list of the differences:

- **Brakes.** Appendix G criteria will not allow a vehicle to pass inspection if it has any brake defects (defective brakes, brakes out-of-adjustment, any air leaks, etc). The out-of-service criteria allows up to 20 percent of the brakes on non-steering axles to be defective

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before the vehicle is to be placed out-of-service. The out-of-service criteria also allows the roadside inspector a certain latitude before placing a vehicle out-of-service for air leaks.

- **Coupling devices.** Vehicles with any fifth wheel fastener missing or ineffective will not pass a periodic inspection under the requirements of Appendix G. The out-of-service criteria allows up to 20 percent missing or ineffective fasteners on frame mountings and pivot bracket mountings. On sliding fifth wheels up to 25 percent of the slider-latching fasteners are allowed to be ineffective. The out-of-service criteria also allows the inspector some latitude on cracked welds.
- **Exhaust.** The out-of-service criteria allows vehicles to exhaust forward of the locations specified in §393.83 as long as the exhaust does not leak or exhaust under the chassis. Otherwise, Appendix G follows §393.83 verbatim.
- **Lights.** Appendix G requires all lighting devices required by Part 393 to be operative. The out-of-service criteria allows a vehicle to stay in service if it has one stop light and turn signal functioning on the rear of the vehicle. In addition, during the hours of darkness, a vehicle can stay in service if it has one operative head lamp and tail lamp.
- **Suspension.** Appendix G does not allow any broken leaves in a leaf spring assembly. The out-of-service criteria allows up to 25% broken or missing leaves before requiring the vehicle be placed out of service.
- **Frame.** The out of service criteria allows a certain latitude in frame cracks before placing a vehicle out-of-service. Appendix G does not allow any frame cracks.
- **Tires.** Appendix G requires a tire tread depth of $\frac{4}{32}$ inch on steering axles and $\frac{2}{32}$ inch on all other axles. The out-of-service criteria only requires $\frac{2}{32}$ inch tire tread depth on steering axles and $\frac{1}{32}$ inch on all other axles.
- **Wheels and rims.** The out-of-service criteria allows a certain amount of latitude for wheel and rim cracks, and missing or defective fasteners. Appendix G does not allow any defects in the wheels and rims, or fasteners.
- **Windshield.** The out-of-service criteria places in a “restricted” service condition any vehicle that has a crack or discoloration in the windshield within the sweep of the wiper on the driver’s side. The out-of-service criteria does not address the remaining area of the windshield. Appendix G addresses the condition of the entire windshield.
- **Windshield wipers.** Appendix G requires all windshield wipers to be operative. The out-of-service criteria only requires that the windshield wiper on the driver’s side be operative during inclement weather.

The out-of-service criteria also includes several items not addressed in Appendix G. Examples include defects involving the vehicle’s driveshaft

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and electrical cables (high wattage wiring that is not overload protected) on buses.

How Part 393, Appendix G, and the CVSA Out-of-Service Criteria fit together. It is important to understand the relationship between the regulations, Appendix G, and the Commercial Vehicle Safety Alliance (CVSA) Out-of-Service Criteria.

Any defect that is a violation of the regulations in Part 393 can be noted as a violation on a roadside inspection. Also, the carrier and/or driver can be warned or cited for any violation of Part 393.

If the inspector finds a defect that is a violation of Part 393 his/her next decision is “Does the defect warrant an out-of-service order?” To determine if the defect warrants an out-of-service order the inspector will compare the defect to Appendix G and the CVSA Out-of-Service Criteria.

If the defect is specifically mentioned in Appendix G or the out-of-service criteria, the vehicle may be placed out of service.

The legal actions taken as a result of a violation (the warning or citation) and the decision to place the vehicle out of service are not necessarily related. A vehicle found to have defective headlights during daylight hours can be warned or cited for having defective required lights, which is a violation of the regulations, but may not be placed out of service.

To sum it up, the out-of-service criteria is strictly intended to get vehicles that are in an unsafe condition repaired before allowing them to continue.

Part 391— Qualification of drivers

Many operations are unaware that their mechanics are actually *drivers* for DOT purposes, if they operate commercial vehicles on the roadways. This means that all the necessary paperwork that would be kept for actual drivers must be kept for mechanics. To determine if your mechanics fall under Parts 390 through 396, you need to consider the following factors:

- Do your mechanics test-run vehicles defined as commercial motor vehicles (CMV) as found in §390.5? According to §390.5 a “commercial motor vehicle” is any vehicle with a gross weight rating, a gross combination weight rating, or an actual weight of over 10,001 or more pounds, and is used for interstate commerce.
- Are these vehicles taken onto a public highway as defined in §390.5? This can include a private driveway or lot which allows vehicles, vendors, and visitors unrestricted access. Even backing a CMV in or out of a stall into a parking spot could qualify your drivers by these definitions.
- Are you involved in interstate commerce as defined in §390.5? If not, you would need to contact your individual state agency to see which of the federal regulations have been adopted for intrastate commerce, and if any exceptions exist or definitions differ.

If you meet the criteria, your mechanics fall under the following areas: driver qualification, hours of service, vehicle inspections, and possibly drug and alcohol testing.

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If your technicians qualify as drivers under the applicable definitions in §390.5, then you and your mechanics are subject to Part 391 — Driver Qualifications, including maintaining a Driver Qualification File.

§391.11 Driver Qualifications. The first question in qualifying a technician as a driver is: Is the technician qualified? According to §391.11(b), an individual is qualified to drive a commercial motor vehicle if the individual:

- Is at least 21 years old;
- Can read and speak the English language sufficiently to converse with the general public, to understand highway traffic signs and signals in the English language, to respond to official inquiries, and to make entries on reports and records (§391.11(b)(2) is “the must be able to read and write English” requirement);
- Can, by reason of experience, training, or both, safely operate the type of CMV you intend to have the driver drive;
- Is physically qualified to drive a commercial motor vehicle (has passed a FMCSA physical and the company has a valid medical certificate or a copy of a MVR showing the technician as medically qualified on file);
- Has one valid commercial motor vehicle operator’s license;
- Has prepared and furnished you with a list of violations (other than parking tickets) covering the last 12 months;
- Is not disqualified to drive a CMV (see §391.15 below); and
- Has successfully completed a road test and has been issued a certificate of driver’s road test, or has presented you with an acceptable equivalent (an operator’s license that required a road test to get or a certificate of road test from a previous employer).

§391.15 Disqualification of drivers, prohibits you from using a *disqualified* driver to operate any of your CMVs. Keep in mind that the disqualification rules found in §391.15 apply to technicians also.

One of the most important things to understand about §391.15 is how it relates to §383.51, disqualification of CDL licensed drivers. Section 383.51 applies to *interstate and intrastate* drivers required to have a CDL to operate the vehicle. Section 391.15 applies to *interstate* drivers of commercial vehicles over 10,000 pounds, transporting hazmat requiring a placard, or transporting more than 15 passengers (including the driver). If a driver is subject to both sections, the more stringent regulation will apply. In most cases that will be §383.51.

Under §391.15(b) Disqualification for loss of driving privileges, if a technician loses his or her CMV operator’s license (either temporarily or permanently) by reason of revocation, suspension, withdrawal, or denial, that driver becomes *disqualified*.

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How do you discover any of the above conditions? Your technician is required to tell you.

§391.15(c) provides further disqualification information including:

- Disqualification for certain criminal offenses;
- Disqualifying offenses; and
- Duration of disqualification.

§391.15(d) Disqualification for violation of out-of-service orders, applies to anyone who drives a commercial vehicle for the company. Any driver or technician who is convicted of violating an out-of-service order is disqualified for the following period of time:

- First violation — A driver is disqualified for not less than 90 days nor more than one year if the driver is convicted of a first violation of an out-of-service order.
- Second violation — A driver is disqualified for not less than one year nor more than five years if, during any 10-year period, the driver is convicted of two violations of out-of-service orders in separate incidents.
- Third or subsequent violation — A driver is disqualified for not less than three years nor more than five years if, during any 10-year period, the driver is convicted of three or more violations of out-of-service orders in separate incidents.

One key point to remember — DO NOT SEND A TECHNICIAN WHO IS QUALIFIED AS A DRIVER TO DRIVE AN OUT-OF-SERVICE VEHICLE TO THE TERMINAL FOR A DRIVER. If your technician is caught operating an out-of-service vehicle, the technician will suffer the same fate as the driver would have. If it is necessary to send a technician out, have him/her repair the vehicle before operating it!

§391.21 provides the requirements (actual content) your driver applications must contain. If your technicians need to be qualified as drivers, they will need to complete a driver application.

§391.23 Investigation and inquiries, can be a very frustrating section for many motor carrier professionals, but it remains a critically important. Keeping things simple, §391.23 requires two basic investigations:

- An inquiry into the technician's driving record for the past three years — a motor vehicle record (MVR) check; and
- An investigation of the technician's safety performance history with Department of Transportation regulated employers during the past three years.

The rules require the following information from a driver applicant's previous DOT-regulated employers:

- General driver identification and employment verification information;
- Information about accidents the applicant may have been involved in;

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- Whether the applicant violated any of the DOT alcohol and drug regulations; and
- Whether the applicant completed a substance abuse rehabilitation program, if required.

Three key points to understand — First, this must be done no matter what the driver applicant's job title was at a previous employer, if the employer was regulated by the DOT. Second, if the applicant has no previous employers who were DOT-regulated, you must document that the applicant did not have any previous employers who were DOT-regulated. Finally, if you are qualifying a technician who previously had not been qualified to drive vehicles on the roadway, you will need to follow the same procedures (driver application and background checks).

§391.25 Annual inquiry and review of driving record, and §391.27 Record of violations, are collectively known as the “annual review process.” Although these regulations may appear very involved and complicated, in reality the annual review process is a fairly straightforward 3-step process. At least once every 12 months, and for each driver you employ (including technicians that are qualified as drivers), you are required to:

- Make an inquiry into the driver's driving record (run an annual MVR — §391.25(a));
- Review the annual MVR, and create a note that includes the name of the person who performed the review, and the date of the review (§391.25(c)(2)); and
- Have each driver prepare a list of all violations he or she has been convicted of in the last 12 months (also known as the driver's annual certification of violations — §391.27(a)).

§391.41 .43 and .45. These regulations require that all drivers operating any commercial vehicle on the road undergo a physical examination at least once every two years (more often if the individual has a medical condition that requires additional monitoring). Upon completion of the physical, the driver is provided with a medical certificate (sometimes referred to as a “medical card” or “fed med card”). Drivers must have a copy of a valid medical card on them whenever driving a commercial vehicle. The driver's employing carrier must have a copy of medical certificate on file.

If the technician has a CDL, the driver must also report to the state licensing authority and “self-certify” that he/she is a non-exempt interstate driver and provide the state driver licensing authority a copy of the medical card whenever the technician passes a physical (the technician was to have done this initially by January 30, 2014). Some states allow this process to be done online, unless the driver is involved in an initial license issue or a CDL renewal. In those cases, the driver will normally have to appear live at the driver licensing authority.

After January 30, 2015, the employing carrier will have to have a motor vehicle report (an MVR, also known as a driving record) on file showing the driver's medical status, rather than have a copy of the medical card,

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for all CDL licensed drivers (including technicians that operate vehicles on the road).

There is no exception to these rules for technicians who only occasionally drive a commercial vehicle on the road.

§391.51 Driver Qualifications file. Proof of the technician's qualification to drive a commercial vehicle must be kept in a "driver qualifications file," also known as a DQ file. A DQ file must contain:

- The application for employment completed in accordance with §391.21 (permanent document);
- A copy of the response by each state agency, pursuant to §391.23 (permanent document);
- The certificate of driver's road test issued to the driver pursuant to §391.31(e), or a copy of the license or certificate which the motor carrier accepted as equivalent to the driver's road test pursuant to §391.33 (permanent document);
- The response of each State agency to the annual driver record inquiry required by §391.25(a) (updated document, retained for 3 years);
- A note relating to the annual review of the driver's driving record as required by §391.25(c)(2) (updated document, retained for 3 years);
- A list or certificate relating to violations of motor vehicle laws and ordinances required by §391.27 (updated document, retained for 3 years);
- A copy of the medical examiner's certificate as required by §391.43(f) or a copy of a MVR showing the driver as medically qualified if the driver (technician) has a CDL. If the most-recent MVR does not have the CDL driver's medical information on it, then a copy of the medical card must be on file (updated document, retained for 3 years);
- Proof that the examiner conducting the medical exam was listed on the National Registry of Certified Medical Examiners (NRCME) at the time of the exam, if the exam took place after May 21, 2014; and
- A letter from the Field Administrator, Division Administrator, or State Director granting a waiver of a physical disqualification, if a waiver was issued under §391.49 (if applicable, retained for 3 years).

Note: As of January 30, 2015, the only acceptable proof of medical qualification for a CDL driver (including technicians who do road tests) in the DQ file will be an MVR with the driver's medical certification information on it. Having a copy of the medical certificate in the DQ file will no longer be considered proof that the driver is medically qualified. The only exception is for the first 15 days after the driver passes a physical. During these 15 days, you can have a copy of the new medical card in the file as proof of medical qualification. During these 15 days the driver is to submit a copy of the card to his/her license state, the state is to enter the information onto the driver's MVR, and the company is to secure a new MVR showing the new medical qualification information and place it into the DQ file.

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Part 395 — Hours of Service

Part 395 is the part of the regulations that contains the hours-of-service regulations. This is a very complicated part, and one that many carriers are fined because of, so we will spend a fair amount of time summarizing it.

Carrier officials view hours-of-service compliance as strictly a safety department issue. The FMCSA views hours-of-service compliance as an operational issue. A carrier's operation is expected to comply with these regulations. Throughout this entire part the terminology used is "No motor carrier shall permit or require a driver to...nor shall a driver..." To sum it up, the carrier is responsible for the actions of their drivers, and controlling their drivers, in this area. This includes technicians who occasionally drive.

Part 395 contains the following active sections that should concern a Maintenance Pro:

- §395.1 Scope of rules in this part;
- §395.2 Definitions;
- §395.3 Maximum driving time for property-carrying vehicles;
- §395.5 Maximum driving time for passenger-carrying vehicles;
- §395.8 Driver's record of duty status;
- §395.13 Drivers declared out of service; and
- §395.15 Automatic on-board recording devices.

§395.1 Scope of rules in this part, contains the *general* applicability and *exceptions* to the HOS regulations.

Basically, the HOS rules apply to *all* interstate motor carriers and their drivers (including technicians operating on the roadway). In addition, most states have adopted either all or most of Part 395.

§395.1 also provides certain exemptions from the regulations. The exemptions that may involve technicians are:

- §395.1(e)(1) CDL vehicle drivers that stay within 100 air-miles of their work reporting location, start and end their day at the same work location, and do not work more than 12 hours (cannot drive more the 11 out of the 12), do not have to fill out a log (see §395.8 for an explanation of the driver's log). The carrier must keep time records that show the starting and ending time, and total hours worked for each workday in place of the log. Finally, the driver may not drive after having reached 60 hours in the last seven days, or 70 hours in the last eight days (depending on the carrier's operations).
- §395.1(e)(2) Non-CDL vehicle drivers that stay within 150 miles of their work reporting location, start and end their day at the same work location, and do not work more than 14 or 16 hours (cannot drive more the 11 out of the 14 or 16), do not have to fill out a log. The carrier must keep time records that show the starting and ending time, and total hours worked for each workday in place of the log. Finally, the driver may not drive after having reached 60 hours in

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the last seven days, or 70 hours in the last eight days (depending on the carrier's operations).

Drivers that qualify for the short-haul exceptions in §395.1 also do not have to take the required 30-minute break that is discussed in §395.3 (the "limits" portion of the hours-of-service regulations discussed next).

Although you should become familiar with all the terms found under §395.2 Definitions, we will examine a few particularly important ones:

- Driving time means all time spent at the driving controls of a commercial motor vehicle in operation.
- On-duty time means all time from the time a driver begins work or is required to be in readiness to work until the time the driver is relieved from work and all responsibility for performing work.

§395.3 Maximum driving time for property-carrying vehicles — Uses straight forward wording to get the point across. No motor carrier shall permit or require any driver to **drive** a property-carrying commercial motor vehicle, nor shall any such driver **drive** a property-carrying commercial motor vehicle:

- If it has been 8 hours (or more) since the driver's last break of 30 minutes or more (this rule does not apply to drivers operating under one of the "short-haul" exceptions found in §395.1(e));
- More than 11 **cumulative** hours following 10 consecutive hours off duty; or
- For any period after the end of the 14th hour after coming on duty following 10 consecutive hours off duty (the exception is drivers operating under one of the short-haul exceptions that allow the driver to drive up to the 16th hour, such as drivers operating under the exception at §395.1(e)(2) discussed earlier).

By the way, if the driver (technician) did not get 10 hours off (only got 8 hours off), the clock is still ticking. The driver must have a full 10 hours off to start the next 11- and 14-hour work cycle.

The next set of rules are in place to combat the effects of cumulative fatigue. No motor carrier shall permit or require a driver of a property-carrying commercial motor vehicle to drive, nor shall any driver **drive** a property-carrying commercial motor vehicle, regardless of the number of motor carriers using the driver's services, for any period after:

- Having been on duty 60 hours in any 7 consecutive days if the employing motor carrier does not operate commercial motor vehicles every day of the week; or
- Having been on duty 70 hours in any period of 8 consecutive days if the employing motor carrier operates commercial motor vehicles every day of the week.

In addition to the above, the regulations contain a *restart* provision, that states that any period of 7 or 8 consecutive days may end with the beginning of any off-duty period of **34** or more consecutive hours. The 34-hour break must meet certain requirements, including:

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- Not starting the restart until 168 hours have passed since the start of the last restart.
- The 34-hour period including two 1 a.m. to 5 a.m. periods.

If the driver cannot meet the requirements — the break is too soon after the driver's last restart, the break is not at least 34 hours long, or the break does not include two 1 a.m. to 5 a.m. periods — the driver cannot count time off as a restart, and must continue calculating his/her hours using the working hours from all of the last 7 or 8 days.

§395.5 Maximum driving time for passenger-carrying vehicles — No motor carrier shall permit or require any driver used by it to drive a passenger-carrying commercial motor vehicle, nor shall any such driver drive a passenger-carrying commercial motor vehicle more than 10 hours following 8 consecutive hours off duty, or for any period after having accumulated 15 hours on duty following 8 consecutive hours off duty.

In addition to the 10- and 15-hour rules, passenger-carrying drivers are also subject to the same 60 hour/7-day or 70 hour/8-day rule.

§395.8 Driver's record of duty status. These regulations provide the form the log is to take and the manner in which it is to be completed and submitted. Violations discovered on the actual record of duty status (log) are commonly referred to as *form-and-manner* violations.

Your drivers are required to record their duty status for each 24-hour period (in duplicate) on a graph/grid. However, if your organization has such technology, your drivers may use an automatic on-board recording device (electronic log) as long as it meets the requirements. Also, if your technicians qualify for one of the exemptions discussed earlier, they do not have to complete a log.

Under §395.8 you are required to systematically retain records of duty status and all supporting documents for each driver you employ for a period of six months from the date of receipt. If you are using time cards to comply (driver is operating under one of the exemptions), they need to be retained for six months.

§395.15 allows carriers to use Automatic On-Board Recording Devices (AOBRD) rather than having their driver complete logs. These regulations provide the technical and operational requirements for AOBRDs. As a Maintenance Pro you may need to become familiar with these devices if your company uses them. The maintenance requirements are generally fairly simple (the unit must be synchronized with the vehicle and record time, speed, and driver input) meaning that the unit will be connected into the J1939 bus and draw power from somewhere on the vehicle. The manufacturers' specifications (vehicle and AOBRD) will assist in deciding where to connect into the vehicle.

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Additional rules that apply to technicians who operate CDL vehicles on the roadway

These final two summaries cover regulations that apply only to drivers of vehicles which require the driver have a CDL to operate. A CDL is required if the vehicle meets the following definition: Commercial motor vehicle means a vehicle used in commerce that:

- Has a GCWR of 26,001 or more pounds with a towed unit of more than 10,000 pounds GVWR (note that a tractor weighing 25,000 pounds towing a 9,500-pound trailer, for example, would be exempt — the trailer must weigh more than 10,000 pounds);
- Has a GVWR of 26,001 or more pounds;
- Is designed to carry 16 or more passengers, including the driver; or
- Is any size and is placarded for hazardous materials.

Part 382 and Part 40, the two parts covering drug and alcohol testing have “liability” written all over them. If your drivers are using drugs or abusing alcohol, they are a walking, talking risk for your company. This applies to all drivers, from the full-timer to the technician that drives once a month. A plaintiff’s attorney would like nothing better than to be able to show in court how your company allowed a substance abuser to drive an 80,000-pound rig into their client’s car.

Part 382 - Controlled substances and alcohol use and testing, contains six Subparts:

- **Subpart A** — General
- **Subpart B** — Prohibitions
- **Subpart C** — Tests Required
- **Subpart D** — Handling of Test Results, Record Retention, and Confidentiality
- **Subpart E** — Consequences for Drivers Engaging in Substance Use-Related Conduct
- **Subpart F** — Alcohol Misuse and Controlled Substances Use Information, Training, and Referral

Together with Part 40, the drug and alcohol testing regulations are chocked full of complex testing, training, and recordkeeping requirements, enough to fill a complete book. Chances are, you’ll be leaving some of the administration of these regulations up to others, so let’s concentrate on those sections that you *need* to understand.

Subpart A — General

§382.111 Other requirements imposed by employers needs to be thoroughly reviewed and seriously considered.

This section reiterates the fact that the federal regulations are the *minimum* requirements. This regulation allows you, in general, to impose additional, or more stringent, requirements.

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However, keep in mind that these regulations are quite strict when it comes to the separation of the DOT drug and alcohol testing program from any company-specific requirements. You must be certain that you are in full compliance with DOT requirements before you start imposing additional restrictions, tests, and/or penalties on your drivers.

Under **§382.113 Requirement for notice**, before you send an employee for a DOT-required drug or alcohol test, you must notify them (verbally or in writing) that the test(s) are required by the DOT under Part 382. If it's a company test (not a DOT test), you must *not* tell them that it's a DOT-required test.

The simplest method to accomplish this may be to hand your drivers a copy of a notification form when you instruct them to report for a test.

§382.121 Employee admission of alcohol and controlled substances use, allows you to set up a "voluntary admission" program that will allow your drivers to admit to a drug or alcohol problem without becoming subject to the DOT's rehabilitation requirements. After undergoing treatment, the employee will return to work for you.

If you want a self-admission program at your company, you'll need a written, voluntary self-identification program or policy that meets the requirements of §382.121.

Employees admitting to a problem under this provision must do so *before* reporting for duty, and must not use this as an excuse to avoid a DOT-required drug or alcohol test.

Subpart B - Prohibitions

All drivers (including the technicians that only occasionally drive a commercial vehicle requiring a CDL to operate) are prohibited from:

- Reporting for duty with a blood-alcohol content (BAC) of 0.04 or greater;
- Using drugs, unless under a doctor's advice;
- Using alcohol while performing, or 4 hours before performing, safety-sensitive functions;
- Using alcohol within 8 hours following an accident or until tested (see discussion of post-accident testing below);
- Refusing to submit to a required alcohol or drug test; or
- Reporting for duty after testing positive for drugs, or after adulterating or substituting a test specimen.

Employer prohibitions — As an employer, you are prohibited from allowing a driver (here again, including the technicians that only occasionally drive a commercial vehicle requiring a CDL to operate) to perform safety-sensitive functions when you have "actual knowledge" that the driver:

- Has a BAC of 0.04 or more;
- Is using alcohol, or used alcohol within the previous four hours;

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- Has used drugs;
- Has tested positive for drugs, or has adulterated or substituted a test specimen; or
- Has refused to undergo a DOT-required test.

What is *actual knowledge*? You only have actual knowledge of a violation if:

- You **directly observe** a driver using drugs or alcohol. If you only observe employee behavior or physical characteristics that *suggest* drug or alcohol use, you may want to conduct a reasonable suspicion test.
- You obtain information from the driver's previous employer(s).
- The driver receives a traffic citation for driving a CMV while under the influence of drugs or alcohol.
- The employee admits to the use of drugs or alcohol (unless the admission falls under the company's self-admission program).

Subpart C — Tests Required

This subpart describes the six types of drug/alcohol tests you may be required to perform:

- Pre-employment tests.
- Post-accident tests.
- Random tests.
- Reasonable-suspicion tests.
- Return-to-duty tests.
- Follow-up tests.

§382.301 Pre-employment testing requires you to have in your hand a *verified* negative drug test result before a new driver first performs a safety-sensitive function for your company. This applies even if the technician is a long-term employee of the company who is just beginning to act as a driver on occasion.

§382.303 Post-accident testing, requires you to test your drivers for drugs and alcohol after certain types of motor vehicle accidents. This requirement includes technicians if they are involved in one of these types of accidents while operating a vehicle on a public roadway that requires a CDL to operate. Here is a table that shows the specific requirements:

Type of accident	Was a citation issued to the CMV driver?	Does a test have to be performed?
Human fatality	YES or NO	YES
Bodily injury with treatment away from the scene	YES	YES
	NO	NO

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Disabling damage requiring tow	YES	YES
	NO	NO

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The alcohol test is to be completed within two hours of the accident. If this is not possible, the driver and carrier need to document why it could not be completed. In such cases the carrier and driver then have an additional six hours to complete the alcohol test, or a total of eight hours from the time of the accident.

The drug test must be completed within 32 hours of the accident. *The FMCSA will not accept any excuses if the tests are not performed.* Once the tests are complete the driver can return to duty.

If you chose to implement a post-accident/injury drug and alcohol testing program to test after all accidents and injuries, you will need to do that under general employment. You cannot test a driver following an accident under these regulations unless the accident meets the requirements shown above.

§382.305 Random testing, is another complex, often-violated regulation. It says you must be randomly testing all of your CDL drivers (including the technicians that only occasionally drive a commercial vehicle requiring a CDL to operate) for drugs and alcohol at the rates required in the regulations.

Presently, you must test at least 50 percent of your drivers for drugs, and 10 percent of your drivers for alcohol, over the calendar year. The test should be performed when the driver is reporting for duty or performing a safety-sensitive function. The driver cannot receive any advanced warning about the test.

Selected drivers must report for testing immediately after being notified. Alcohol tests must take place while the driver is performing safety-sensitive functions, or immediately before or immediately after performing safety-sensitive functions.

Your random program must test *randomly*. This is where many companies get into trouble. Drawing names or ID numbers out of a hat is *not* random selection.

Even if you have only two drivers, you must select them for random testing using a *scientifically valid method*.

Each person at the company that operates commercial vehicles requiring a CDL to operate must be in the selection pool, including the technicians that only occasionally drive, and they all must have an equal chance of being selected each time a selection is made. This means that a driver may be tested more than once each year.

The drivers must be tested during the selection period in which they are chosen. For example, if you have quarterly selection periods and you select a driver in January, he or she must be tested by the end of March.

As with the post-accident testing, once the test is complete the driver can return to duty.

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§382.307 Reasonable suspicion testing, states that you *shall* require a driver (including a technician that only occasionally drives a commercial vehicle requiring a CDL to operate) to submit to a drug or alcohol test when you have reasonable suspicion to believe that the driver has violated the DOT's prohibitions on drug and alcohol use.

Several conditions must be met before you can send a driver for a reasonable-suspicion test:

- A trained supervisor must make the observation, but he/she may not administer the test. The supervisor must have received the required two hours of reasonable-suspicion training (see the regulation at §382.603).
- The supervisor must base his/her decision on “specific, contemporaneous, articulable observations concerning the appearance, behavior, speech, or body odors of the driver.” In other words, the supervisor must directly observe the driver exhibiting signs that he/she is under the influence of drugs or alcohol, and the supervisor must be able to document those observations in writing. Observation of the chronic and withdrawal effects of drug use may be used as the basis for a drug test.
- For an alcohol test, the observations must be made while, just before, or just after the driver performs safety-sensitive functions. If the alcohol test does not take place within **two hours** after it is determined that a test is necessary, you must document why the test was not done promptly. If the test is not done within **eight hours**, it must not take place at all, and you must document why it was not done.

In the case of a reasonable-suspicion test, you should not return the driver to duty until you have *verified* negative results in hand.

One of the keys to a *successful* reasonable-suspicion test is good documentation. A detailed written record of your observations is not only required, but also will help protect you in the event you have to take disciplinary action against the employee.

Subpart D — Handling of Test Results, Record Retention, and Confidentiality

The recordkeeping requirements found within Subpart D describe what records to keep, when you can toss them, and to whom you can release them.

Generally, this section requires you to keep these records under lock and key, such as in a locked filing cabinet. The records may be combined with driver qualification files or personnel records, but then those records as well must be secured. The records should only be released to anyone other than program administrators if a release signed by the driver is presented.

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The record retention requirements vary depending on the type of record and the results of the drug/alcohol test(s). Generally, all records pertaining to a positive test (or refusal) must be kept for five years, and all records pertaining to a negative test must be kept for one year.

Subpart E - Consequences for Drivers Engaging in Substance Use-Related Conduct

§382.501 Removal from safety-sensitive function. If one of your drivers (including one of the technicians that only occasionally drive a commercial vehicle requiring a CDL to operate) is found to have violated any of the prohibitions described in Subpart B (described above, including failing or refusing any DOT drug or alcohol test), you must immediately remove that driver from performing any safety-sensitive functions. Remember that positive test results must be verified before you can take action against the driver.

It might be obvious, but “immediately” means *immediately*. Do whatever it takes to get that driver out of the cab before disaster strikes.

Once removed from safety-sensitive functions, the driver cannot return to duty until completing an evaluation by a Substance Abuse Professional (SAP) and passing a return-to-duty test. The employee must also undergo a prescribed regiment of follow-up tests to verify compliance after being returned to duty.

Note: The return-to-duty and follow-up testing requirements apply to you only if you wish to continue the driver’s employment and return him/her to duty as a driver. If you chose to terminate the driver, all you must do is provide the driver with SAP contact information. The driver will need to make arrangements for the SAP evaluation, and for the return-to-duty and follow-up tests, on their own or with their next employer.

§382.505 Other alcohol-related conduct. If a driver’s DOT alcohol test result is between 0.02 and 0.04 BAC, the driver must be removed from duty for at least 24 hours. The driver should not return to work until his or her next regularly scheduled duty period.

Subpart F - Alcohol Misuse and Controlled Substances Use Information, Training, and Referral

§382.601 Employer obligation to promulgate a policy on the misuse of alcohol and use of controlled substances states you must provide your all drivers (including the technicians that only occasionally drive a commercial vehicle requiring a CDL to operate) with a copy of your written policies and other materials concerning alcohol abuse and drug use, and you must obtain a signed receipt from them certifying that the drivers have received these materials.

382.603 Training for supervisors requires that supervisors receive at least two hours of training to help them determine when “reasonable suspicion” exists to require drivers to undergo drug or alcohol testing. Supervisors must receive one hour of training on the signs of alcohol abuse and one hour on the signs of drug use.

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Many carriers have their maintenance supervisors undergo this training. This then allows the maintenance supervisors to send drivers that they believe are under the influence of controlled substances or alcohol (based on observations) for a reasonable suspicion test.

Like the educational materials provided to drivers, this training only has to be provided once. If you have proof that another employer has trained one of your supervisors, you do not *have* to train him or her again. However, it makes sense to keep your supervisors' observational skills sharp by providing your own training, and by providing it on a recurring basis.

You must maintain documentation of this training until two years after the supervisor stops performing the functions of a supervisor.

Part 383 tells you who needs a commercial driver's license (CDL), how to obtain one, and how to lose one. In other words, it governs the issuance of CDLs and the *disqualification* of licensed drivers who violate safety regulations. As with Part 382, everything in Part 383 applies to your technicians that occasionally drive a commercial vehicle requiring a CDL to operate.

Much of this Part applies to the states, which are charged with implementing the federal CDL regulations and issuing driver's licenses. However, motor carriers operating vehicles that require CDLs must be familiar with this Part, and should incorporate portions of the rules and regulations into their policies, training programs, and safety management system.

Part 383 - Commercial Driver's License Standards; Requirements and Penalties, contains 10 Subparts:

- **Subpart A** General Requirements.
- **Subpart B** Single License Requirement.
- **Subpart C** Notification Requirements and Employer Responsibilities.
- **Subpart D** Driver Disqualifications and Penalties.
- **Subpart E** Testing and Licensing Procedures.
- **Subpart F** Vehicle Groups and Endorsements.
- **Subpart G** Required Knowledge and Skills.
- **Subpart H** Tests.
- **Subpart J** Commercial Driver's License Document.

Because portions of Part 383 apply only to the states, we'll discuss only those sections that affect carriers and drivers.

Subpart A — General

As the title implies, Subpart A contains general information that applies to the entire Part, including definitions. It contains the definitions used in this part, and the applicability (states, carriers, and drivers). A new definition in Part 383 is a "CDL downgrade." This is the withdrawal of the driver's CDL driving privileges due to the driver not having provided

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medical information (a copy of the medical card) to the state driver licensing authority (see the earlier information in this chapter on §391.41 for an explanation of the process).

Subpart B — Single License Requirement

Subpart B contains only two sections: one requires that CMV drivers hold a CDL, and the other requires that they only hold a *single* license.

Subpart C — Notification Requirements and Employer Responsibilities

The regulations in Subpart C are aimed at keeping you abreast of your drivers' traffic violations, license suspensions, and driving history.

Your drivers are required to report convictions and suspensions to you. This is where your safety management controls come into play — make sure your written policies clearly state that your drivers are required to report convictions and suspensions to you. We'll go into more detail below, but here is a quick summary of the requirements:

IF your driver:	THEN he or she must:
Is convicted of a traffic violation in any type of vehicle	Notify you within 30 days, supplying specific information in writing.
Has his or her license suspended or otherwise loses the right to drive	Notify you by the end of the business day following the day the driver was notified.

§383.35 Notification of previous employment, closes a loophole and requires that CDL-licensed drivers provide a 10-year employment history on their application for employment.

§383.37 Employer responsibilities, contains some general, common-sense prohibitions directed at the employer. In simple terms, you can't let a driver operate a CMV if he or she has an invalid license or has been disqualified, is subject to an out-of-service order, or is violating a railroad-highway grade crossing rule.

Subpart D — Driver Disqualifications and Penalties

This subpart concerns *disqualification*, and you and your drivers must be familiar with the violations that can result in disqualification, because a disqualified driver must not get behind the wheel. It describes “major” violations, which are ones that can result in immediate disqualification, and “serious” violations, which, when combined with another serious violation within a three year time span, can result in the driver being disqualified.

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Which offenses can result in disqualification? The following table summarizes the four categories of offenses, what they include, and the disqualification period that can result:

CATEGORY	INCLUDES	PERIOD
Major offenses	DUI/DWI, refusing to take an alcohol test, leaving an accident scene, using a vehicle to commit a felony, causing a fatality through negligent driving, etc.	1 year to life
Serious traffic violations	Speeding (15+ mph over limit), reckless driving, following too closely, driving without a CDL or the proper endorsement, etc.	60-120 days
Railroad-highway grade crossing offenses	Failing to slow down or stop when required, failing to leave enough space in front of or underneath vehicle, failing to obey traffic control device, etc.	60 days to 1 year or more
Violations of out-of-service orders	Violating a driver or vehicle out-of-service order	90 days to 5 years

Subpart F — Vehicle Groups and Endorsements

Subpart F provides the regulations on vehicle classes and endorsements. Drivers are required to have a CDL with the correct class and endorsement when they are operating the vehicle on a public roadway. The “roadway” is defined as any roadway to which the public has unrestricted access. In some cases parking lots qualify as roadways!

Compliance reviews

Section 215 of the Motor Carrier Safety Act of 1984 directed the Secretary of Transportation, in cooperation with the Interstate Commerce Commission, to establish a procedure to determine the safety fitness of owners and operators of commercial motor vehicles operating in interstate or foreign commerce. The Secretary, in turn, delegated this responsibility to the Federal Highway Administration (FHWA). When the FHWA was replaced by the Federal Motor Carrier Safety Administration (FMCSA) in 2000, the new agency took over the investigation of motor carrier safety.

The “Safety Fitness Procedures” established a system to determine the safety fitness of motor carriers through the assignment of safety ratings and established a “safety fitness standard” which motor carriers must meet to obtain a satisfactory safety rating.

To meet the safety fitness standard, a motor carrier must demonstrate to the FMCSA that it has adequate safety management controls in place which function effectively to ensure acceptable compliance with the applicable safety requirements. A “safety rating methodology” (SFRM) was developed which uses data from compliance reviews (CRs) to rate motor carriers.

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The safety rating process used by the FMCSA evaluates safety fitness and assigns one of three safety ratings (satisfactory, conditional or unsatisfactory) to motor carriers operating in interstate commerce. This process conforms with 49 CFR Part 385.

The process also identifies motor carriers needing improvement in their compliance with the Federal Motor Carrier Safety Regulations (FMCSRs) and applicable Hazardous Material Regulations (HMRs). These are carriers rated unsatisfactory or conditional.

The compliance review (CR) is an in-depth examination of a motor carrier's operations and is used 1) to rate unrated motor carriers, 2) to conduct a follow-up investigation on motor carriers rated unsatisfactory or conditional as a result of a previous review, 3) to investigate complaints, or 4) in response to a request by a motor carrier to reevaluate its safety rating.

Since December 2010, a performance-based system called the Safety Measurement System (SMS), a component of the Compliance Safety Accountability (CSA) program, has been the major source for selecting carriers for compliance reviews. The SMS combines data from roadside inspections, previous compliance reviews, and state-reported accidents to build a picture of a carrier's relative safety status compared to other carriers. Carriers that appear to pose the greatest potential risk to highway safety are placed at the top of the priority list for compliance reviews.

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During the compliance review, documents such as those contained in driver qualification files, records of duty status, and vehicle maintenance records are thoroughly examined for compliance with the FMCSRs and HMRs. Violations are cited on the CR document. Performance-based information, when available, is utilized to evaluate the carrier's compliance with the vehicle regulations. Recordable preventable accident information is also collected.

The FMCSA gathers information through an in-depth examination of the motor carrier's compliance with identified acute or critical regulations of the FMCSRs and HMRs.

"Acute" are those identified regulations, where noncompliance is so severe as to require immediate corrective actions by a motor carrier regardless of the overall safety posture of the motor carrier. An example of an acute regulation is Sec. 383.37(b) — Knowingly allowing, requiring, permitting, or authorizing an employee with more than one commercial driver's license to operate a commercial motor vehicle. Noncompliance with Sec. 383.37(b) is usually discovered when the motor carrier's driver qualification file reflects that the motor carrier had knowledge of a driver with more than one commercial driver's license, and still permitted the driver to operate a commercial motor vehicle. If the motor carrier did not have knowledge or could not reasonably be expected to have knowledge, then a violation would not be cited.

"Critical" are those identified regulations, where noncompliance relates to management and/or operational controls. These are indicative of breakdowns in a carrier's management controls. An example of a critical regulation is Sec. 395.3(a) (1) — Requiring or permitting a driver to drive more than 10 hours.

See Attachment A below for a list of the acute and critical regulations pertaining to maintenance which are used in determining safety ratings.

Noncompliance with acute regulations and patterns of noncompliance with critical regulations are quantitatively linked to inadequate safety management controls and usually higher than average rates of recordable preventable accidents. The FMCSA has used noncompliance with acute regulations and patterns of noncompliance with critical regulations since 1989 to determine motor carriers' adherence to the Sec. 385.5 — Safety fitness standard.

Compliance with the regulatory factors, 1) Parts 387 and 390; 2) Parts 382, 383 and 391; 3) Parts 392 and 395; 4) Parts 393 and 396, when there are less than 3 vehicle inspections in the last 12 months to evaluate; and 5) Parts 397 and 177, will be evaluated as follows:

For each instance of noncompliance with an acute regulation or each pattern of noncompliance with a critical regulation during the CR, one point will be assessed. A pattern is more than one violation. When large numbers of documents are reviewed, the number of violations required to meet a pattern is equal to at least 10 percent of those examined. However, each pattern of noncompliance with a critical regulation relative to Part 395, Hours of Service of Drivers, will be assessed two points.

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The Vehicle Factor

When there are a combination of three or more inspections recorded in the Motor Carrier Management Information System (MCMIS) during the twelve months prior to the CR or performed at the time of the review, the Vehicle Factor (Parts 393 and 396) will be evaluated on the basis of the Out-of-Service (OOS) rates and noncompliance with acute regulations and/or a pattern of noncompliance with critical regulations. The results of the review of the OOS rate will affect the Vehicle Factor rating as follows:

- If a motor carrier has three or more roadside vehicle inspections in the twelve months prior to the carrier review, or three vehicles inspected at the time of the review, or a combination of the two totaling three or more, and the vehicle OOS rate is 34% or greater, the initial factor rating will be conditional. The Part 396 — Inspection, Repair, and Maintenance systems requirements will be examined during each review. The results of the examination could lower the factor rating to unsatisfactory if noncompliance with an acute regulation or a pattern of noncompliance with a critical regulation is discovered. If the examination of the Part 396 requirements discovers no such problems with the systems the motor carrier is required to maintain for compliance, the Vehicle Factor remains conditional.
- If a carrier's vehicle OOS rate is less than 34%, the initial factor rating will be satisfactory. If noncompliance with an acute regulation or a pattern of noncompliance with a critical regulation is discovered during the examination of the Part 396, the factor rating will be lowered to conditional. If the examination of the Part 396 requirements discovers no such problems with the systems the motor carrier is required to maintain for compliance, the Vehicle Factor remains satisfactory.

Over 3 million vehicle inspections occur on the roadside each year. This vehicle inspection information is retained in the MCMIS and is integral to evaluating motor carriers' ability to successfully maintain their vehicles, thus preventing them from being placed OOS during roadside inspections. Since many of the roadside inspections are targeted to visibly defective vehicles and since there are a limited number of inspections for many motor carriers, the use of data is limited. Each CR will continue to have the Part 396 — Inspection, Repair, and Maintenance requirements reviewed as indicated by the above explanation.

Accident factor

In addition to the five regulatory rating factors, a sixth factor is included in the process to address the accident history of the motor carrier. This factor is the recordable accident rate which the carrier has experienced during the past 12 months.

The definition of a recordable accident is found in Sec. 390.5. Under the definition, a recordable accident means an occurrence involving a commercial vehicle where there is 1) a fatality; 2) bodily injury that requires one or more persons to receive immediate medical treatment away from

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the accident scene; or 3) disabling damage to one or more vehicles requiring any vehicle to be towed or otherwise transported away from the scene.

The recordable accident rate is how many recordable accidents occurred per million miles the carrier operated. To calculate the recordable accident rate, the number of recordable accidents is multiplied by 1 million and then divided by the total number of miles operated by the carrier in the 365 days prior to the compliance review.

The accident factor will be rated either satisfactory or unsatisfactory — no conditional ratings are given. An urban carrier with a recordable accident rate greater than 1.7 will be rated unsatisfactory in this factor. Carriers that operate entirely within a 100 air-mile radius are considered urban carriers and are allowed a higher accident rate tolerance because they generally have a higher exposure to accident situations because of their environment.

For all other carriers, a recordable accident rate greater than 1.5 will be considered unsatisfactory.

The cut-off rates were determined by roughly doubling the national average accident rate for each type of carrier rated in fiscal years 1994, 1995 and 1996.

Rate Adjustments: The accident rate breakpoints are reexamined periodically to determine if adjustments are needed.

Factor ratings

In the methodology, parts of the FMCSRs and the HMRs having similar characteristics are combined together into five regulatory areas called “factors.”

The following table shows the five regulatory factors, parts of the FMCSRs and HMRs associated with each factor, and the accident factor.

Factors

Factor 1 General	=	Parts 387 & 390
Factor 2 Driver	=	Parts 382, 383 & 391
Factor 3 Operational	=	Parts 392 & 395
Factor 4 Vehicle	=	Parts 393 & 396
Factor 5 Haz Mat	=	Parts 397 & 177
Factor 6 (Accident Factor)	=	Recordable Preventable Rate

Factor Ratings are determined as follows:

Satisfactory if the acute and/or critical = 0 points

Conditional if the acute and/or critical = 1 point

Unsatisfactory if the acute and/or critical = 2 or more points

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Safety rating

The ratings for the five factors, along with the recordable accident rate for the 12 months prior to the review, are then entered into a rating table which establishes the motor carrier's safety rating.

The FMCSA has developed a rating formula for assessing the information obtained from the CR document and is using that formula in assigning a safety rating.

Motor carrier safety rating table

Factor Ratings		Overall
Unsatisfactory	Conditional	Safety Rating
0	2 or less	Satisfactory
0	More than 2	Conditional
1	2 or less	Conditional
1	More than 2	Unsatisfactory
2 or more	0 or more	Unsatisfactory

Proposed safety rating

Within 30 days of the compliance review, the carrier will receive written notification of the proposed safety rating. This written notification will appear on a compliance review document, MCS-151, Part B. The notification will include one of the following messages.

"Your proposed safety rating is SATISFACTORY," or;

"Your proposed safety rating is CONDITIONAL." The proposed rating will become the final rating 45/60 days after you receive this notice.

"Your proposed safety rating is UNSATISFACTORY." The proposed safety rating will become the final safety rating 45/60 days after you receive this notice.

Assignment of Rating/Motor carrier notification

When the official rating is determined in Washington, D.C., the FHWA notifies the motor carrier in writing of its safety rating as prescribed in Sec. 385.11. Notification of a conditional or unsatisfactory rating includes a list of those Parts of the regulations, or recordable preventable accident rate for which corrective actions must be taken by the motor carrier to improve its overall safety performance.

If the proposed safety rating is unsatisfactory, the motor carrier will be informed that Sec. 385.13 prohibits carriers rated unsatisfactory from transporting hazardous materials requiring placarding or more than 15 passengers including the driver.

Motor carrier rights to a change in the safety rating

Under Sec. 385.15 and 385.17, motor carriers have the right to petition for a review of their ratings if there are factual or procedural disputes, and to request another review after corrective actions have been taken. These two sections should be read carefully. They are the procedural

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avenues a motor carrier which believes its safety rating to be in error may exercise, and the means to request another review after corrective action has been taken.

Conclusion

The FMCSA believes this “safety rating methodology” is a reasonable approach for assigning a safety rating which best describes the current safety fitness posture of a motor carrier as required by the safety fitness regulations (Sec. 385.9). This methodology has the capability to incorporate regulatory changes as they occur.

Improved compliance with the regulations leads to an improved rating, which in turn increases safety. This increased safety is FMCSA’s regulatory goal.

Attachment A

Acute and critical regulations pertaining to maintenance

§396.3(b)	Failing to keep minimum records of inspection and vehicle maintenance. (critical)
§396.9(c)(2)	Requiring or permitting the operation of a motor vehicle declared “out-of-service” before repairs were made. (acute)
§396.11(a)	Failing to require driver to prepare driver vehicle inspection report. (critical)
§396.11(c)	Failing to correct out-of-service defects listed by driver in a driver vehicle inspection report before the vehicle is operated again. (acute)
§396.17(a)	Using a commercial motor vehicle not periodically inspected. (critical)
§396.17(g)	Failing to promptly repair parts and accessories not meeting minimum periodic inspection standards. (acute)

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Overview Occupational Safety and Health Administration (OSHA) Just as the EPA is primarily concerned with protection of the environment, OSHA is primarily concerned with workplace safety and health. Following you will find some general information about the agency and how it functions, and a roundup of employer and employee rights and responsibilities under the Occupational Safety & Health Act. Need for legislation More than 90 million Americans spend their days on the job. They are our most valuable national resource. Yet, until 1970, no uniform and comprehensive provisions existed for their protection against workplace safety and health hazards. In 1970, Congress considered annual figures such as these: • Job-related accidents accounted for more than 14,000 worker deaths. • Nearly 2½ million workers were disabled. • Ten times as many person-days were lost from job-related disabilities as from strikes. • Estimated new cases of occupational diseases totaled 300,000. In terms of lost production and wages, medical expenses, and disability compensation, the burden on the nation's commerce was staggering. Human cost was beyond calculation. Therefore, the Occupational Safety and Health Act (OSHA Act) of 1970 was passed by a bipartisan Congress "...to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources." OSHA's purpose Under the Act, the Occupational Safety and Health Administration (OSHA) was created within the Department of Labor to: • Encourage employers and employees to reduce workplace hazards and to implement new or improve existing safety and health programs.	

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- Provide for research in occupational safety and health to develop innovative ways of dealing with occupational safety and health problems.
- Establish “separate but dependent responsibilities and rights” for employers and employees for the achievement of better safety and health conditions.
- Maintain a reporting and recordkeeping system to monitor job-related injuries and illnesses.
- Establish training programs to increase the number and competence of occupational safety and health personnel.
- Develop mandatory job safety and health standards and enforce them effectively.
- Provide for the development, analysis, evaluation and approval of state occupational safety and health programs.

While OSHA continually reviews and redefines specific standards and practices, its basic purposes remain constant. OSHA strives to implement its Congressional mandate fully and firmly with fairness to all concerned.

In all its procedures, from standards development through implementation and enforcement, OSHA guarantees employers and employees the right to be fully informed, to participate actively, and to appeal actions.

The Act’s coverage

In general, coverage of the Act extends to all employers and their employees in the 50 states, the District of Columbia, Puerto Rico, and all other territories under Federal Government jurisdiction. Coverage is provided either directly by federal OSHA or through an OSHA-approved state program.

As defined by the Act, an employer is any “person engaged in a business affecting commerce who has employees, but does not include the United States or any State or political subdivision of a State.”

Therefore, the Act applies to employers and employees in such varied fields as manufacturing, construction, longshoring, agriculture, law and medicine, charity and disaster relief, organized labor, and private education. Such coverage includes religious groups to the extent that they employ workers for secular purposes.

The following are not covered under the Act:

- Self-employed persons.
- Farms at which only immediate members of the farm employer’s family are employed.
- Workplaces already protected by other federal agencies under other federal statutes.

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Even when another federal agency is authorized to regulate safety and health working conditions in a particular industry, if it does not do so in specific areas, then OSHA standards apply.

Over the years there has been considerable confusion about the applicability of the OSHA regulations when it comes to motor carriers. The easiest way to clarify the relationship between the Department of Transportation (DOT) regulations and the OSHA regulations is if DOT and OSHA both have rules covering a specific activity a driver is undertaking, the driver is subject to the DOT rules. Drivers working at the fixed facility would be subject to the OSHA rules. Other employees who are not directly controlled by DOT regulations, such as technicians, are always subject to the OSHA rules.

If there is no applicable DOT regulation concerning what the driver or employee is doing, then the OSHA regulations must be followed. Therefore, if a driver gets out of the vehicle and starts working in the repair shop, as far as OSHA is concerned he/she has just become a covered employee.

This is an important point to remember. Each year motor carriers are fined by OSHA for a variety of violations, including violating standards related to:

- Hazard communication
- Powered industrial trucks (forklifts and other material handling equipment)
- Electrical: wiring methods, components, and equipment
- Electrical: systems design
- Machine guarding
- Control of hazardous energy (lockout/tagout, including making sure vehicles being worked on cannot be moved by another person)
- Respiratory protection
- Fall protection

However, motor carriers generally receive the largest fines for violating the “whistleblower protections” afforded to all employees by OSHA. If a driver, technician, or other employee at a motor carrier refuses to participate in an unsafe activity, raises a safety concern to the company, contacts a regulating agency with a safety concern, or cooperates with an agency investigation, the employer cannot retaliate in any way.

To give you an idea of the fines and penalties that can be assessed under the whistleblower protections, it is not uncommon for a company to be ordered to pay \$100,000 or more in backpay (lost wages), interest, and penalties for firing an employee who either refused to follow instructions or orders that were not safe, or who reported a safety concern.

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Rights and responsibilities under OSHA

Employer responsibilities and rights

Employers have certain responsibilities and rights under the Occupational Safety and Health Act of 1970. The checklists which follow provide a review of many of these. States with their own occupational safety and health programs must be at least as stringent as OSHA, but may have additional requirements.

Responsibilities

As an employer under federal OSHA, you must:

- Meet your general duty responsibility to provide a workplace free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees, and comply with standards, rules, and regulations issued under the Act.
- Be familiar with mandatory OSHA standards and make copies available to employees for review upon request.
- Inform all employees about OSHA.
- Examine workplace conditions to make sure they conform to applicable standards.
- Minimize or reduce hazards. Part of this is doing an assessment of the workplace and then documenting hazards and efforts to minimize them.
- Make sure employees have and use safe tools and equipment (including appropriate personal protective equipment), and that such equipment is properly maintained.
- Provide any personal protective equipment that is unique to the work place.
- Use color codes, posters, labels or signs when needed to warn employees of potential hazards.
- Establish or update operating procedures and communicate them so that employees follow safety and health requirements.
- Provide training as required in the OSHA standards.
- Provide medical examinations when required by OSHA standards.
- Report to the nearest OSHA office within 8 hours any fatal accident or one which results in the hospitalization of three or more employees.
- Keep records of work-related injuries and illnesses (using OSHA Form 300 Log of Work-Related Injuries and Illnesses, and OSHA Form 301 Injury and Illness Incident Report). Below you will find a decision flow chart explaining how to decide which injuries must be recorded.

Compliance Management

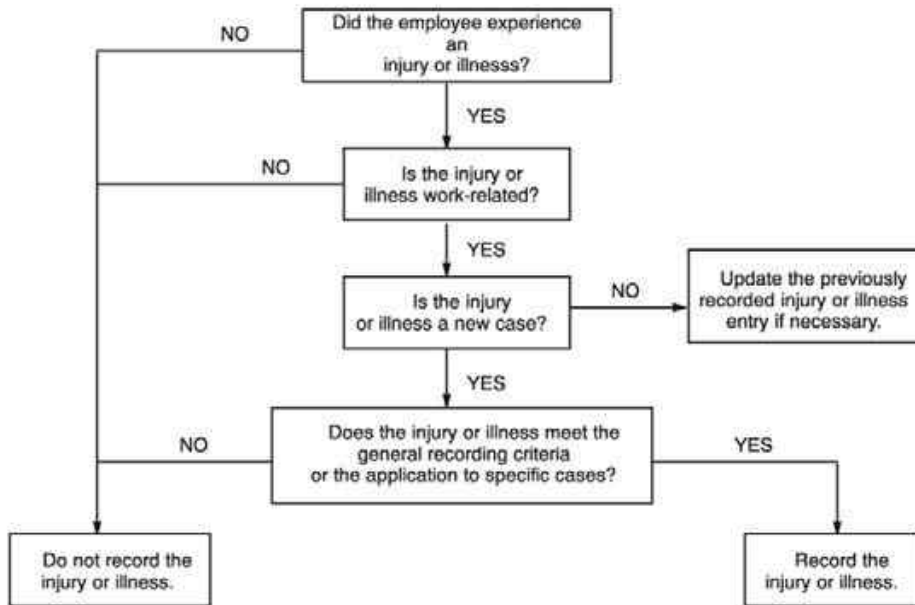
- Post a copy of the totals from the last page of OSHA Form No. 300 on OSHA Form No. 300A Summary, from February 1 to April 1 each year (this applies to employers with 11 or more employees) Samples of OSHA forms 300, 300A, and 301 are included below.
- Post, at a prominent location within the workplace, either OSHA poster (OSHA 2203 or OSHA 3165) informing employees of their rights and responsibilities. (In states operating OSHA-approved job safety and health programs, the state's equivalent poster may be required.)
- Provide employees, former employees, and their representatives access to the Log and Summary of Occupational Injuries and Illnesses (OSHA No. OSHA 300 and 300A) at a reasonable time and in a reasonable manner.
- Provide access to employee medical records and exposure records.
- Cooperate with the OSHA compliance officer by furnishing names of authorized employee representatives who may be asked to accompany the compliance officer during an inspection. (If none, the compliance officer will consult with a reasonable number of employees concerning safety and health in the workplace.)
- Not discriminate against employees who properly exercise their rights under the Act.
- Post OSHA citations at or near the worksite involved. Each citation, or copy thereof, must remain posted until the violation has been abated, or for three working days, whichever is longer.
- Abate (eliminate) cited violations within the prescribed period.

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One set of criteria is used to determine if work-related injuries and illnesses are recordable (this is covered on the flowchart at the step entitled “Does this illness or injury meet the general recording criteria or the application to specific cases”). Any work-related injury or illness resulting in one of the following must be recorded on an incident report (OSHA Form 301), and on the Log and Summary forms (OSHA Form 300 and OSHA Form 300A):

- Death;
- Days away from work;
- Restricted work or transfer to another job;
- Medical treatment beyond first aid;
- Loss of consciousness; or
- Diagnosis of a significant injury/illness by a physician or other licensed health care professional.

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OSHA's Form 301
Injury and Illness Incident Report

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary*, these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by _____ Date ____/____/____
Title _____
Phone (____) _____

Information about the employee

- 1) Full name _____
2) Street _____
City _____ State _____ ZIP _____
3) Date of birth ____/____/____
4) Date hired ____/____/____
5) ☐ Male ☐ Female

Information about the physician or other health care professional

- 6) Name of physician or other health care professional _____
7) If treatment was given away from the worksite, where was it given?
Facility _____
Street _____
City _____ State _____ ZIP _____

- 8) Was employee treated in an emergency room?
☐ Yes ☐ No
9) Was employee hospitalized overnight as an in-patient?
☐ Yes ☐ No

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.



U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

Information about the case

- 10) Case number from the Log _____ (Transfer the case number from the Log after you record the case.)
11) Date of injury or illness ____/____/____
12) Time employee began work ____ AM / PM
13) Time of event ____ AM / PM ☐ Check if time cannot be determined

14) **What was the employee doing just before the incident occurred?** Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. *Examples:* "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."

15) **What happened?** Tell us how the injury occurred. *Examples:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."

16) **What was the injury or illness?** Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or "sore." *Examples:* "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."

17) **What object or substance directly harmed the employee?** *Examples:* "concrete floor"; "chlorine"; "radial arm saw." If this question does not apply to the incident, leave it blank.

18) **If the employee died, when did death occur?** Date of death ____/____/____

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Persons are not required to respond to the collection of information unless it displays a current valid OSHA control number. If you have any comments about this estimate or any other aspects of this data collection, including suggestions for reducing this burden, contact: U.S. Department of Labor, OSHA Office of Statistical Analysis, Room N-3614, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed form to this office.

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OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35; in OSHA's recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
60	78	90	100

$$\frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \quad \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
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86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

(K)

Injury and Illness Types

Total number of ...

- (iv)
- | | |
|----------------------------|-------|
| (1) Injuries | _____ |
| (2) Skin disorders | _____ |
| (3) Respiratory conditions | _____ |
| (4) Poisonings | _____ |
| (5) Hearing loss | _____ |
| (6) All other illnesses | _____ |

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including time to review the instructions, search existing data sources, gathering the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any aspect of this data collection, including suggestions for reducing the burden, to Washington, DC 20503. Do not send this information to the collection of information. Send comments to the Office of Management and Budget, Paperwork Project Director (0304-0188), Washington, DC 20503.



Year 20

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

Establishment information

Your establishment name _____

Street

City _____ State _____ ZIP _____

Industry description (e.g., Manufacture of motor truck trailers)

Standard Industrial Classification (SIC), if known (e.g., 3715)

OR

North American Industrial Classification (NAICS), if known (e.g., 336212)

Employment information (If you don't have these figures, see the Worksheet on the back of this page to estimate.)

Annual average number of employees

Total hours worked by all employees last year

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive	Title

Compliance Management

Rights

As an employer, you have the right to:

- Seek advice and off-site consultation as needed by writing, calling, or visiting the nearest OSHA Office. (OSHA will not inspect merely because an employer requests assistance.)
- Be active in your industry association's involvement in job safety and health.
- Request and receive proper identification of the OSHA compliance officer prior to inspection.
- Be advised by the compliance officer of the reason for an inspection.
- Have an opening and closing conference with the compliance officer.
- Have a company OSHA compliance officer present during an inspection.
- File a Notice of Contest with the OSHA area director within 15 working days of receipt of a notice of citation and proposed penalty.
- Apply to OSHA for a temporary variance from a standard if unable to comply because of the unavailability of materials, equipment, or personnel needed to make necessary changes within the required time.
- Apply to OSHA for a permanent variance from a standard if you can furnish proof that your facilities or method of operation provide employee protection at least as effective as that required by the standard.
- Take an active role in developing safety and health standards through participation in OSHA Standards Advisory Committees, through nationally recognized standards-setting organizations, and through evidence and views presented in writing or at hearings.
- Be assured of the confidentiality of any trade secrets observed by an OSHA compliance officer during an inspection.
- Submit a written request to NIOSH for information on whether any substance in your workplace has potentially toxic effects in the concentrations being used.

Employee responsibilities and rights

Although OSHA does not cite employees for violations of their responsibilities, each employee "shall comply with all occupational safety and health standards and all rules, regulations, and orders issued under the Act" that are applicable. Employee responsibilities and rights in states with their own occupational safety and health programs are generally the same as for workers in federal OSHA states.

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Responsibilities

Employees should:

- Read the OSHA poster at the jobsite.
- Comply with all applicable OSHA standards.
- Follow all employer safety and health rules and regulations, and wear or use prescribed protective equipment while engaged in work.
- Report hazardous conditions to the supervisor.
- Report any job-related injury or illness to the employer, and seek treatment promptly.
- Cooperate with the OSHA compliance officer conducting an inspection if he or she inquires about safety and health conditions in your workplace.
- Exercise their rights under the Act in a responsible manner.

11(c) rights: Protection for using rights

Employees have a right to seek safety and health on the job without fear of punishment. That right is spelled out in Section 11(c) of the Act.

The law says employers shall not punish or discriminate against workers for exercising rights such as:

- Complaining to an employer, union, OSHA, or any other government agency about job safety and health hazards.
- Filing safety or health grievances.
- Participating on a workplace safety and health committee or in union activities concerning job safety and health.
- Participating in OSHA inspections, conferences, hearings, or other OSHA-related activities.

If an employee is exercising these or other OSHA rights, the employer is not allowed to discriminate against that worker in any way, such as through firing, demotion, taking away seniority or other earned benefits, transferring the worker to an undesirable job or shift, or threatening or harassing the worker.

If the employer has knowingly allowed the employee to do something in the past (such as leaving work early), he or she may be violating the law by punishing the worker for doing the same thing following a protest of hazardous conditions. If the employer knows that a number of workers are doing the same thing wrong, he or she cannot legally single out for punishment the worker who has taken part in safety and health activities.

Workers believing they have been punished for exercising safety and health rights must contact the nearest OSHA office within 30 days of the time they learn of the alleged discrimination. A union representative can file the 11(c) complaint for the worker.

Compliance Management

Section 405 of the Surface Transportation Assistance Act (STAA) was enacted on January 6, 1983, and provides protection from reprisal by employers for truckers and certain other employees in the trucking industry involved in activity related to interstate commercial motor vehicle safety and health. Secretary of Labor's Order No. 9-83 (48 FR 35736, August 5, 1983) delegated to the Assistant Secretary of OSHA the authority to investigate and to issue findings and preliminary orders under Section 405.

Employees who believe they have been discriminated against for exercising their rights under Section 405 can file a complaint with OSHA within 180 days of the incident. The Secretary will then investigate the complaint, and within 60 days after it was filed, issue findings as to whether there is a reason to believe Section 405 has been violated.

If the Secretary finds that a complaint has merit, he/she also will issue an order requiring, where appropriate, abatement of the violation, reinstatement with back pay and related compensation, payment of compensatory damages, and the payment of the employee's expenses in bringing the complaint. Either the employee or employer may object to the findings. If no objection is filed within 30 days, the findings and order are final. However, if a timely-filed objection is made, the objecting party is entitled to a hearing on the objection before an Administrative Law Judge of the Department of Labor.

Within 120 days of the hearing the Secretary will issue a final order. A party aggrieved by the final order may seek judicial review in a court of appeals within 60 days of the final order.

The following activities of truckers and certain employees involved in interstate commercial motor vehicle operation are protected under Section 405:

- Filing of safety or health complaints with OSHA or other regulatory agency relating to a violation of a commercial motor vehicle safety rule, regulation, standard, or order.
- Instituting or causing to be instituted any proceedings relating to a violation of a commercial motor vehicle safety rule, regulation, standard, or order.
- Testifying in any such proceedings relating to the above items.
- Refusing to operate a vehicle when such operation constitutes a violation of any Federal rules, regulations, standards, or orders applicable to commercial motor vehicle safety or health; or because of the employee's reasonable apprehension of serious injury to himself or the public due to the unsafe condition of the equipment.
- Complaining directly to management about job safety or health conditions relating to commercial motor vehicle operation.

Complaints under Section 405 are filed in the same manner as complaints under 11(c). The filing period for Section 405 is 180 days from the alleged discrimination, rather than 30 days as under Section 11(c).

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The worker does not have to complete any forms. An OSHA staff member will complete the forms, asking what happened and who was involved.

Following a complaint, OSHA investigates. If an employee has been illegally punished for exercising safety and health rights, OSHA asks the employer to restore that worker's job earning and benefits. If necessary, and if it can prove discrimination, OSHA takes the employer to court. In such cases the worker does not pay any legal fees.

If a state agency has an OSHA-approved state program, employees may file their complaint with either federal OSHA or the state agency under its laws.

Other rights

Employees also have the right to:

- Review copies of appropriate OSHA standards, rules, regulations and requirements that the employer should have available at the workplace.
- Request information from their employer on safety and health hazards in the area, on precautions that may be taken, and on procedures to be followed if an employee is involved in an accident or is exposed to toxic substances.
- Receive adequate training and safety information.
- Request the OSHA area director to conduct an inspection if you believe hazardous conditions or violations of standards exist in your workplace.
- Have their names withheld from employers if they file a written and signed complaint, if so requested.
- Be advised of OSHA actions regarding complaints and have an informal review, if requested, of any decision not to inspect or to issue a citation.
- Have an authorized employee representative accompany the OSHA compliance officer during the inspection tour.
- Respond to questions from the OSHA compliance officer, particularly if there is no authorized employee representative accompanying the compliance officer.
- Observe any monitoring or measuring of hazardous materials and have the right to see these records, as specified under the Act.
- Review, or have an authorized representative review, the Log and Summary of Occupational Injuries (OSHA No. 200, 300/300A) at a reasonable time and in a reasonable manner.
- Request a closing discussion with the compliance officer following an inspection.

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- Submit a written request to NIOSH for information on whether any substance in the workplace has potentially toxic effects in the concentration being used, and have names withheld from the employer if so requested.
- Object to the abatement period set in the citation issued to an employer by writing to the OSHA area director within 15 working days of the issuance of the citation.
- Be notified by their employer if the employer applies for a variance from an OSHA standard, and testify at a variance hearing, and appeal the final decision.
- Submit information or comment to OSHA on the issuance, modification, or revocation of OSHA standards and request a public hearing.

OSHA and the General Duty Clause

A single sentence contained in the Occupational Safety and Health Act of 1970 has been used increasingly by OSHA in the last years in enforcement and penalty actions. The following section describes that clause and how OSHA uses it.

What is the General Duty Clause?

Section 5(a)(1) of the Occupational Safety and Health Act of 1970 requires that every working man and woman must be provided with a safe and healthful workplace. The section, more commonly known as the General Duty Clause, specifically states:

“Each employer shall furnish to each of his employees employment and a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees.”

In simple terms, this statement means that you, as an employer, may be obligated to protect your employees from recognized hazards in the workplace even if there is not an OSHA standard which applies to the situation or if hazards still exist after compliance with a standard. In effect, the General Duty Clause obligates employers to take additional steps toward safety if the well-being of employees is in jeopardy.

How does OSHA use the General Duty Clause?

The General Duty Clause extends OSHA's authority beyond the specific requirements of the OSHA standards when a recognized workplace hazard exists or potentially exists. From January 1, 2006, through December 31, 2006, the General Duty Clause was used as the basis for over 1,361 OSHA citations. Over \$805,000 in adjusted penalties were collected as a result of these citations. The General Duty Clause is often used by OSHA when there is no specific standard which applies to a recognized hazard in the workplace. OSHA may also use the General Duty Clause when a standard exists, but it is clear that the hazards

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involved warrant additional precautions beyond what the current safety standards require.

OSHA's action on ergonomic hazards in the workplace is a good example of the application of the General Duty Clause in situations where a standard does not currently exist. There are no standards governing job or work station design to reduce or prevent cumulative trauma disorders or other injuries. However, OSHA has widely applied the General Duty Clause to address ergonomic hazards in the workplace. Typically in these situations, OSHA will discover ergonomic-related problems while reviewing a company's accident and injury records. The highly publicized citations issued to several meatpacking plants for cumulative trauma disorders are an example of the use of the General Duty Clause to correct ergonomic hazards. The action in this area eventually led to the issuance of ergonomic guidelines for the meatpacking industry and consideration of a standard for the general industry.

OSHA has also issued General Duty Clause citations on other issues where no apparent safety standard exists. Citations have been issued for lack of training, failure to have additional safety or alarm equipment to detect or warn of chemical leaks, and failure to provide safe locations or safe access to valves or other instruments necessary to an employee's job.

What about situations where a safety standard currently exists on a particular subject? Are you doing enough if you are in compliance with OSHA's safety standard? The answer, unfortunately, is maybe not. OSHA has also used the General Duty Clause to cite employers who knew that an OSHA standard was inadequate to protect their employees from harm.

At least one Circuit Court decision (*International Union UAW v. General Dynamics*, 815 F.2d 1570, D.C. Cir. 1987) has validated OSHA's use of the General Duty Clause in this manner. In this situation, after several injuries and eventually a death involving the use of freon in confined spaces, OSHA cited General Dynamics under the General Duty Clause for not having a confined space procedure in situations where an employee could be asphyxiated or chemically poisoned by the cleaning compound (freon) being used. General Dynamics appealed the citation to the Occupational Safety and Health Review Commission which ruled in favor of the company noting that since there was a specific OSHA exposure standard for freon (eight-hour time-weighted average), OSHA could not cite the company under the General Duty Clause. The Commission's decision was then reviewed by the Circuit Court of the District of Columbia which decided in favor of OSHA. The court stated that:

“ . . if (as alleged in this case) an employer knows a particular safety standard is inadequate to protect his workers against the specific hazard it is intended to address, or that the conditions in his place of employment are such that the safety standards will not adequately deal with the hazards to which his employees are exposed, he has a duty under Section 5(a)(1) to take whatever measures may be required by the Act, over and above those mandated by the safety standard, to safeguard his workers.”

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Conclusion

Section 5(a)(1) of the Occupational Safety and Health Act of 1970 places additional responsibilities on the employer and the safety manager to ensure that a safe work environment is provided to all employees. The General Duty Clause is being increasingly applied to a wide variety of situations, many of which have not been addressed by a specific OSHA standard. What may be even more disconcerting, however, is that general duty citations can also be issued if OSHA feels that additional safety equipment or procedures are necessary beyond what is required in an OSHA standard. Thus, the General Duty Clause is making it increasingly difficult for companies to fully comply with OSHA's requirements.

One way to deal with the increasing threat of general duty violations is to make good faith efforts to correct existing workplace hazards and continually assess the workplace to identify and address new hazards as they appear. Some steps you can take to accomplish this goal include:

- Regularly review your accident and injury records to identify injury patterns or areas for concern.
- Investigate every accident, injury, or near-miss in the workplace to determine the specific cause and to determine whether any action needs to be taken to prevent the accident or injury from recurring.
- Conduct job hazard analyses on a regular basis in order to identify the specific hazards associated with every job and to identify new job hazards.
- Document your training efforts and conduct periodic retraining as necessary.
- Consider establishing an employee safety committee in the workplace.

One final thought on the General Duty Clause. When you have met the letter of the law, step back, and critically assess whether some processes might still be unsafe. If there are, you may need to go beyond the letter of the law to provide the employees with a safe worksite. If you do not, you may fall victim to the General Duty Clause.

Hazard Communications Standard

OSHA developed the Hazard Communication Standard (HCS) to protect workers in all industries from dangerous exposures to hazardous materials. The standard was originally based on a simple concept — that employees have both a need and a right to know about the hazards and identities of the chemicals they are exposed to when working. In 2012, OSHA changed the HCS drastically, using the concept that the employees have a “right to understand” about the hazards of chemicals they are exposed to. They also need to know what they can do to protect themselves.

The HCS establishes uniform requirements to make sure that the hazards of all chemicals used in U.S. workplaces are evaluated and classified and that this hazard information is communicated to employers and exposed employees. Basically, the rule incorporates a downstream flow of information. This means that chemical manufacturers have the primary

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responsibility for generating and disseminating information and chemical users must obtain the information and transmit it to their exposed employees.

Evaluating and classifying chemical hazards involves technical concepts and is a process that requires the professional judgement of experienced experts. This is why the rules make it the responsibility of the producers and importers of the materials, who must then pass that information to the purchasers and end-users. The HCS is designed so that employers who simply use chemicals (such as motor carriers) are not required to evaluate the hazards of those substances.

Employers that don't produce or import chemicals need only focus on those parts of the rule that deal with establishing a workplace program and communicating information to their workers.

On March 26, 2012, OSHA published a new rule to align the HCS with a new global system developed by the United Nations, called the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). This important change adapts the HCS into a more uniform way of transmitting information that all chemical manufacturers, importers and distributors, along with employers, must use to communicate the hazards of chemicals to workers.

The rule became effective May 26, 2012; however, there is a phase-in period for certain elements.

Phase-in period for Hazcom 2012

Date	Requirement(s)	Who
December 1, 2013	Train employees on the new label elements and safety data sheet (SDS) format.	Employers
June 1, 2015 December 1, 2015	Compliance with all modified provisions of this final rule, except: The Distributor shall not ship containers labeled by the chemical manufacturer or importer unless it is a GHS label	Chemical manufacturers, importers, distributors and employers
June 1, 2016	Update alternative workplace labeling and hazard communication program as necessary, and provide additional employee training for newly identified physical or health hazards.	Employers
Transition Period to the effective completion dates noted above	May comply with the March 26, 2012, rule, the old rule, or both.	Chemical manufacturers, importers, distributors, and employers

Because there is a phase-in period, employers can still comply with the older HCS requirements through the dates above.

The HCS requires information to be prepared and transmitted regarding all hazardous chemicals. It covers both physical hazards (such as flammability), and health hazards (such as irritation, lung damage, and cancer).

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Most chemicals used in the workplace have some hazard potential and are covered by the HSC rule (old and new).

Employers that use hazardous chemicals need to have a program in place to ensure the hazard information is provided to exposed employees. “Use” means to package, handle, react, or transfer. This is an intentionally broad scope, and includes any situation where a chemical is present in such a way that employees may be exposed under normal conditions or in an emergency.

If your employees are exposed to chemicals, you will need to develop a written hazard communication program that covers:

- A chemical inventory list;
- Container labels and other forms of warning;
- Collection and availability of safety data sheets (or SDSs, formerly known as material safety data sheets, or MSDSs); and
- Employee information and training.

Here is a checklist that can be helpful when trying to comply with the HCS:

- Obtain a copy of the HCS rule
- Make sure to comply with the HCS 2012 requirements by the specified timeframes
- Read and understand the rule’s requirements as it pertains to employers
- Prepare a written hazard communication program
- Assign responsibilities
- Prepare a chemical inventory
- Ensure that all chemical containers are labeled
- Ensure that there is an SDS for each chemical
- Provide training for all workers with exposure risks
- Review the program routinely (set a review date)

The basis for all “hazard communication” is that the chemical has been evaluated and classified as to its hazards. This responsibility generally falls to the chemical manufacturer or importer. OSHA requires that these parties evaluate and classify each substance using pre-determined “Hazard Classes,” (e.g., “flammable gas,” “corrosive,” etc.) and assign a “Category” to show severity of the hazard. The lower the Category number, the higher the severity within that Class (for example, a Category 1 flammable gas is more flammable than a Category 2). Depending on the Class, there can be up to 5 Categories. As a result of the GHS/Hazcom revisions in 2012, all of this information is standardized, both in the evaluation and classification method, as well as in label elements, SDS elements, and hazard statements. In other words, if a chemical is determined to be a “Category 1 flammable gas” then there is a predefined list

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of pictograms, label elements, SDS wording, etc., that manufacturers or importers must utilize.

Note: Employers are not required to classify chemicals unless they choose not to rely on the classification performed by the chemical manufacturer or importer of the chemical to satisfy this requirement.

The following list identifies some types of potentially hazardous chemicals that may be present in a maintenance facility:

Acids	Glues
Adhesives	Greases
Aerosols	Industrial oils
Asbestos	Janitorial supplies
Battery fluids	Kerosene
Benzene	Lacquers
Catalysts	Lead
Caustics	Oxalic Acid
Cleaning agents	Paints
Coal tar pitch	Plastic resins
Coatings	Resins
Degreasing agents	Sealers
Detergents	Shellacs
Dusts	Solders
Etching agents	Solvents
Fiberglass	Strippers
Flammables	Sufactants
Foaming resins	Thinners
Fuels	Varnishes
Gasoline	Xylene

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All workplaces where employees are exposed to hazardous chemicals are required to have a written plan describing how hazard communication will be carried out in that facility. Plan preparation is not just a paper exercise — all of the elements must be implemented in order to be in compliance with the rule. This is one of the most important aspects of your compliance program. It is also one of the first items that an OSHA compliance officer will examine to determine if your hazard communication program is adequate.

The plan does not have to be lengthy or complicated. It is intended to be a blueprint for implementation of your program — an assurance that all aspects of the requirements have been addressed. It serves to communicate to your employees and to OSHA exactly what you have done to comply with the HCS. In general, the written program must describe how the requirements for labels and other forms of warning, safety data sheets, employee information, and training are going to be met in your facility.

Remember that the written program needs to reflect what you are doing in your workplace. If you use a generic program, it must be adapted to address the facility it covers. For example, the written plan must list the chemicals present at the site, indicate who is to be responsible for the various aspects of the program in your facility, and indicate where written materials will be made available to employees. Your written program must cover the following topics.

The next step is developing an inventory of chemicals. This is the inventory of chemicals for which you must have SDSs. The list may be compiled for the workplace as a whole or for individual work areas. Remember to include any consumer products that you have determined are covered by the standard as well as any substances you may inadvertently produce, such as carbon monoxide. This list must be made available to employees, upon request.

You need only list the chemical name, but OSHA suggests that for your own use, you include all information that will assist in clearly identifying the substance in question, such as chemical name, common or trade name, manufacturer's product name, and CAS number.

Your written program should address the following points regarding labeling:

- Designate the person responsible for ensuring all containers are labeled;
- Designate the person responsible for ensuring all shipped containers are labeled;
- Describe any labeling system used, either on shipped containers or in-plant (include examples of labels used);
- Describe written alternatives to labeling of in-plant containers, if used (for example, putting the label information on stationary tanks);
- Procedures to review and update label information when necessary and to ensure that labels that fall off or become unreadable are immediately replaced;

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- A copy of posters and other written materials used to inform employees about the HCS, or where the information is located.

The label must contain the following elements:

- **Pictogram:** a symbol plus other graphic elements, such as a border, background pattern, or color that is intended to convey specific information about the hazards of a chemical. Each pictogram consists of a different symbol on a white background within a red square frame set on a point (i.e. a red diamond). There are nine pictograms under the GHS. However, only eight pictograms are required under the HCS.
- **Signal words:** a single word used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The signal words used are “danger” and “warning.” “Danger” is used for the more severe hazards, while “warning” is used for less severe hazards.
- **Hazard Statement:** a statement assigned to a hazard class and category that describes the nature of the hazard(s) of a chemical, including, where appropriate, the degree of hazard.
- **Precautionary Statement:** a phrase that describes recommended measures to be taken to minimize or prevent adverse effects resulting from exposure to a hazardous chemical, or improper storage or handling of a hazardous chemical.
- Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party.

Labels are not intended to be either the sole or the most complete source of information regarding the nature or identity of all hazardous chemicals in the workplace. The chemical identity on the label must be keyed to the chemical’s SDS, which contains more extensive information.

Here are the required pictograms. **Note:** The following illustration is shown in black and white. On actual container labels, each pictogram is required to have a red border/frame.

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	Flame Over Circle • Oxidizers		Flame • Flammables • Self Reactives • Pyrophorics • Self-Heating • Emits Flammable Gas • Organic Peroxides		Exploding Bomb • Explosives • Self Reactives • Organic Peroxides
	Skull and Crossbones • Acute toxicity (severe)		Corrosion • Corrosives		Gas Cylinder • Gases Under Pressure
	Health Hazard • Carcinogen • Respiratory Sensitizer • Reproductive Toxicity • Target Organ Toxicity • Mutagenicity • Aspiration Toxicity		Environment • Environmental Toxicity		Exclamation Mark • Irritant • Dermal Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract • Hazardous to Ozone Layer

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The role of an SDS is to provide detailed information on each hazardous chemical, including its potential hazardous effects, its physical and chemical characteristics, and recommendations for appropriate protective measures. This information is useful to you as the employer responsible for designing protective programs, as well as to your employees.

As of June 1, 2015, the HCS will require new SDSs to be in a uniform format, and include the section numbers, the headings, and associated information under the headings below:

Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.

Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.

Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.

Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.

Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.

Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.

Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.

Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).

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Section 9, Physical and chemical properties lists the chemical's characteristics.

Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.

Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.

Section 12, Ecological information*

Section 13, Disposal considerations*

Section 14, Transport information*

Section 15, Regulatory information*

Section 16, Other information, includes the date of preparation or last revision.

***Note:** Since other Agencies regulate this information, OSHA will not be enforcing Sections 12 through 15.

You (the employer), as the end user, are entitled to receive an SDS for each chemical product you purchase. If you do not receive one automatically, you should request one. If you receive one that is obviously inadequate, with, for example, blank spaces that are not completed, you will need to request an appropriately completed one. If your request for a data sheet or for a corrected data sheet goes unanswered within a reasonable amount of time (OSHA suggests 30 days), you should contact your local OSHA area office for assistance in obtaining the SDS. If you are still unable to get the data sheet, consider purchasing from another vendor.

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SDS Number: UR-101 * * * * Effective Date: 05/27/12 * * * * Supersedes: 05/08/00

Solvent X (contains Methylene Chloride)

1. Product and Company Identification

Product Name: Solvent X
Synonyms: Machine solvent, industrial solvent, equipment flushing solvent
CAS No.: Not applicable to mixtures
Molecular Weight: Not applicable to mixtures
Emergency Contact: +1-123-555-1212

Product Use: Various industrial uses
Restrictions: Not to be used as a skin cleaner
Chemical Formula: Not applicable to mixtures
Product Codes: UR-101
Manufacturer: U. R. Chemical
Little Hill, KS 01234
Telephone: +1-123-555-0101
Fax: +1-123-555-0102

2. Hazards Identification

GHS CLASSIFICATION:			
Health	Category 4	Environment	None Known
Acute Toxicity:	Category 4	Acute Toxicity:	None Known
Skin Irritation:	Category 2	Chronic Toxicity:	None Known
Skin Sensitization:	n.d.		
Eye:	Category 3H		
GHS LABEL:		Signal Word:	Warming
		WHMIS CLASSIFICATION:	CLASS D, DIVISION 1
HAZARD STATEMENTS		PRECAUTIONARY STATEMENTS	
H302: Causes eye irritation. H332: May cause respiratory irritation. H336: May cause drowsiness or dizziness. H351: Suspected of causing cancer.		P201+P202: Keep away from heat/spark/open flames/hot surfaces - No smoking. P201: Avoid breathing dust/fume/gas/mist/vapors/spray. P202: Wear protective gloves/protective clothing/eye protection/face protection. P203+P233: Get medical advice/attention. P231+P232: Store in a well-ventilated place. Keep container tightly closed. P501: Dispose of contents/container in accordance with local regulation.	

3. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methylene Chloride	75-09-2	40%	Yes
Ethyl Alcohol	64-17-5	30%	Yes
Acetic Acid	64-19-7	15%	Yes
Paraffinic Petroleum Distillates	64742-65-0	15%	Yes

4. First Aid Measures

Inhalation: Remove to fresh air. Get medical attention for any breathing difficulty. If breathing stops, administer artificial respiration.
Ingestion: Do not induce vomiting. Keep individual calm. Obtain medical attention immediately.
Skin Contact: Remove contaminated clothing and shoes. Wash exposed area with soap and water for at least 15 minutes. Get medical advice if irritation develops. Wash contaminated clothing before reuse.
Eye Contact: Flush thoroughly with running water for at least 15 minutes, occasionally lifting the eyelids. Obtain medical attention.

5. Fire Fighting Measures

Fire: Fire is possible if concentrated vapors are exposed to elevated temperatures.
Fire Extinguishing Media: Water spray, dry chemical, alcohol foam, or carbon dioxide.
Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up spill for recovery or disposal and place in a closed container. Keep spilled material away from sewage/drainage systems and waterways.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
methylene chloride = 5000 ppm (TWA);
ethyl alcohol = 1000 ppm;
acetic acid = none established;
paraffinic petroleum distillates = 400 ppm.
- ACGIH Threshold Limit Value (TLV):
methylene chloride = 50 ppm (TWA);
ethyl alcohol = 1000 ppm;
acetic acid = none established;
paraffinic petroleum distillates = 400 ppm.

Ventilation System:
Sufficient to maintain vapor concentration below TLV. Do not use in a closed or confined space.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear an appropriate NIOSH N95 respirator, full-facepiece respirator, or airlined hood.

Skin Protection:
Wear impervious protective clothing, including gloves and apron, to prevent skin contact.

Eye Protection:
Use chemical safety goggles or full face shield when splashing is a concern. Maintain eye-wash fountain and quick-drench facility in the work area.

Other Control Measures:
Protective equipment for laboratory bench use should be chosen using professional judgment based on the size and type of reaction.

Notice: Chemical and other data represented in this safety data sheet image is for example purposes only.

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9. Physical and Chemical Properties

Appearance:
Clear, yellowish liquid.
Odor:
Sweet, aromatic odor.
Solubility:
1.4 grams per 100 grams at 77°F
Specific Gravity:
1.2 at 77°F
pH:
No information found.
% Volatiles by volume @ 21°C (70°F):
Not available
Boiling Point:
No information found.

Melting Point:
199°C (390°F) Decomposes.
Freezing Point:
-96.7°C (-142.1°F)
Flash Point:
16°C (61°F)
Flammability:
Non-flammable liquid. Vapor will burn at high temperatures.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Burning may produce carbon monoxide, carbon dioxide, nitrogen oxides.

Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers and reactive metals.
Conditions to Avoid:
Incompatibles and hot surfaces which can cause thermal decomposition.

11. Toxicological Information

Methylene chloride: oral rat LD50: 16000mg/kg; inhalation rat LC50: 52gm/m3; investigated as a tumorigen, mutagen, reproductive effector.
Ethyl alcohol: oral rat LD50= 7060mg/kg; inhalation rat LC50= 20,000ppm/10H; investigated as a tumorigen, mutagen, reproductive effector.
Acetic acid: No LD50/LC50 information found relating to normal routes of occupational exposure.
Paraffinic petroleum distillates: Not known.

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days.

Ecotoxicological Data:
96 hr. NOEL (minnow) 110 mg/L
24 hr EC50 (Daphnia Magna) 460 mg/L

13. Disposal Considerations

Recover or recycle if possible. It is the responsibility of the waste generator to determine the proper waste classification and disposal methods in compliance with applicable federal, state, and local regulations. Do not dispose of in the environment, in drains or water courses. Drain container thoroughly. Send to recycler/reclaimer.

14. Transport Information

Transport in accordance with all federal, state, and local regulations.
UN number 2929
UN proper shipping name Toxic liquid, flammable, n.o.s.
Hazards class 6.1; Packing Group III

15. Regulatory Information

-----\Chemical Inventory Status - Part I\-----				
Ingredient	TSCA	EC	Japan	Australia
Methylene Chloride (75-09-2)	Yes	Yes	Yes	Yes
Ethyl Alcohol (64-17-5)	Yes	Yes	Yes	Yes
Acetic Acid (64-19-7)	Yes	Yes	Yes	Yes
Paraffinic Petroleum Distillates (64742-65-0)	Yes	Yes	No	Yes

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 1 Reactivity: 0
HMIS Ratings: Health: 3 Flammability: 1 Physical Hazard: 0
This SDS was prepared by U. R. Chemical.

Revision Information: Revised 05/27/12

Notice: Chemical and other data represented in this safety data sheet image is for example purposes only.

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SDSs must be readily accessible to employees when they are in their work areas. This can be accomplished in many different ways. You will need to decide what is the best media and storage method for your particular workplace.

For example, SDSs can be paper, electronic data, faxed materials, CD ROM, or available from SDS services. You can even use SDSs that are available on the internet. Because there is no mandatory media that must be used, data sheets are available in a wide variety of formats.

OSHA also does not have a specific requirement for storing SDSs. They can be stored in a binders (or binders) at specific locations or on your computer network. You can choose the best method for your company. Remember, when choosing a format or a storage method, the SDS must be readily available to all employees no matter what shift they work.

Training is critical to effective hazard communication. It is the forum in which hazard information can best be presented. Under the Hazard Communication Standard, all covered facilities are required to establish an effective training and information program for every employee routinely exposed to hazardous chemicals.

Prior to the initial job assignment, each employee who has exposure risks to hazardous chemicals must be provided information and training. Scheduled required training is not required under the regulation. However, additional training has to be done whenever a chemical with new physical or health hazards is introduced into the work area.

There are no specific instructor requirements. you simply need to make sure that whoever does the chemical-specific training thoroughly understands the safe handling aspects of the chemicals being covered. If you have several people, such as supervisors, conducting training for their work areas, sit in on a session or two to observe how the training is being handled.

The key term used in the regulations as far as training is concerned is “understanding.” Not only do employees have to be trained, but they must walk away from that training understanding what they are working with. Giving an employee a data sheet to read does not satisfy the intent of the HCS. The training should include an opportunity for them to ask questions, thus ensuring that they understand the information.

One of the questions that is routinely asked in this area is, “What if we use one of the other labeling systems in-house?” While the Hazcom 2012 rule requires shipped containers to conform to the GHS-style labeling system, OSHA still allows employers to use their own workplace labeling systems (for example, HMIS®III and NFPA) for in-house usage. If an employer does choose to continue using an alternative labeling system, the employer must ensure that the system is updated as necessary so that it does not conflict with GHS-style labeling/classification.

Employers who use general, nonspecific in-plant labeling systems such as HMIS or NFPA must ensure through their hazard communication program that their employees can correlate the visual warning on the in-plant container with the applicable chemical and its appropriate hazard warnings.

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The other marking and labeling system used by industry, the DOT system is also addressed in the HCS rules. Packages holding hazardous materials are required to be marked and labeled according to the DOT hazardous materials regulations (HMR) while being transported. These containers must retain the labels until the hazardous materials are removed. This requirement comes from §1910.1201, Retention of DOT Markings, Placards, and Labels, an OSHA rule related to the HCS.

The rule requires employers who receive hazardous materials to retain markings and any other information specified by HMR until the materials have been removed so they no longer pose a health or safety risk. It applies primarily to bulk packages (defined by the DOT as containers with a capacity of more than 119 gallons), but also applies to non-bulk receptacles that are repackaged and reshipped.

The HCS requires that labels, tags, and markings be attached in a way that does not conflict with the HMR. Consequently, the HCS warning labels, tags, or markings do not appear on the outer packagings of combination packagings (*e.g.* bottles in a box). The inner packagings are required to be labeled according to HCS guidelines, while the outside packaging is marked or labeled according to HMR guidelines. Without restricting the regulation to bulk packaging, employers would be faced with confusing, redundant, and sometimes inconsistent labeling requirements between DOT and OSHA.

This requirement applies only to the employer that receives the hazardous materials — not the person responsible for transporting it. The transported is subject to only the DOT HMR requirements.

Typical OSHA compliance issues

If you find yourself responsible for OSHA compliance in your company, and don't quite know where to turn, it's not a surprise. The regulations of this agency are voluminous and complex — far too complex to cover in any complete fashion here. Basically, the bulk of regs you have to be concerned about are found in 29 CFR, Part 1910. (See the listing of the table of contents of this Part in the Compliance Section to get an idea of the subjects covered.

The following list of topics are also likely to be found in your maintenance area, or related parts of the company you work for. The topic includes the 1910 subpart where those regulations can be found:

- Floors, walkways, and stairs (Subpart D, 1910.21-1910.30).
- Confined spaces (Subpart J, 1910.146).
- Personal protective equipment (Subpart I, 1910.132-1910.138).

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Specialized work areas

Servicing large tires and rims

OSHA has a standard requiring the training of all technicians on the servicing of multi-piece and single piece rim wheels used on large vehicles such as trucks, tractors, trailers, buses and off-road machines. These regulations also specify the equipment that must be used, and the condition it must be in. See §1910.177 for full details.

You have to provide a program to train all employees who service these rim/wheels/tires on the hazards involved in servicing them and the safety procedures to be followed. The information provided to the technicians and used in the training program has to include, at a minimum, the information contained in the OSHA's charts and rim manuals.

OSHA requires that the materials (poster and/or manuals) be available in the immediate area where the work takes place for reference. While OSHA provides these materials in §1910.177, materials provided by others (such as tire and rim manufacturers, and J. J. Keller & Associates, Inc.) is acceptable, as long as it includes the required information.

As well as training the technicians, you have to make sure that each technician that works on these tires and rims demonstrates and maintains the ability to do the work safely. This includes being able to perform the following tasks safely and in accordance with the regulations, when working on multi-piece and single piece rims, wheels, and tires:

- Dismounting of tires (including deflation);
- Inspection and identification of the rim, tire, and wheel components;
- Mounting of tires (including inflation with a restraining device or other safeguards, such as using proper fluids);
- Use of the restraining device or barrier, and other equipment required to safely inflate the tires (such as a locking chuck);
- Handling of rims, wheels, and tires;
- Inflation of the tire when mounted on a vehicle;
- An understanding of the necessity of standing outside the trajectory area both during inflation of the tire and during inspection of the rim wheel following inflation; and
- Installation and removal of rims, wheels, and tires.

You need to actually evaluate each technician's ability to perform these tasks safely, and shall provide additional training as necessary to assure that each employee maintains his or her proficiency.

While some people have taken these regulations to mean that they cannot service multi-piece rims in their facilities, this is not the case. The regulations simply mean that the shop must have the proper safety equipment, and the technicians involved in this work must be full trained and equipped to do it. However, there is no regulation saying that you **MUST** work on multiple-piece rims. You can always refuse to service such rims. Due to the risks involved, many shops have done just that.

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Following you will find illustrations of several kinds of work areas which are likely to be present in a maintenance shop, plus references to the corresponding standards and marking requirements OSHA has for each of these areas. See the sections immediately following on:

- Welding areas.
- Spray paint booths or areas.
- Maintenance shop work areas.
- Vehicle maintenance area.

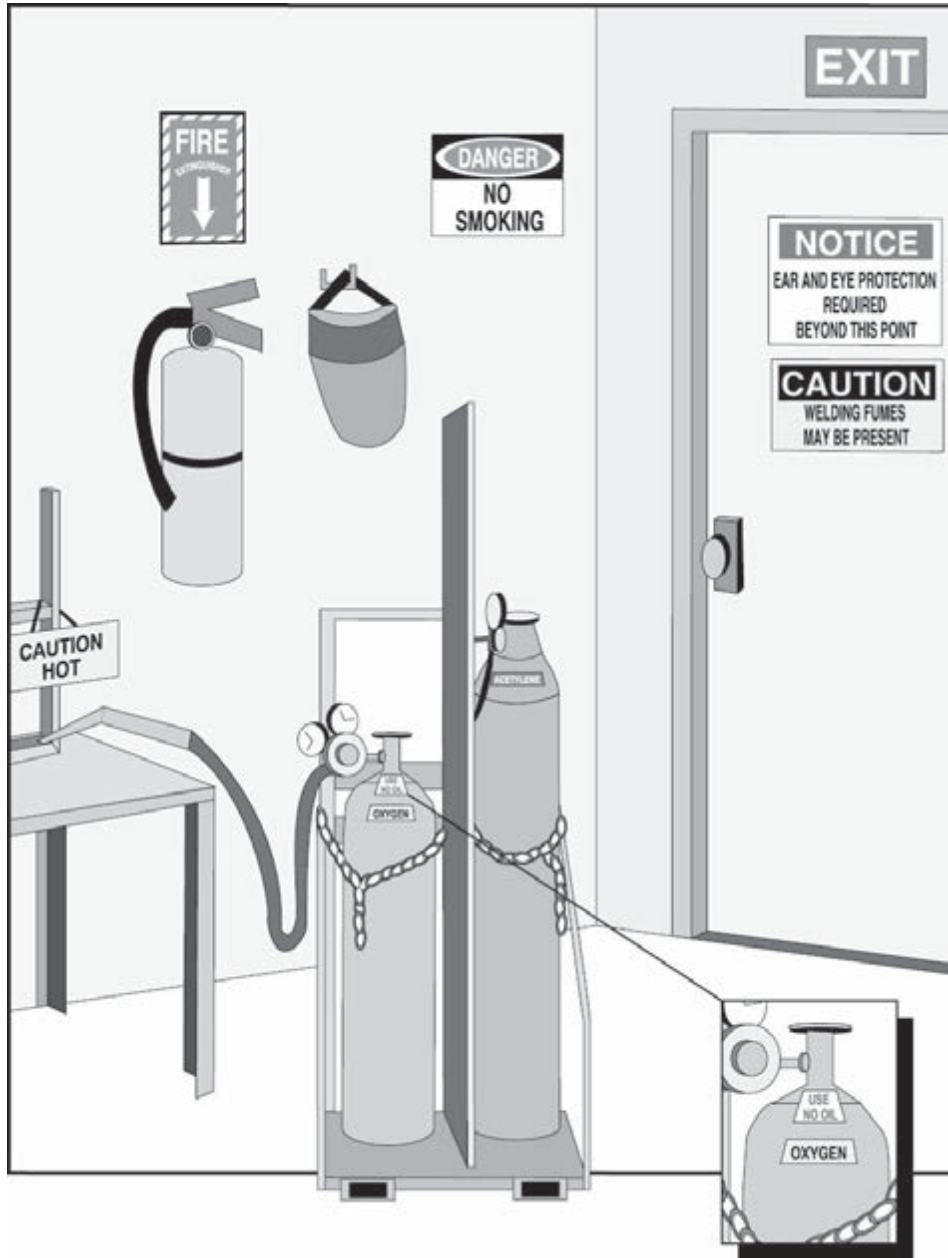
Welding situation

Almost every facility has the need to do some kind of welding. The welding process presents some of the greatest hazards to both safety and health. Therefore, OSHA has some recent, very stringent regulations spelled out to protect worker safety. These regulations include certain marking requirements.

The term “welding” is used broadly to include gas welding, electric-arc welding, resistance welding, soldering, and brazing. You might have a single portable welding unit to do the occasional spot welding task, or you might have large electric welders used in daily production tasks. You may have a separate welding room or rooms, or you may have one corner of a larger area designated as your welding area.

Whatever the physical dimensions of your welding operation, you must comply with certain marking requirements. The illustrations show some typical markings. Read the text for even more requirements.

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Fire Extinguisher .157(c)(1) and .252(a)(2)(ii). The employer shall provide portable fire extinguishers and shall mount, locate and identify them so that they are readily accessible to employees without subjecting the employees to possible injury.

Suitable fire extinguishing equipment shall be maintained in a state of readiness for instant use. Such equipment may consist of pails of water, buckets of sand, hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed.

EXIT .35 and .37(b). Lighting and marking must be adequate and appropriate. Each exit route must be adequately lighted so that an

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employee with normal vision can see along the exit route. Each exit must be clearly visible and marked by a sign reading “Exit.”

Each exit route door must be free of decorations or signs that obscure the visibility of the exit route door. If the direction of travel to the exit or exit discharge is not immediately apparent, signs must be posted along the exit access indicating the direction of travel to the nearest exit and exit discharge. Additionally, the line-of-sight to an exit sign must clearly be visible at all times. Each doorway or passage along an exit access that could be mistaken for an exit must be marked “Not an Exit” or similar designation, or be identified by a sign indicating its actual use (e.g., closet).

Each exit sign must be illuminated to a surface value of at least five foot-candles (54 lux) by a reliable light source and be distinctive in color. Self-luminous or electroluminescent signs that have a minimum luminance surface value of at least .06 footlamberts (0.21 cd/m²) are permitted. Each exit sign must have the word “Exit” in plainly legible letters not less than six inches (15.2 cm) high, with the principal strokes of the letters in the word “Exit” not less than three-fourths of an inch (1.9 cm) wide.

An employer who demonstrates compliance with the exit route provisions of the National Fire Protection Association’s publication NFPA 101-2000, Life Safety Code, will be deemed to be in compliance with the corresponding requirements in §§1910.34, 1910.36, and 1910.37.

HOT METAL .252(b)(4)(vii). After welding operations are completed, the welder shall mark the hot metal or provide some other means of warning other workers.

CAUTION: WELDING FUMES .1200(f)(5), (I) and (ii). Under Hazard Communication, the employer must ensure that every container of hazardous chemicals in the workplace, where there is the potential of exposure, is labeled, tagged, or marked. In this case, the room is the container, the welding fumes are the hazardous chemical, and workers are being exposed to the fumes.

Except as provided in paragraphs (f)(6) and (f)(7) of this section, the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged or marked with the following information:

- Identity of the hazardous chemical(s) contained therein; and,
- Appropriate hazard warnings, or alternatively, words, pictures, symbols, or combination thereof, which provide at least general information regarding the hazards of the chemicals, and which, in conjunction with the other information immediately available to employees under the hazard communication program, will provide employees with the specific information regarding the physical and health hazards of the hazardous chemical.

NO SMOKING .106(e)(6)(I). Adequate precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks;

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spontaneous ignition, including heat-producing chemical reactions; and radiant heat.

EAR AND EYE PROTECTION REQUIRED .145 and .252(b)(3). Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with the requirements of §1910.132. Appropriate protective clothing required for any welding operation will vary with the size, nature, and location of the work to be performed. If the employer determines that the nature of the hazard is such that failure to designate it may lead to an accidental injury, then a sign in accordance with §1910.145 or other effective means like proper training is required. Otherwise, it is optional.

USE NO OIL .253(e)(6)(iii). Gages on oxygen regulators shall be marked "USE NO OIL."

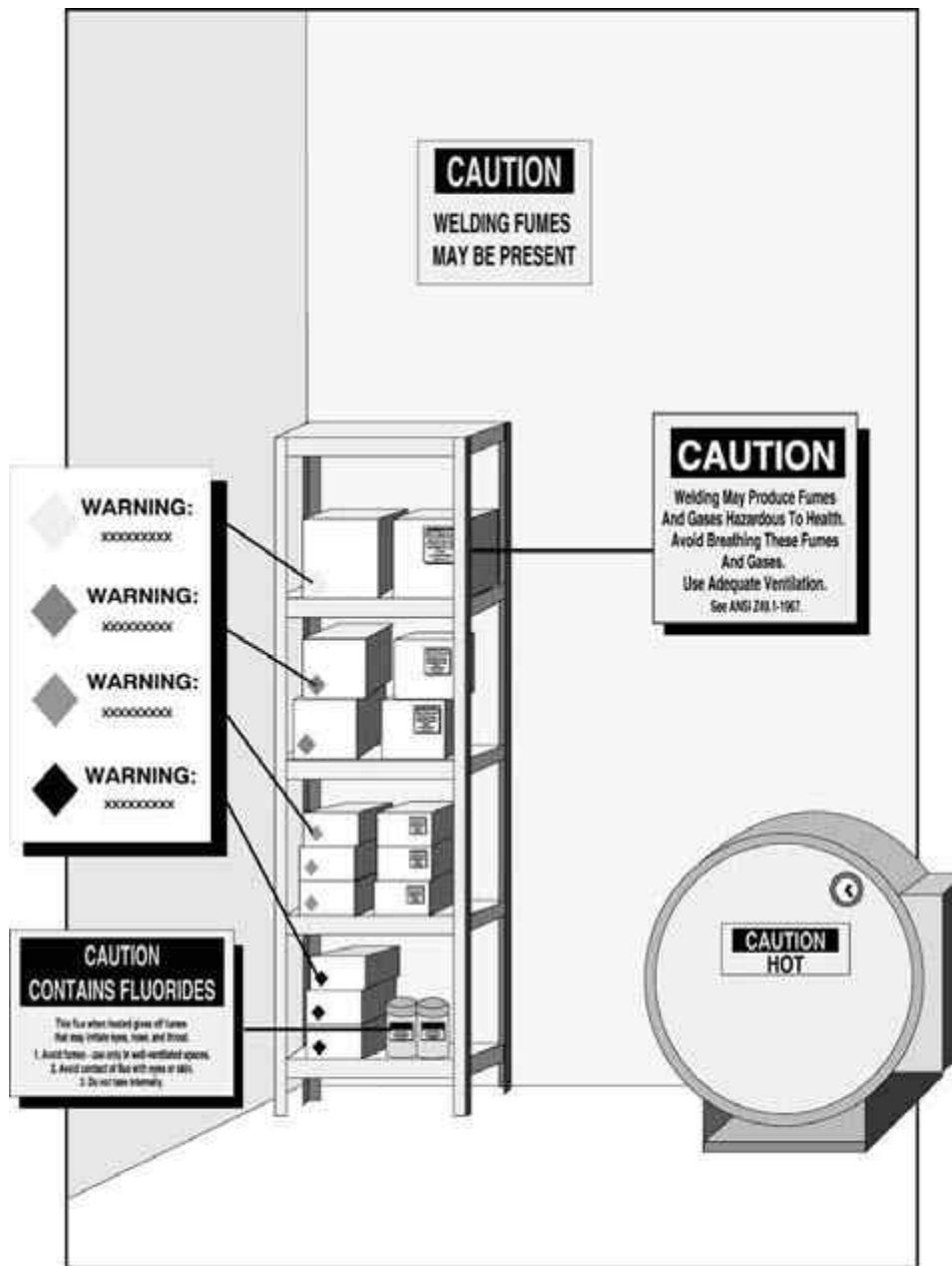
Oxygen/Acetylene Barrier .253(b)(4)(iii). Acetylene is highly flammable, and the presence of oxygen dramatically increases the hazards. Therefore, oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet or by a noncombustible barrier at least five feet high having a fire-resistance rating of at least one-half hour.

Cylinders and Containers .253(b)(1)(I) and (ii). All portable cylinders used for the storage and shipment of compressed gases shall be constructed and maintained in accordance with the regulations of the U.S. Department of Transportation, 49 CFR parts 171-179.

Compressed gas cylinders shall be legibly marked, for the purpose of identifying the gas content, with either the chemical or the trade name of the gas. Such marking shall be by means of stenciling, stamping, or labeling, and shall not be readily removable. Whenever practical, the marking shall be located on the shoulder of the cylinder.

This method conforms to the American National Standard Method for Marking Portable Compressed Gas Containers to Identify the Material Contained, ANSI Z48.1-1954, which is incorporated by reference as specified in §1910.6.

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CAUTION: Welding may produce fumes and gases hazardous to health, etc. .252(c)(1)(iv) and (A)

A number of potentially hazardous materials are employed in fluxes, coatings, coverings, and filler metals used in welding and cutting or are released to the atmosphere during welding and cutting.

The suppliers of welding materials shall determine the hazard, if any, associated with the use of their materials in welding, cutting etc. All filler metals and fusible granular materials shall carry the following notice, as a minimum, on tags, boxes, or other containers:

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CAUTION. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z49.1-1967. Safety in Welding and Cutting published by the American Welding Society.

CAUTION: CONTAINS FLUORIDES .252(c)(1)(iv)(c). Brazing and gas welding fluxes containing fluorine compounds shall have a cautionary wording to indicate that they contain fluorine compounds. One cautionary wording recommended by the American Welding Society for brazing and gas welding fluxes reads as follows:

CAUTION

CONTAINS FLUORIDES

This flux when heated gives off fumes that may irritate eyes, nose, and throat.

1. Avoid fumes-use only in well-ventilated spaces.
2. Avoid contact of flux with eyes or skin.
3. Do not take internally.

CAUTION: WELDING FUMES .1200(f)(5). Under Hazard Communication, the employer must ensure that every container of hazardous chemicals in the workplace, where there is the potential of exposure, is labeled, tagged, or marked. In this case, the room is the container, the welding fumes are the hazardous chemical, and workers are being exposed to the fumes.

Warning Labels on packages on shelves .1200(f). Under Hazard Communication, the employer must ensure that every container of hazardous chemicals in the workplace is labeled, tagged, or marked with the chemical name and the hazard warning.

OTHER WELDING MARKINGS, NOT PICTURED

WARNING: CONTAINS CADMIUM .252(c)(1)(iv)(b). Brazing (welding) filler metals containing cadmium in significant amounts shall carry the following notice on tags, boxes, or other containers:

WARNING

CONTAINS CADMIUM-POISONOUS

FUMES MAY BE FORMED ON HEATING

Do not breathe fumes. Use only with adequate ventilation such as fume collectors, exhaust ventilators, or air-supplied respirators. See ANSI Z49.1-1967.

If chest pain, cough, or fever develops after use, call physician immediately.

Manifolding of Cylinders .253(c)(3)(v). The following sign shall be conspicuously posted at each low-pressure oxygen manifold (for use with cylinders having a Department of Transportation service pressure not exceeding 200 psig):

LOW-PRESSURE MANIFOLD

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DO NOT CONNECT HIGH-PRESSURE CYLINDERS

MAXIMUM PRESSURE-250 psig (1.7MPa)

Service Piping Systems .253(d)(4)(ii) and (iii). Aboveground piping systems shall be marked in accordance with the American National Standard Scheme for the Identification of Piping Systems, ANSI A13.1-1956. Station outlets shall be marked to indicate the name of the gas.

Acetylene Generators .253(f)(1). Generators shall be plainly marked with:

1. The maximum rate of acetylene in cubic feet per hour for which they are designed.
2. The weight and size of carbide necessary for a single charge.
3. The manufacturer's name and address.
4. The name or number of the type of generator.

Calcium Carbide Storage .253(g)(1)(ii). Packages containing calcium carbide shall be conspicuously marked "CALCIUM CARBIDE -DANGEROUS IF NOT KEPT DRY" or with equivalent warning.

Spray paint booth or area

Most spray painting materials are flammable so areas where spray painting is done can present particular safety hazards. OSHA defines a "spraying area" as any area in which dangerous quantities of flammable vapors or mists, or combustible residues, dusts, or deposits are present due to the operation of spraying processes.

You might have a more enclosed structure where your painting is done. This would be a "spray booth," a power-ventilated structure provided to enclose or accommodate a spraying operation to confine and limit the escape of spray, vapor, and residue, and to safely conduct or direct them to an exhaust system.

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Fire Extinguisher .107(f)(4), .157(a), (c)(1), (d)(1), and (e)(2) - (4). An adequate supply of suitable portable fire extinguishers must be installed near all spraying areas. You must mount, locate, and identify them so that they are readily accessible to employees.

When portable fire extinguishers are provided for employee use, they must be selected and distributed based on the classes of anticipated workplace fires and on the size and degree of the hazard which would affect their use. You will notice that many fire extinguishers will indicate the fire classes they are capable of extinguishing; however, these markings are not required.

Instruction labels for using the fire extinguisher are often times provided by the extinguisher manufacturer, but are not required.

Although not required by OSHA, many employers choose to tag their extinguisher to indicate what type of extinguishing agent it contains, what the full weight is, when it was inspected, who performed the inspection, and the annual maintenance check result (the extinguisher was serviced, recharged, or new). This documents the required monthly visual inspection.

Also, many employers who must comply with hydrostatic testing and maintenance procedures, choose to label their extinguishers with the date of the last hydrostatic test, though not required.

Emergency Eyewash .151(c) and ANSI Z358.1-1998 (informational marking). Suitable facilities for quick drenching or flushing of the eyes and body must be provided in the work area for emergency use if workers' eyes or bodies are exposed to injurious corrosive materials. While not required by OSHA, ANSI Z358.1-1998, American National Standard for

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Emergency Eyewash and Shower Equipment, recommends that companies use signs to identify eyewash locations.

Right to Know/Material Safety Data Sheets (MSDSs) .1200(g)(10). Material safety data sheets must be readily accessible to employees. A right to know or MSDS station containing MSDSs does not need to be posted in the workplace; however, it is a convenient way to keep them accessible to employees in the work area in the event of an emergency.

Hazard Communication Labels On Containers .1200(f)(5). The employer must ensure that every container of hazardous chemicals in the workplace is labeled, tagged, or marked with the chemical name and an appropriate hazard warning. It is an acceptable format to use the red, blue, orange, and white label, as long as specific information on the chemical's hazards and toxic organ effects is given during training. The label depicted in the graphic is the Hazardous Materials Identification System III developed by the National Paint & Coatings Association. We have left the ratings blank; however, the ratings would be entered on the label in an actual situation.

Marked Pressure Gage .94(c)(7)(iii). Clean fresh air, free of contamination from adjacent industrial exhaust systems, chimneys, stacks, or vents, must be supplied to a spray booth or room in quantities equal to the volume of air exhausted through the spray booth.

Where the air supply to a spray booth or room is filtered, the fan static pressure must be calculated on the assumption that the filters are dirty to the extent that they require cleaning or replacement. The rating of filters must be governed by test data supplied by the manufacturer of the filter. A pressure gage must be installed to show the pressure drop across the filters. This gage must be marked to show the pressure drop at which the filters require cleaning or replacement. Filters must be replaced or cleaned whenever the pressure drop across them becomes excessive or whenever the air flow through the face of the booth falls below that specified in Table G-10 in §1910.94.

Warning: Use Only Non-Sparking Tools .107(g)(2) and (m)(2). All spraying areas shall be kept as free from the accumulation of deposits of combustible residues as practical, with cleaning conducted daily if necessary. Scrapers, spuds, or other such tools used for cleaning purposes shall be of non-sparking material. Only non-sparking tools must be used in any area where organic peroxides are stored, mixed, or applied.

Caution: Keep door closed when spray painting (informational marking). While this sign is not required by OSHA, it will encourage employees to keep the door closed while spray painting. Therefore, vapors will be less likely to enter the areas outside the paint booth and the ventilation system can work efficiently to remove paint vapors from within the paint booth.

Inspection Record for Automatic Sprinkler System .159(c)(2) and (3). Although not required by OSHA, many employers and sprinkler inspectors choose to tag automatic sprinkler systems to indicate inspection tests and dates. This documents the required inspections such as the annual main drain flow test, the opening of the test valve every two

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years, and the acceptance tests; state and local required tests; and the tests recommended by NFPA 25-1998, Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, and other NFPA standards.

The employer must properly maintain an automatic sprinkler system installed to comply with OSHA regulations. The employer must assure that a main drain flow test is performed on each system annually. The inspector's test valve must be opened at least every two years to assure that the sprinkler system operates properly.

The employer must conduct proper acceptance tests on sprinkler systems installed for employee protection after January 1, 1981, and record the dates of such tests. Proper acceptance tests include:

- Flushing of underground connections,
- Hydrostatic tests of piping in system,
- Air tests in dry-pipe systems,
- Dry-pipe valve operation, and
- Test of drainage facilities.

No Smoking .107(g)(7), (l)(4)(iii), and (m)(2). "No Smoking" signs in large letters on contrasting color background shall be conspicuously posted at all spraying areas and paint storage rooms.

This requirement produces many citations each year.

"No Smoking" signs in large letters on contrasting color background must be conspicuously posted at all powder-coating areas and powder storage rooms as well.

Smoking must be prohibited and "No Smoking" signs must be prominently displayed and only non-sparking tools must be used in any area where organic peroxides are stored, mixed or applied.

Warning: Carbon Dioxide .160(b)(5). If you have a fixed extinguishing system for fire protection, the employer shall post hazard warning or caution signs at the entrance to, and inside of, areas protected by fixed extinguishing systems which use agents in concentrations known to be hazardous to employees safety and health.

Red Oily Waste Can .107(g)(3) and .144(a)(1)(ii). Residue scrapings and debris contaminated with residue must be immediately removed from the premises and properly disposed of. Approved metal waste cans must be provided wherever rags or waste are impregnated with finishing material and all such rags or waste deposited therein immediately after use. OSHA does not require oily waste cans to be red. This is simply a popular practice.

On a somewhat related note, safety cans or other portable containers of flammable liquids having a flash point at or below 80 degrees Fahrenheit, table containers of flammable liquids (open cup tester), excluding shipping containers, must be painted red with some additional clearly visible identification either in the form of a yellow band around the can

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or the name of the contents conspicuously stenciled or painted on the can in yellow.

Oily Waste Can Empty Every Night .107(g)(3) (informational marking). The contents of waste cans, containing rags or waste impregnated with finishing material, must be properly disposed of at least once daily or at the end of each shift.

Markings Not Shown

Safe Distance Sign .107(h)(6). A safe distance must be maintained between goods being painted and electrodes or electrostatic atomizing heads or conductors of at least twice the sparking distance. A suitable sign indicating this safe distance must be conspicuously posted near the assembly.

Maintain Ventilation Warning Sign .107(j)(4)(v). Automobile refinishing spray booths or enclosures, otherwise installed and maintained in full conformity with §1910.107, may alternately be used for drying with portable electrical infrared drying apparatus when, among other things, the drying apparatus contains a prominently located, permanently attached warning sign indicating that ventilation should be maintained during the drying period and that spraying should not be conducted in the vicinity that spray will deposit on apparatus.

Grounding Warning .107(i)(6) and (l)(7)(iii). All electrically conductive objects in the electrostatic hand-spraying area must be adequately grounded. This requirement applies to paint containers, wash cans, and any other objects or devices in the area. The equipment must carry a prominent permanently installed warning regarding the necessity for this grounding feature.

For powder-coating operations, all electrically conductive objects within the charging influence of the electrodes must be adequately grounded. The powder-coating equipment must carry a prominent, permanently installed warning regarding the necessity for grounding these objects.

Maintenance shop

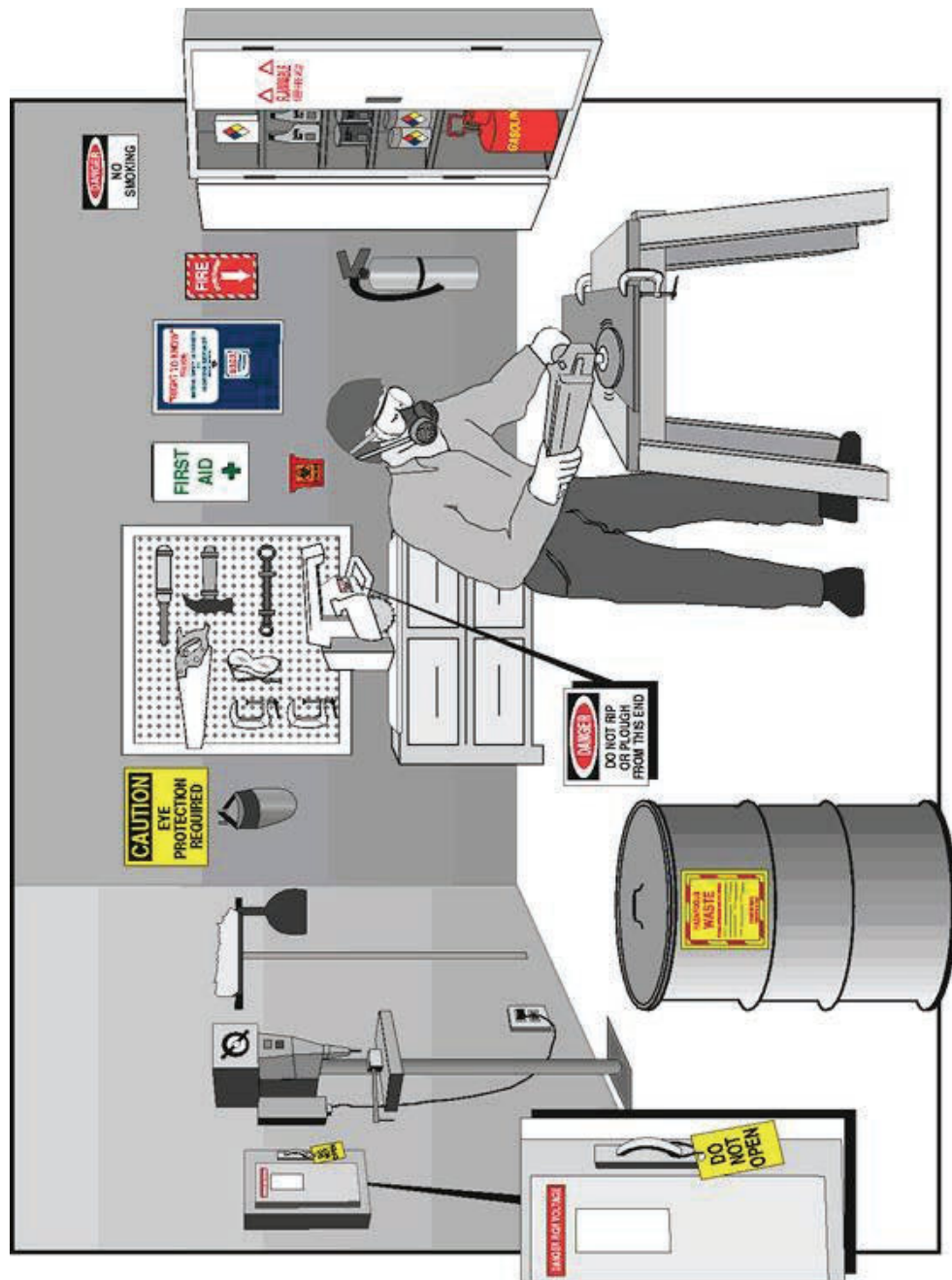
Another typical scene in most facilities is the maintenance shop. Here you may do major or minor repairs, and general maintenance. You might have some chemicals — gasoline, solvents, cleaning supplies. You might have some electrical devices — drills, saws, meters. There are any number of hazards that could exist in this environment.

These are some of the marking requirements you may have to comply with.

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Flammable: Keep Fire Away .106(d)(3)(ii). Storage cabinets in which you keep flammable liquids, such as gasoline, must be labeled in conspicuous lettering, “FLAMMABLE - KEEP FIRE AWAY.”

Gasoline Can Markings .144(a)(1)(ii). Safety cans or other portable containers of flammable liquids that have a flash point at or below 80° F, table containers of flammable liquids (open cup tester), excluding shipping containers, have to be painted red with some additional, clearly visible identification either in the form of a yellow band around the can

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or the name of the contents clearly stenciled or painted on the can in yellow.

Danger High Voltage Marking (informational marking). While a HIGH VOLTAGE marking is not required for cabinets, boxes, and fittings other than pull and junction boxes for systems over 600 volts, nominal under §1910.305(b)(3)(iii), you may wish to mark other cabinets, boxes, and fittings over 600 volts, nominal, with the HIGH VOLTAGE marking. We marked the panel in our graphic with a DANGER HIGH VOLTAGE marking for informational purposes.

Lockout/Tagout .147(c)(2), (5)(ii), and (iii). If an energy isolating device is not capable of being locked out, then you may use a tagout system. The tagout devices must warn against hazardous conditions if the machine or equipment is energized and shall include a legend such as the following: DO NOT START, DO NOT OPEN, DO NOT CLOSE, DO NOT ENERGIZE, DO NOT OPERATE. This includes vehicles that are being worked on!

Lockout and tagout devices used throughout your facility must be standardized in at least one of the following criteria: color, shape, or size and print and format. This aids employee recognition.

Tagout devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all-environment-tolerant nylon cable tie.

Fire Extinguisher .106(d)(7) and .157(c)(1). Suitable fire control devices must be available at locations where flammable and combustible liquids are stored. At least one portable fire extinguisher having at least a 12-B units rating must be located outside of, but not more than 10 feet from, the door opening into any room used for storage. At least one portable fire extinguisher having at least a 12-B units rating must be located not less than 10 feet, nor more than 25 feet, from any Class I or Class II liquid storage area located outside of a storage room but inside a building.

If you are using portable fire extinguishers, you must mount, locate, and identify them so that they are readily accessible to employees.

Danger: No Smoking .106(d)(7)(iii) and (e)(6). Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas.

Adequate precautions shall be taken to prevent the ignition of flammable vapors. Smoking is prohibited, except in designated localities. “No Smoking” signs must be conspicuously posted where hazards from flammable liquid vapors is normally present. Sources of ignition include but are not limited to open flames, lightning, and smoking.

Hazard Communication Labels .1200(f)(5). Employers must ensure that every container of hazardous chemicals in the workplace is labeled, tagged, or marked with the chemical name and an appropriate hazardwarning. If the containers already have labels on them when they

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arrive in your facility, you are not required to relabel them as long as the label has the chemical name and the appropriate hazard warnings. If you decide to relabel, an acceptable format to use is the red/blue/yellow/white label, as long as specific information on the chemical's hazards are given during training.

Right to Know/Material Safety Data Sheet Station .1200(g)(10). Material safety data sheets (MSDSs) must be readily accessible to employees. A Right to Know or MSDS station containing MSDSs does not need to be posted in the workplace; however, it is a convenient way to keep MSDSs accessible to employees in the work area in the event of an emergency.

Hazardous Waste Marking 40 CFR 262.32 and 49 CFR 172.304. Before transporting hazardous waste off-site, a generator must mark each container of 119 gallons or less with the following words and information in accordance with the requirements of 49 CFR 172.304:

HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.

Generator's Name and Address _____ .

Generator's EPA Identification Number _____ .

Manifest Tracking Number _____ .

Red Waste Container .1030(d)(4) and (g)(1). Contaminated sharps and regulated waste must be placed in properly-labeled containers. Warning labels must be affixed to containers of regulated waste containing blood or other potentially-infectious material.

First Aid Supplies .151(b) (informational marking). First aid supplies shall be readily available.

Eye Protection Required §1910.133(a), .145(c)(2), and .252(b)(3). Employees must use appropriate eye or face protection when exposed to eye or face hazards from flying particles. Caution signs can be posted to indicate a possible hazard against which proper precautions should be taken. If the employer determines that the nature of the hazard is such that failure to designate it may lead to an accidental injury, then a sign in accordance with §1910.145 or other effective means, like proper training, is required. Otherwise, it is optional.

Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with the requirements of §1910.132 of this part. Appropriate protective clothing required for any welding operation will vary with the size, nature, and location of the work to be performed.

Respiratory Protection .134(a). Respirators must be provided by the employer when such equipment is necessary to protect the health of the employee. Respiratory protection must be provided for air contaminated with harmful dust, fog, fumes, mist, gas, smoke, spray, or vapor.

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If the employer determines that the nature of the hazard is such that failure to designate it may lead to an accidental injury, then a sign in accordance with §1910.145 or other effective means, like proper training, is required. Otherwise, it is optional.

Radial Saws .213(h)(5). Ripping and ploughing must be against the direction in which the saw turns. The direction of the saw rotation must be conspicuously marked on the hood. In addition, a permanent label not less than 1½ by ¾ inch shall be affixed to the rear of the guard at approximately the level of the arbor, reading as follows: “Danger: Do Not Rip or Plough From This End.”

Markings Not Shown

Hearing Protection Required (informational marking). Whenever an employee is exposed to sound levels exceeding the levels prescribed by OSHA, the employer must ensure that hearing protection is worn. This informational marking serves to remind employees that hearing protection may need to be worn when power tools are operated.

Portable Containers of Flammable Liquid .144(a)(1)(ii). Safety cans or other portable containers of flammable liquids that have a flash point at or below 80° F, table containers of flammable liquids (open cup tester), excluding shipping containers, have to be painted red with some additional, clearly visible identification either in the form of a yellow band around the can or the name of the contents clearly stenciled or painted on the can in yellow.

Respirator certification .134(d)(1)(ii), (3)(iv), and (j). Select a NIOSH-certified respirator. For protection against particulates that create atmospheres that are not immediately dangerous to life or health, you may provide:

- An atmosphere-supplying respirator;
- An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR 84; or
- For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

Ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

Vehicle maintenance area

Many companies repair and maintain their own fleet of vehicles and have facilities on-site to accomplish this. There are a variety of signs and labels required in a vehicle maintenance area, regardless of whether the fleets being maintained are 5 cars or 175 trucks. The markings will vary depending upon the tasks performed in the maintenance area. The illustrations show some typical situations that may be found at any facility.

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Vehicle Maintenance — Mezzanine

Caution: Eye And Ear Protection Required .145(c)(2). Caution signs can be posted to indicate a possible hazard against which proper precautions should be taken. If the employer determines that the nature of the hazard is such that failure to designate it may lead to an accidental injury, then a sign in accordance with §1910.145 or other effective means, like proper training, is required. Otherwise, it is optional.

ACME COMPANY .133(a)(4). Eye and face personal protective equipment must be distinctly marked to facilitate identification of the manufacturer. **DISCLAIMER:** ACME, ACME, Inc., or ACME Company

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as used in this workplace situation is a fictional creation and has no relationship to any business or organization, past or present. Any similarity in the name or the situations presented is purely coincidental.

Carbon Monoxide Wall Placard (informational marking). Under the hazard communication standard, every workplace exposure that an employee experiences is the responsibility of the employer. The worker has the right to know what he is being exposed to. If you have motors running in the vehicle maintenance area, it is more than likely that you have carbon monoxide fumes. Hazard communication training is required for employees that have carbon monoxide in their work area. In addition, you may post a sign to raise awareness regarding this exposure.

Exit .35 and .37(b). Lighting and marking must be adequate and appropriate. Each exit route must be adequately lighted so that an employee with normal vision can see along the exit route.

Each exit must be clearly visible and marked by a sign reading "Exit." Each exit route door must be free of decorations or signs that obscure the visibility of the exit route door. If the direction of travel to the exit or exit discharge is not immediately apparent, signs must be posted along the exit access indicating the direction of travel to the nearest exit and exit discharge. Additionally, the line-of-sight to an exit sign must clearly be visible at all times. Each doorway or passage along an exit access that could be mistaken for an exit must be marked "Not an Exit" or similar designation, or be identified by a sign indicating its actual use (e.g., closet).

Each exit sign must be illuminated to a surface value of at least five foot-candles (54 lux) by a reliable light source and be distinctive in color. Self-luminous or electroluminescent signs that have a minimum luminance surface value of at least .06 footlamberts (0.21 cd/m²) are permitted. Each exit sign must have the word "Exit" in plainly legible letters not less than six inches (15.2 cm) high, with the principal strokes of the letters in the word "Exit" not less than three-fourths of an inch (1.9 cm) wide.

An employer who demonstrates compliance with the exit route provisions of the National Fire Protection Association's publication NFPA 101-2000, Life Safety Code, will be deemed to be in compliance with the corresponding requirements in §§1910.34, 1910.36, and 1910.37.

Floor Marking .22(b)(1) and (2). Permanent aisles and passageways in the workplace must be appropriately marked. Where mechanical handling equipment is used, sufficient safe clearances shall be allowed for aisles, at loading docks, through doorways, and wherever turns or passage must be made. Aisles and passageways shall be kept clear and in good repair, with no obstruction across or in the aisles that could create a hazard.

Right To Know/Material Safety Data Sheet Station .1200(g)(10) (informational marking). Material safety data sheets (MSDSs) must be readily accessible to employees. A right to know or MSDS station containing MSDS sheets does not need to be posted in the workplace;

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however, it is a convenient way to keep MSDS sheets accessible to employees in the work area in the event of an emergency.

Load Rating Plate .22(d)(1). In every building or structure used for mercantile, business, industrial, or storage purposes, the loads approved by the building official shall be marked on plates of approved design and shall be affixed by the owner of the building, or his authorized agent, in a conspicuous place in each space to which they relate. The plates should not be removed or defaced. If lost, removed, or defaced, they should be replaced by the owner or his agent.

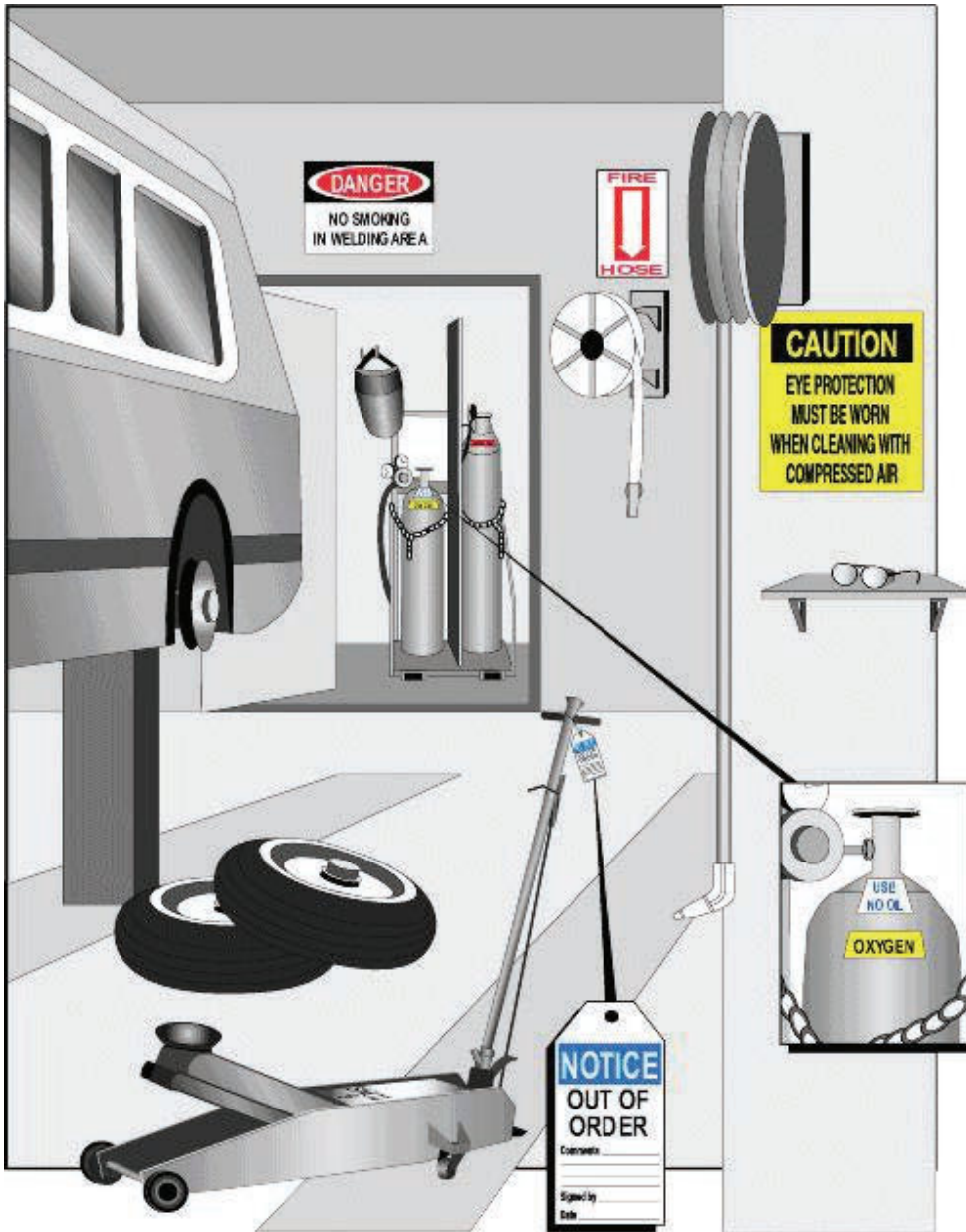
It is unlawful to place a load on a floor, roof, or other structure greater than that for which the floor or roof of a building or other structure was approved by the building official.

MAX 6600 RPM .215(d)(1) and .243(c)(5). The spindle speed of the machine must be checked before mounting of the wheel to be certain that it does not exceed the maximum operating speed marked on the wheel.

DANGER Defective Equipment .177(e)(2). Multi-piece wheel components and single piece wheels must be inspected prior to assembly. Any wheel or wheel component which is bent out of shape, pitted from corrosion, broken, or cracked must not be used and must be marked or tagged unserviceable and removed from the service area. Damaged or leaky valves must be replaced.

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Vehicle Maintenance Compressed Gases Area



Cylinders and Containers .253(b)(1). Compressed gas cylinders must be legibly marked, for the purpose of identifying the gas content, with either the chemical or the trade name of the gas.

Such marking shall be by means of stenciling, stamping, or labeling, and shall not be readily removable. Whenever practical, the marking shall be located on the shoulder of the cylinder.

This method conforms to the American National Standard Method for Marking Portable Compressed Gas Containers to Identify the Material Contained, ANSI Z48.1-1954. Use No Oil §1910.253(e)(6) Gages on oxygen regulators shall be marked "USE NO OIL."

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No Smoking .106(e)(6). Adequate precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to, open flames, lightning, smoking, and cutting and welding.

Caution: Eye Protection Required .145(c)(2) and .242(b). Compressed air may only be used for cleaning purposes when the pressure is reduced to less than 30 p.s.i. and then only when effective chip guarding and personal protective equipment is used.

Caution signs can be posted to indicate a possible hazard against which proper precautions should be taken. If the employer determines that the nature of the hazard is such that failure to designate it may lead to an accidental injury, then a sign in accordance with §1910.145 or other effective means, like proper training, is required. Otherwise, it is optional.

Fire Hose .158(c)(1). Where reels or cabinets are provided to contain fire hoses, the employer must be sure that they are conspicuously identified and used only for fire equipment.

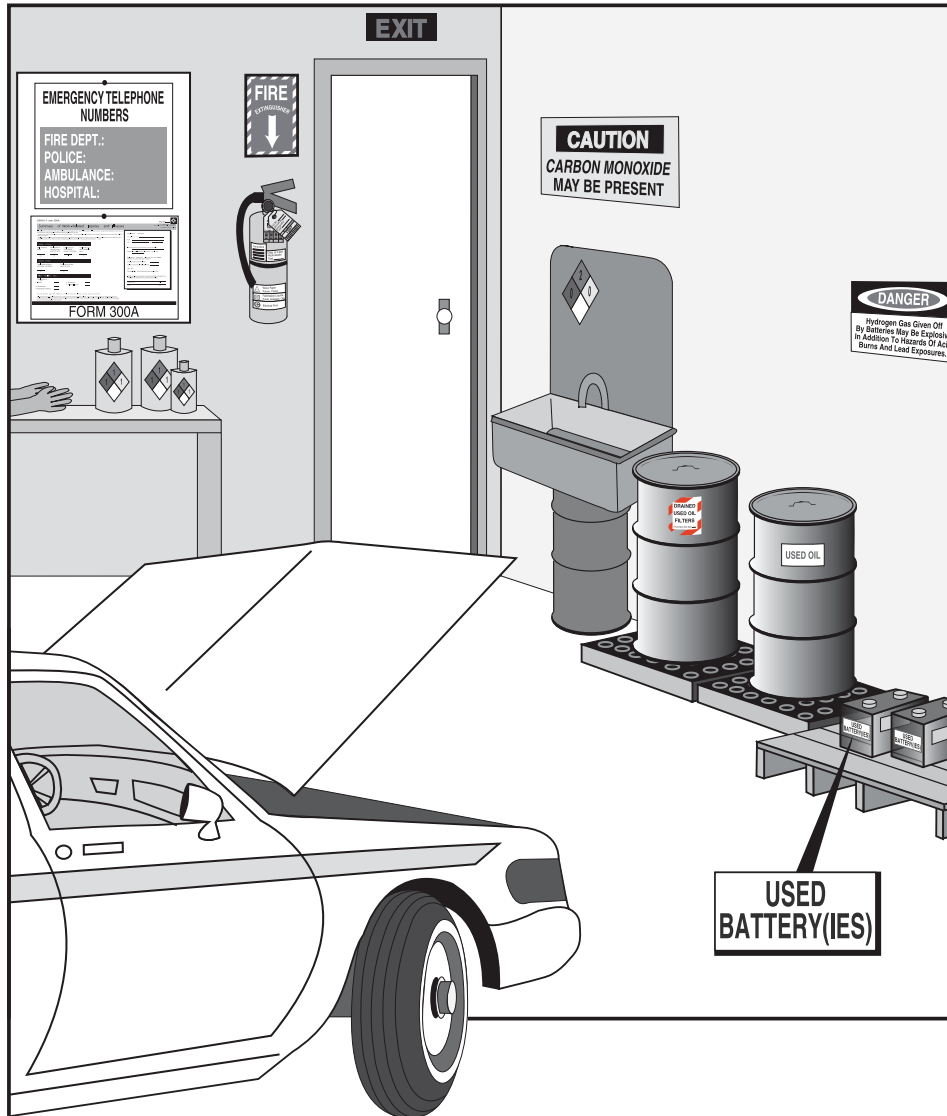
5 TONS .244(a)(1). The operator must make sure that the jack used has a rating sufficient to lift and sustain the load. The rated load must be legibly and permanently marked in a prominent location on the jack by casting, stamping, or other suitable means.

NOTICE Out Of Order .244(a)(2)(viii). Jacks which are out of order must be tagged accordingly, and must not be used until repairs are made.

Vehicle Maintenance — Dip Tank & Used Oil

Many of the materials shown and discussed in this section are also covered in the EPA Compliance Management section of this manual. This section is looking strictly at the OSHA aspects of having these materials in your shop.

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Emergency Telephone Numbers .151(a). OSHA medical and first aid requirements provide that employers must ensure the ready availability of medical personnel for advice and consultation on health matters. While there is no specific requirement to post emergency telephone numbers, it is certainly a good idea to make this information available to employees in the event of an emergency to ensure that medical personnel are readily available when needed.

OSHA No. 300-A Form .32. An annual summary of occupational injuries and illnesses for each establishment must be posted by employers. The summary must be presented on the OSHA No. 300-A form (or equivalent according to §1904.32(b)(2)(iii)) and must contain information regarding the calendar year covered, the company name, the name and address of the establishment, average number of employees covered by the OSHA 300 Log, the total hours worked by all employees covered by

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the OSHA 300 Log, a company executive's signature certifying the accuracy of the information, the executive's title and phone number, and the date. The summary for the previous calendar year is to be posted no later than February 1 and must remain posted until April 30.

Carbon Monoxide Wall Placard (informational marking). Under the hazard communication standard, every workplace exposure that an employee experiences is the responsibility of the employer. The worker has the right to know what he is being exposed to. If you have motors running in the vehicle maintenance area, it is more than likely that you have carbon monoxide fumes. Hazard communication training is required for employees that have carbon monoxide in their work area. In addition, you may post a sign to raise awareness regarding this exposure.

Hazard Communication Labels On Containers .1200(f)(5). The employer must ensure that every container of hazardous chemicals in the workplace is labeled, tagged, or marked with the chemical name and an appropriate hazard warning. In this illustration, portable containers that are often found throughout a vehicle maintenance facility are shown with labels, along with the parts-cleaner unit which contains a chemical solvent. The red, blue, yellow label shown on the portable bottles and the parts cleaner are an acceptable labeling format to use in-house to comply with the hazard communication standard, as long as specific information on the chemical's hazards are given during training.

Exit .35 and .37(b). Lighting and marking must be adequate and appropriate. Each exit route must be adequately lighted so that an employee with normal vision can see along the exit route. Each exit must be clearly visible and marked by a sign reading "Exit."

Each exit route door must be free of decorations or signs that obscure the visibility of the exit route door. If the direction of travel to the exit or exit discharge is not immediately apparent, signs must be posted along the exit access indicating the direction of travel to the nearest exit and exit discharge. Additionally, the line-of-sight to an exit sign must clearly be visible at all times. Each doorway or passage along an exit access that could be mistaken for an exit must be marked "Not an Exit" or similar designation, or be identified by a sign indicating its actual use (e.g., closet).

Each exit sign must be illuminated to a surface value of at least five foot-candles (54 lux) by a reliable light source and be distinctive in color. Self-luminous or electroluminescent signs that have a minimum luminance surface value of at least .06 footlamberts (0.21 cd/m²) are permitted. Each exit sign must have the word "Exit" in plainly legible letters not less than six inches (15.2 cm) high, with the principal strokes of the letters in the word "Exit" not less than three-fourths of an inch (1.9 cm) wide.

An employer who demonstrates compliance with the exit route provisions of the National Fire Protection Association's publication NFPA 101-2000, Life Safety Code, will be deemed to be in compliance with the corresponding requirements in §§1910.34, 1910.36, and 1910.37.

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Fire Extinguisher .157(c)(1). When portable fire extinguishers are provided for employee use, they must be selected and distributed based on the classes of anticipated workplace fires and on the size and degree of the hazard which would affect their use. You will notice that many fire extinguishers will indicate the fire classes they are capable of extinguishing; however, this is not required.

If you are using portable fire extinguishers, you must mount, locate, and identify them so that they are readily accessible to employees.

Instruction labels for using the fire extinguisher are often times provided by the extinguisher manufacturer, but are not required according to OSHA. However, if your employees are designated to use portable fire extinguishers, you must train them in the use of the appropriate equipment. For portable fire extinguishers this training must be given upon initial employment and at least annually thereafter.

Portable fire extinguishers must be visually inspected monthly. They must also have a maintenance check annually. Although not required by OSHA, many employers choose to tag their extinguisher to indicate what type of extinguishing agent it contains, what the full weight is, when it was inspected, who performed the inspection, and the annual maintenance check result (the extinguisher was serviced, recharged, or new).

In addition to an external visual examination, you must ensure that an internal examination of cylinders and shells to be tested is made prior to hydrostatic tests. Stored pressure extinguishers do not require an internal examination.

You must assure that portable extinguishers are hydrostatically tested at the intervals as required.

Used Oil Label 40 CFR 279.22(c). Containers and aboveground tanks used to store used oil at generator facilities must be labeled or marked clearly with the words, "Used Oil." Fill pipes used to transfer used oil into underground storage tanks at generator facilities must be labeled or marked clearly with the words, "Used Oil."

Drained Used Oil Filters Label (possible state requirement). There is no federal requirement for labeling properly gravity hot-drained oil filters, drained according to 40 CFR 261.4(b)(13). However, if the filters are not properly drained then the filters are not exempt and fall under 40 CFR 279 and must be labeled with the words, "Used Oil."

Some states may have more stringent rules which require your company to label properly gravity hot-drained oil filters. In California, for example, containers of these filters must be marked with the words "Drained Used Oil Filters" along with the initial date of accumulation.

New and Used Battery Storage Posting (informational marking). Batteries can pose many hazards, especially when stored in unventilated areas. While not a requirement, it is a good idea for companies to post safety signs stating that the hydrogen gas given off by batteries may be explosive in addition to the hazards of acid burns and lead exposures.

Universal Waste - Battery(ies) 40 CFR 273.14. Universal waste batteries (i.e., each battery), or a container in which the batteries are

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contained, must be labeled or marked clearly with any one of the following phrases: "Universal Waste-Battery(ies)," or "Waste Battery(ies)," or "Used Battery(ies)."

Markings Not Shown

Hot Metal §1910.252(b)(4)(vii). After welding operations are completed, the welder shall mark the hot metal or provide some other means of warning other workers.

Caution: Welding May Produce Fumes And Gases Hazardous to Health, etc. .252(c)(1)(iv)(A). A number of potentially hazardous materials are employed in fluxes, coatings, coverings, and filler metals used in welding and cutting or are released to the atmosphere during welding and cutting.

The suppliers of welding materials shall determine the hazard, if any, associated with the use of their materials in welding, cutting, etc. All filler metals and fusible granular materials shall carry the following notice, as a minimum, on tags, boxes, or other containers:

CAUTION: Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z49.1-1967.

Caution: Welding Fumes May Be Present .1200(f)(5). Under the hazard communication standard, the employer must ensure that every container of hazardous chemicals in the workplace, where there is the potential of exposure, is labeled, tagged, or marked. In this case, the room would be the container and the welding fumes would be the hazardous chemical to which employees are exposed. This situation is similar to the situation discussed above where labeling would be required for any carbon monoxide fumes that may be present in the area.

Personal Protective Equipment Required (Welding Area) .252(b)(3) and (Battery Handling Area) .132. Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with the requirements of §1910.132. Appropriate protective clothing required for any welding operation will vary with the size, nature, and location of the work to be performed.

Employees who handle batteries may be exposed to battery acids. For this reason, they must be protected by personal protective equipment in accordance with the requirements of §1910.132. Appropriate protective clothing should include gloves, eye and face protection, foot protection, and an apron. Signs may be used to reinforce this requirement.

Eyewash Station §1910.151(c) and ANSI Z358.1-1998. Where the eyes or body of any person may be exposed to injurious corrosive materials (like battery acid), suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Signs marking the location of the eyewash station are helpful in emergencies. While not required by OSHA, ANSI Z358.1-1998, American National Standard for Emergency Eyewash and Shower Equipment, recommends signs be used to identify eyewash locations.

Compliance Management

Remember, this is only a sampling of the diverse topics that OSHA regulates in the workplace.

Hazardous waste operations and emergency response (HAZWOPER)

This OSHA regulation, found in 29 CFR 1910.120, may affect your company. Following is a brief explanation of this complex regulation.

Hazardous waste is a serious safety and health problem that continues to endanger human and animal life and environmental quality. Hazardous waste — discarded chemicals that are toxic, flammable, or corrosive (see EPA Compliance section) — can cause fires, explosions, and pollution of air, water, and land. Unless hazardous waste is properly treated, stored, or disposed of, it will continue to do great harm to all living things that come into contact with it now or in the future.

Because of the seriousness of the safety and health hazards related to hazardous waste operations, the Occupational Safety and Health Administration (OSHA) has issued a standard specifically developed to protect workers in this environment and to help them handle hazardous wastes safely and effectively. This regulation can be found at 29 CFR 1910.120.

The standard covers workers employed in cleanup operations at uncontrolled hazardous waste sites and at EPA-licensed waste treatment, storage and disposal (TSD) facilities; as well as workers responding to emergencies involving hazardous materials (e.g., spills).

State, county, and municipal employees such as police, ambulance workers, and firefighters with local fire departments, will be covered by the regulations issued by the 25 states operating their own OSHA-approved safety and health programs. EPA regulations will cover these employees in states without state plans. These regulations will be based on OSHA's standard.

An effective and comprehensive safety and health program is essential in reducing work-related injuries and illnesses and in maintaining a safe and healthy work environment. The standard, therefore, requires each employer to develop and implement a written safety and health program that identifies, evaluates, and controls safety and health hazards and provides emergency response procedures for each hazardous waste site or treatment, storage, and disposal facility.

This written program must include specific and detailed information on the following topics:

- An organizational workplan.
- Site evaluation and control.
- A site-specific program.
- Information and training program.
- Personal protective equipment program.
- Monitoring.

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- Medical surveillance program.
- Decontamination procedures.
- Emergency response program.

The written safety and health program must be periodically updated and made available to all affected employees, contractors, and subcontractors. The employer also must inform contractors and subcontractors, or their representatives, of any identifiable safety and health hazards or potential fire or explosion hazards before they enter the work site.

Surviving an OSHA inspection

Workplace inspections are performed by OSHA compliance officers who are knowledgeable and experienced in the occupational safety and health field and who are trained in OSHA standards and in the recognition of safety and health hazards. Similarly, states with their own occupational safety and health programs conduct inspections using qualified state compliance safety and health officers.

Following on the next pages is some information on how an OSHA inspection is carried out, inspection priorities used by the agency, and a description of the inspection process.

Inspections are usually conducted without advance notice. In fact, alerting an employer without proper authorization in advance of an OSHA inspection can bring a fine of up to \$1,000 and/or a six-month jail term. This is true for OSHA compliance officers as well as state inspectors.

There are, however, special circumstances under which OSHA may give notice to the employer, but such a notice will normally be less than 24 hours. These circumstances include:

- Imminent danger situations which require correction as soon as possible.
- Inspections which must take place after regular business hours or which require special preparation.
- Cases where notice is required to assure that the employer and employee representative or other personnel will be present.
- Cases where an inspection must be delayed for more than 5 working days when there is good cause.
- Situations in which the OSHA area director determines that advance notice would produce a more thorough or effective inspection.

Employers who receive advance notice of an inspection must inform their employees' representative or arrange for OSHA to do so.

If an employer refuses to admit an OSHA compliance officer or if an employer attempts to interfere with the inspection, the Act permits appropriate legal action.

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Based on a 1978 Supreme Court ruling (*Marshall v. Barlow's Inc.*), OSHA usually may not conduct warrantless inspections without valid consent. They may, however, inspect after acquiring a judicially-authorized search warrant based upon administrative probable cause or upon evidence of a violation.

The remainder of this section is divided into five parts: inspection priorities; preparing for the inspection; the inspection; the inspection process; inspection results; and appeals process.

Inspection priorities

Obviously, not all workplaces covered by the Act can be inspected immediately. The worst situations need attention first. Therefore, OSHA has established a system of inspection priorities.

Imminent danger

Imminent-danger situations are given top priority. An imminent danger is any condition where there is reasonable certainty that a danger exists that can be expected to cause death or serious physical harm immediately or before the danger can be eliminated through normal enforcement procedures.

Serious physical harm is any type of harm that could cause permanent or prolonged damage to the body or which, while not damaging the body on a prolonged basis, could cause such temporary disability as to require in-patient hospital treatment. OSHA considers that "permanent or prolonged damage" has occurred when, for example, a part of the body is crushed or severed; an arm, leg, or finger is amputated; or sight in one or both eyes is lost.

This kind of damage also includes that which renders a part of the body either functionally useless or substantially reduced in efficiency on or off the job. An example: bones in a limb shattered so severely that mobility or dexterity will be permanently reduced.

Temporary disability requiring in-patient hospital treatment includes injuries such as simple fractures, concussions, burns, or wounds involving substantial loss of blood and requiring extensive suturing or other healing aids.

Injuries or illnesses that are difficult to observe are classified as serious if they inhibit a person in performing normal functions, cause reduction in physical or mental efficiency, or shorten life.

Health hazards may constitute imminent-danger situations when they present a serious and immediate threat to life or health.

For a health hazard to be considered an imminent danger, there must be a reasonable expectation (1) that toxic substances such as dangerous fumes, dusts or gases are present, and (2) that exposure to them will cause immediate and irreversible harm to such a degree as to shorten life or cause reduction in physical or mental efficiency, even though the resulting harm is not immediately apparent.

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Employees should inform the supervisor or employer immediately if they detect or even suspect an imminent-danger situation in the workplace. If the employer takes no action to eliminate the danger, an employee or the authorized employee representative may notify the nearest OSHA office and request an inspection.

The request should identify the workplace location, detail the hazard or condition and include the employee's name, address and telephone number. Although the employer has the right to see a copy of the complaint if an inspection results, the name of the employee will be withheld if the employee so requests.

The OSHA area director reviews the information and immediately determines whether there is a reasonable basis for the allegation. If it is decided the case has merit, the area director will alert the OSHA regional administrator and the regional solicitor, and assign a compliance officer to conduct an immediate inspection of the workplace.

Upon inspection, if an imminent-danger situation is found, the compliance officer will ask the employer to voluntarily abate the hazard and to remove endangered employees from exposure. Should the employer fail to do this, OSHA, through the regional solicitor, may apply to the nearest Federal District Court for appropriate legal action to correct the situation.

Before the OSHA inspector leaves the workplace, he or she will advise all affected employees of the hazard. Should OSHA "arbitrarily or capriciously" decline to bring court action, the affected employees may sue the Secretary of Labor to compel the Secretary to do so. Such action can produce a temporary restraining order (immediate shutdown) of the operation or section of the workplace where the imminent danger exists.

Walking off the job because of potentially unsafe workplace conditions is not ordinarily an employee right. To do so may result in disciplinary action by the employer. However, an employee does have the right to refuse (in good faith) to be exposed to an imminent danger. OSHA rules protect employees from discrimination if:

- Where possible, he or she asked the employer to eliminate the danger, and the employer failed to do so; and
- The danger is so imminent that there is not sufficient time to have the danger eliminated through normal enforcement procedures; and
- The danger facing the employee is so grave that "a reasonable person" in the same situation would conclude there is a real danger of death or serious physical harm; and
- The employee has no reasonable alternative to refusing to work under these conditions.

If an imminent-danger situation is found, the compliance officer will ask the employer to voluntarily abate the hazard and to remove endangered employees from exposure. Should the employer fail to do this, OSHA, through the regional solicitor, may apply to the Federal District Court for an injunction prohibiting further work as long as unsafe conditions exist.

Compliance Management

Fatality or multiple hospitalization incidents

Second priority is given to investigation of fatalities and incidents resulting in hospitalization of three or more employees.

Such catastrophes must be orally reported by phone or in person to OSHA by the employer within 8 hours. OSHA investigates to determine the cause of such accidents, whether existing OSHA standards were violated, and whether additional standards are necessary to help avoid a recurrence of similar accidents.

Employee complaints

Third priority is given to formal employee complaints of alleged violations of standards or of unsafe or unhealthful working conditions.

The Act gives each employee the right to request an OSHA inspection when the employee feels he or she is in imminent danger from a hazard or when he or she feels that there is a violation of an OSHA standard that threatens physical harm.

OSHA will maintain confidentiality if requested, will inform the employee of any action it takes regarding the complaint, and if requested, will hold an informal review of any decision not to inspect.

Programmed inspections

Next in priority are programmed inspections aimed at specific high-hazard industries, occupations or health substances, or other industries identified in OSHA's current inspection procedures. Industries are selected for inspection on the basis of such factors as the injury incidence rates, previous citation history, employee exposure to toxic substances, or random selection. Special-emphasis programs may also be developed and may be regional or national in scope, depending on the distribution of the workplaces involved. Comprehensive safety inspections in manufacturing will be conducted normally in those establishments with lost-workday injury rates at or above the BLS national rate for manufacturing currently in use by OSHA. States with their own occupational safety and health programs may use somewhat different systems to identify industries for inspection.

Follow-up inspections

A follow-up inspection determines if previously -cited violations have been corrected. If an employer has failed to abate a violation, the compliance officer informs the employer that he/she is subject to "Failure to Abate" alleged violations and proposed additional daily penalties while such failure to abate or violation continues.

Records review

A records review is an examination of the employer's injury and illness records to determine whether there will be a comprehensive inspection of the workplace. The compliance officer reviews the OSHA 300 Log of

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occupational injuries and illnesses and employment data of the establishment. Using these data, the compliance officer calculates the DART (days away from work, restricted work, or job transfer) and DAFWII (days away from work injury and illness) rates for the establishment. These figures are compared to the national average for the industry segment, which are published by the Bureau of Labor Statistics (BLS). If the calculated DART and DAFWII rates are below the BLS rates, the compliance officer will not normally conduct a comprehensive safety inspection. However, if the rates are above the national average, an inspection will be conducted.

The inspection process

After the opening conference, the compliance officer and accompanying representatives proceed through the establishment to inspect work areas for safety or health hazards.

The route and duration of the inspection are determined by the compliance officer. While talking with employees, the compliance officer makes every effort to minimize work interruptions. The compliance officer observes safety and health conditions and practices, consults with employees, takes photos and instrument readings, examines records, collects air samples, measures noise levels, surveys existing engineering controls, and monitors exposure to toxic fumes, gases, and dust.

Trade secrets observed by the compliance officer will be kept confidential. An inspector who releases confidential information without authorization is subject to a \$1,000 fine and/or one year in jail. The employer may require that the employee representative have a confidential clearance for any area in question.

Employees are consulted during the inspection tour. The compliance officer may stop and question workers, in private, about safety and health conditions and practices in their own work-places. Each employee is protected, under the Act, from discrimination for exercising his or her safety and health rights.

OSHA places special importance on posting and recordkeeping. The compliance officer will inspect records of deaths, injuries and illnesses which the employer is required to keep. He or she will check to see that the OSHA 300A Summary has been posted and that the OSHA workplace poster (OSHA 2203 or 3165) is prominently displayed. Where records of employee exposure to toxic substances and harmful physical agents have been required, they are also examined for compliance with the recordkeeping requirements.

The compliance officer also explains that while the following items are not required for all OSHA standards they should be recorded to accurately monitor and assess occupational hazards.

- **Initial and periodic monitoring**, including the data of measurement, for operations involving exposure; sampling and analytical methods used and evidence of their accuracy; number, duration, and results of samples taken; type of respiratory protective devices worn; and name, social security number, and the results of all

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employee exposure measurements. This record should be kept for 30 years.

- **Employee physical/medical examinations**, including the name and social security number of the employee; physician's written opinions; any employee medical complaints related to exposure to toxic substances; and information provided to the examining physician. These records should be maintained for the duration of employment plus 30 years.
- **Employee Training.** These records should be kept for one year beyond the last date of employment of that employee.

The compliance officer also explains the requirements of the Hazard Communication Standard. Under that rule, manufacturing employers must establish a written, comprehensive hazard communication program which includes provisions for container labeling, material safety data sheets, and an employee training program. The program must contain a list of the hazardous chemicals in each work area and the means the employer will use to inform employees of the hazards non-routine tasks.

During the course of the inspection the compliance officer will point out to the employer any unsafe or unhealthful working conditions observed. At the same time, the compliance officer will discuss possible corrective action if the employer so desires.

Some apparent violations detected by the compliance officer can be corrected immediately. When they are corrected on the spot, the compliance officer records such corrections to help in judging the employer's good faith in compliance. Even though corrected, however, the apparent violations may still serve as the basis for a citation and, if appropriate, a notice of proposed penalty.

An inspection tour may cover part or all of an establishment, even if the inspection resulted from a specific complaint, fatality, or catastrophe.

Closing conference

After the inspection tour, a closing conference is held between the compliance officer, the employer, and the employer representative. It is a time for free discussion of problems and needs; a time for frank questions and answers.

The compliance officer also will give the employer a copy of "Employer Rights and Responsibilities Following an OSHA Inspection," and then briefly discuss the information in the booklet and answer any questions.

The compliance officer discusses with the employer all unsafe or unhealthful conditions observed on the inspection and indicates all apparent violations for which a citation may be issued or recommended. The employer is also informed of appeal rights. The compliance officer will not indicate any specific proposed penalties. Only the OSHA area director has that authority.

During the closing conference, the employer may wish to produce records to show compliance efforts and to provide information which can help

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OSHA determine how much time may be needed to abate an alleged violation.

When appropriate, more than one closing conference may be held. This is usually necessary when health hazards are being evaluated or when laboratory reports are required.

If the employee representative did not participate in the opening conference held with the employer, a closing discussion is held with the employee representative, if requested, to discuss matters of direct interest to employees.

The compliance officer explains that OSHA area officers are full-service resource centers that inform the public of OSHA activities and programs, comment periods, or public hearings; provide technical experts and materials, including courses offered at the OSHA Training Institute; refer callers to other agencies and professional organizations as appropriate; and promote effective safety and health programs through voluntary protection programs and expanded employer abatement assistance efforts.

Inspection results

After the compliance officer reports the findings, the area director determines if citations will be issued and if penalties will be proposed.

Citations

Citations inform the employer and employees of the regulations and standards alleged to have been violated and the length of time set for their abatement. The employer will receive citations and notices of proposed penalties by certified mail. The employer must post a copy of each citation at or near the place the violation occurred, for three days or until the violation is abated, whichever is longer.

Follow-up inspection and failure to abate

If you receive a citation, a follow-up inspection may be conducted to verify that you have:

- Posted the citation as required;
- Corrected the violations as required in the citation; and/or
- Adequately protected employees during multi-step or lengthy abatement periods.

In addition to providing for penalties for failure-to-post citations and failure-to-abate violations, the Act clearly states that you have a continuing responsibility to comply with the Act and assure your employees of safe and healthful working conditions. Any new violations discovered during a follow-up inspection will be cited.

To achieve abatement by the date set forth in the citation, it is important that abatement efforts be promptly initiated.

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Employer discrimination

The Act prohibits employers from discharging or otherwise discriminating against an employee who has exercised any right under this law, including the right to make safety and health complaints or to request as OSHA inspection. Complaints from employees who believe that they have been discriminated against will be investigated by OSHA. If the investigation discloses probable violations of employee rights, court action may follow.

Organize for safety

After you have analyzed the shop's layout for the best vehicle traffic patterns and orderly workflow, lightened, brightened, and aired the interior, put all equipment in its place, and properly posted hazards, you can look at how safely the staff operates. If you've decided that procedures need to be tightened up and you'd like to set some standards, there is nothing controversial about setting safety standards and enforcing them. By doing this you are demonstrating the fleet's interest in its employees' health and welfare on the job, and assuring compliance with the OSHA regulations. It is an excellent way to start bringing the concept of standards into the shop, and to build cooperation and trust in your staff.

The safety standard

Just like the other maintenance standards, the fleet's safety policy should be in writing. Action needs to be taken to enforce those standards. The Maintenance Pro is responsible on both counts — setting the policy and enforcing it. Before you begin to write safety standards for your shop you must believe that such a program will benefit both the fleet and its employees. You must also be convinced that:

- Preventing injuries is good business.
- All injuries are preventable.
- Management is responsible for preventing injuries.
- Employees have the right to a safe working environment.
- Employees can be trained to work safely.
- A safety program will not work without the cooperation of employees.

The safety inspection

Safety professionals refer to the inspection as a safety audit. It means going around the shop while work is in progress and identifying safety hazards. A safety inspection must be conducted frequently, because even if a shop has been designed with safety in mind, it doesn't automatically stay that way! To begin a regular inspection procedure, you may decide to:

- Hire an outside consultant. The professional will do a thorough job and create a checklist for your shop that can be used for future

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inspections; hiring an outside professional may give credibility to the project and take you off the hook for being the bad guy.

- Conduct the inspection yourself. You should develop, then, a written checklist and consult some safety references and literature for help in creating that list (don't forget DOT, EPA and OSHA regulations — they can be a starting point).
- Appoint a "safety committee" of employees. This can be a way to get technicians involved and ensure better cooperation later when the standards are put into practice. You can also ask for volunteers, but make sure you know and they know that fleet management will be behind them 100%. All suggestions may not be followed, but all will be heard.

Any safety inspection should concentrate on four areas, says a specialist who has developed guidelines which can be applied to the trucking industry too:

- storage and use of hazardous and flammable materials,
- electrical equipment,
- personal protective equipment, and
- housekeeping.

Let's look at each of these areas individually:

Flammable substances such as paints, solvents, gasoline, etc. must be handled with great care. These kinds of materials must be stored in sturdy cabinets with doors. Only the materials needed for each working day (or better, for each job) should be removed from the cabinets, and containers must be returned.

If such products are in bulk storage, be sure that employees know how to draw off and transfer them according to prescribed methods. Solvent drums should be grounded to prevent static electricity buildup; all storage containers should be kept tightly sealed except during transfer. Only approved safety cans should be used for transfer.

Electrical equipment multiplies quickly in a shop, so if you're starting from scratch, plan the location of all electrically-operated equipment at the beginning. Determine phasing of each machine; make sure that capacity won't be less than demand. Be sure that there are enough outlets and add extra ones rather than using three-in-one connectors and other make-do solutions.

Electrical hand power tools should be inspected regularly for wear and/or damage. Some things to keep in mind for tools and equipment:

- Tools or extension cords with frayed, cracked, or missing insulation should not be used. Protect cords from oil, heat, and cutting; if damaged, cords should be replaced, not patched.
- Switches, outlets, or junction boxes should be covered. Don't permit any do-it-yourself wiring. Bare wires, broken fixtures, outlets, etc. must be reported right away.

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- All power tools must have a ground connection (separate groundwire or three-pronged plug); don't use an ungrounded adapter.
- Sparks from power tools can ignite vapors from open containers of flammable materials and spray booths. Spray areas should have explosion-proof lights, and circuits must not be overloaded. Equipment that is not equipped with explosion-proof motors must be used at least 20 feet away from spray areas.

Personal protective equipment is often annoying to employees, and it does take time to find and put on a pair of goggles. The potential for injury in a maintenance shop is great and every employee from helper to first-class technician should be aware that taking proper precautions is part of being a professional:

- Tools and heavy parts are hazards to feet; safety shoes with metal toe inserts and non-slip soles should be worn by all shop employees.
- There are special gloves for almost every job in the shop: welding gloves, rubber gloves for handling caustics, acids, batteries, and solvents, and gloves for handling glass or jagged metal should all be provided for the personnel. Make sure that they have a place and are used for every special job.
- Eye and face protection devices also vary according to the job. Special tinted goggles for gas welding, brazing, etc. and helmets with special lenses for all welding are examples. Goggles, face shields, or prescription industrial-safety glasses (does your shop pay for these? It is a nice perk) must be used in any work area where grinding, sanding, drilling, etc. is going on or where glare, radiation, or splashes of harmful liquids are hazards. A technician working under a vehicle where pieces may fall into the eyes is another situation that should require the use of safety glasses or goggles. Specialized tasks may also require eye protection. Eye and face protection is very important when working on air conditioners, for example.
- Respiratory protection when sanding or grinding is necessary. The filter mask should fit well around nose and mouth. Filters should be checked frequently. Air-supply respirators or approved organic vapor (charcoal) cartridge respirators should be worn whenever the employee is mixing or applying painting materials (product labels will indicate which type of respiratory protection is recommended and/or required). Be sure that each employee's respirator fits correctly.
- Harmful noise levels over a period of time can cause hearing loss. Ear plugs are inexpensive and easy to use; headset-type devices are more costly, but they provide superior protection. Cutting, sanding or drilling metal, using air impacts, hammering, and running engines are all situations where hearing protection should be required.
- The specific maintenance tasks in the shop should be checked for hazards; for example, truck air conditioning, cooling system, battery work, etc. have hazardous liquids; any time a technician works

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under a vehicle, whether on a hoist or over a pit, there is potential danger. Every shop employee should be on the lookout for unsafe acts. There are also specific rules for tire and rim work. Multipiece tire rims have been known to fly apart during inflation or deflation. Accidents happen with single-piece rims too. The shop must have standard procedures for working with safety cages. Displaying posters which illustrate procedures can remind employees of the correct way to do things.

If you have decided that the standard should be written by a safety committee, the committee members should establish the safe and correct way to conduct shop inspections and service procedures. Safety is also important in the use of hand tools. Some simple rules:

- use the right tool
- use the tool properly
- maintain the tool regularly, and
- use approved eye protection.

The screwdriver, for example, is one of the most misused tools. Like not matching the tip with the screw. Or using a hammer on the screwdriver. Or holding the work in one hand while using a screwdriver with the other. Tips need watching. A hand file should be used to recondition the blade, not a bench grinder (replacement blades are available as well!). Are hammers used improperly? Are technicians encouraged to purchase special tools (or will the shop purchase them) if they are safer to use?

Good housekeeping is actually the first step in a safety program. Train your people to put things away. Equipment goes back in its proper place; junk gets disposed of immediately. The jagged edges of metal can cause damage; insist that technicians use gloves when bringing rusty metal pieces to the trash (and make sure that their tetanus shots are up to date). First-aid kits and emergency telephone numbers should be available in several locations.

Aisles and walkways must be kept free of tools, creepers, electrical wires, hoses, etc. to prevent tripping accidents. These additional important areas should also be kept clear of obstructions: fire exits, fire extinguishers, electrical fixtures/switches, heating equipment, and any stored hazardous materials.

Did you spill? Did it leak? Clean it up. Immediately. Grease, oil, water, and other liquids are not only a hazard, but a mess besides. Make sure that personnel clean up after themselves. technicians should not only wipe up the floor, but also clean up any part of the vehicle that they are working on. It doesn't take that much extra effort and the engine compartment of the truck will stay cleaner and easier to inspect, for example.

Those greasy shop towels and rags belong in a covered metal container away from any heat and should be disposed of daily. Changes of clothing should also be on hand (and while we're at it, insist that personnel be dressed neatly; torn clothing and hanging buttons create a work hazard). A shower in the technician's washroom is a practical safety measure. The

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sink there should be a janitorial model so technicians can scrub to the shoulders.

Floors should be swept and washed daily. A shop vac is ideal so that dust and debris aren't blown into the air. technicians should ensure that their bays are cleaned up after each job. Storage areas should always look neat and organized. Have specified locations for equipment, painting outlines on the floor if necessary. Racks and shelves should be strong; check that things are stacked safely, not too high, not too heavy, not hanging over. Obviously heavy items belong on the lower shelves. Be sure that transfer equipment is available to move heavy items and to spare employees' backs. Consider a portable shop crane to move heavy parts around.

It's important that your safety standards be part of every employee's daily routine. They are also part of every employee's job orientation and should be reviewed regularly. Posting safety signs can be a useful reminder, but change them frequently when employees no longer see them. Periodic safety campaigns that concentrate on one particular work procedure or habit are a good way to review the standards methodically. You and any other supervisory staff set the tone for enforcement. No Smoking signs mean just that — for everyone.

Fire prevention and hazardous materials training should also be conducted frequently and regularly. Make sure that everyone knows about the different kinds of fires and firefighting equipment. Similarly, training should be conducted on the kinds of hazardous substances present in the shop and how they are to be disposed of safely.

Equipment and tools (and personal protective devices like respirators, asbestos gloves, etc.) should be regularly inspected and repaired or replaced. Protective guards should also be on all machines where required.

OSHA Training

The first decisions you must make are what topics you want to train on and how to accomplish the training. Some topics, such as shop safety, machine safety, emergency procedures, tire mounting and dismounting, forklift operation, and hazardous materials (hazard communications) are required. Other topics you will want to train on to reduce the odds of injury in your facility (slips and falls as an example). Most OSHA training standards are performance-oriented, specifying the results but not mandating the methods to be used. Therefore, you can set up the type of training program that fits best into your operation.

There are a number of different approaches that can be taken. You could use videos, interactive computer programs, classroom instruction, or a combination of methods. The best attack is to set up training which allows employees an opportunity to ask questions to ensure that they understand the information presented to them.

WARNING: Giving an employee a sheet of paper to read does not satisfy the intent of the standards.

The next decision to make is who will do the training. OSHA allows you to select the instructors. However, it is up to you to make sure they are

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qualified (knowledgeable) in the area they are instructing. Let's look at selecting an instructor for conducting hazardous materials training.

You may want to split the training into two parts — the information section and the chemical-specific training because of the technical nature of the material. Then you could have one person give all employees the information training, and have area supervisors handle the training for the chemicals used in their work areas (more specific knowledge).

Be sure that whoever does the chemical-specific training thoroughly understands the safe handling aspects of the chemicals he will be covering. Many times a supervisor is more production-oriented rather than safety-oriented, and may emphasize shortcuts that are not recommended for the safe use of a hazardous substance. If you have several people, such as supervisors, conducting training for their work areas, sit in on a session or two, to observe how the training is being handled and to show your support for safety in the workplace.

Having written training programs is your documentation of how you have complied with any training requirements (such as the the Hazard Communication Standard).

This section provides sample training programs that a maintenance pro can use to train technicians on issues that OSHA is concerned with. These programs are designed to be short and easy to use. Ideally, these programs can be completed in 5 to 30 minutes at the start or the end of the workday. They can also be expanded and included in a new-employee orientation.

This is not a full and complete training program. You will need to assess the hazards and behaviors present in your facility to determine if other programs are necessary.

Entrances and exits training

Entrances and exits handout

All buildings must have a way of allowing occupants fast exit to the outside or a safe place of refuge in case of an emergency. Emergency exit routes are not something that you think about all of the time, but a lot of effort goes into making sure they are safe and ready to use.

What is an exit route?

An "exit route" is a clear path of exit travel from any point in a workplace to a place of safety. The exit route can include aisles, stairs, ramps, etc. A workplace must have at least two exit routes that are remote from each other. If a fire or other emergency blocks access to one exit route, the other exit route can be used.

Exit routes must be kept free of obstructing material or equipment, and they must have enough lighting. The purpose of an exit route is to reach an exit — the exit route cannot lead employees toward a dead end or through a room that can be locked.

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The exit route must be wide enough to handle all of the people who may use it.

Signs must be posted along the exit route to show the direction of travel to the nearest exit.

The exit route may not direct employees toward areas where there are unprotected materials that burn very quickly, emit poisonous fumes, or are explosive.

What is an exit?

An “exit” is part of the exit route. Exits are separated from other areas and provide a protected way of travel to the exit discharge. Exits must be separated from the rest of the workplace, and they must be protected by a self-closing fire door.

Each exit must be easy to see and marked with an “Exit” sign.

Any door that might be mistaken for an exit must be marked “Not an Exit” or with a sign showing what the door leads to, “Storeroom” for example.

Exit doors must be easy to open without having to use keys or tools.

Exits must lead to a safe area with enough room for all of the people who are likely to use the exit.

What must my employer do?

Your employer will explain how to locate exits in your facility and what you should do if you are required to exit the building in an emergency.

What must I do?

You must know at least two exits from your area of the workplace.

You must not block or obstruct exits or paths of exit, and alert your employer if you notice exits are blocked.

Entrances and exits training exercise

Exit route tour

Take the trainees on a tour of an exit route that they may need to take during a drill or emergency evacuation. At each point along the way, ask the trainees to note examples of how the exit route meets the regulation’s requirements.

They should be able to point out “Exit” signs, adequate width of the exit route, an exit route that is free of obstructions, direction of travel that doesn’t lead toward hazards, direction of travel marked along the way, the use of fire doors at exits, adequate space for people beyond the exit, etc. When you see an example of how the requirements are being met, be sure to discuss it if the trainees haven’t noticed it.

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Assembly area

Show the trainees the assembly area(s) where they will assemble for a headcount following an emergency evacuation. Explain how the headcount will be handled.

Entry protocol

Show the trainees the entrance(s) they will be expected to use, and demonstrate any company-specific access/check-in procedures for employees and visitors.

Fire Protection

Fire protection handout

Because of the deadly danger of fire, it's to your benefit to know what to do if a fire starts. You should be aware of certain procedures to protect yourself and others from injury during fires and other emergencies. Your employer will conduct regular emergency drills so that you and your coworkers will know what to do and where to proceed during an emergency. You should be familiar with:

- How to report fires, hazardous chemical spills, and other emergencies.
- The route you are assigned to take during a building evacuation.
- Who to ask for more information.

Alarm systems

Most companies use alarm systems to alert employees to evacuate an area or to take a specific action. You must be able to recognize these alarms. In areas where production noise could prevent an alarm from being heard, flashing lights are often installed as a second, visual alarm.

Emergency shutdown of equipment

If time permits before evacuation, turn off any equipment you are operating, such as forklifts or conveyors. Your employer may designate certain workers to shutdown critical facility systems, such as gas and electrical power, before evacuating the work area.

Evacuation

Your employer will develop emergency escape routes for the various locations in your facility. Floor plans or work-area maps clearly define emergency escape routes and are commonly used to convey this information.

Your employer will designate certain employees to take a head count of all workers after evacuation and to inform emergency responders of any missing personnel.

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When a fire starts...

When a fire starts on-site, think first of your safety and the safety of others. Sound the alarm and alert the fire department. Try to put out the fire **only if you have been trained** to use extinguishers, and the fire is small and tame enough to be extinguished by a hand-held extinguisher or whatever other firefighting equipment or supplies are available to you on the job site.

Be aware of smoke and noxious fumes. These fumes enter the lungs and leave persons unconscious and at the mercy of the smoke and flames.

Fire protection exercise

Discussion

Lead trainees in discussing/analyzing fire protection topics as they apply to your workplace. As workers discuss the details of how effective fire prevention devices are, they learn more about them and are better prepared to act in the event of a fire.

The discussion described in the exercise may provide ideas or activities for fire prevention at your facility. Seek cooperation from participants' supervisors and use them to the extent that they are feasible. Tell your trainees' supervisors ahead of time that new ideas may be generated, and seek their support for implementation. Supervisors, in addition, may also be willing to follow-up on and reinforce what trainees have learned in the session — an extremely valuable tool for any trainer.

It is a good idea for companies to discuss specific fire protection measures at their facilities.

Make sure you have enough copies of fire protection handouts so that each participant has his or her own.

Electrical safety

Electrical safety handout

Electricity is an integral part of our lives both at home and in the workplace. Using safe work practices while working on or near de-energized electrical parts can decrease your chances of being injured from electricity.

Employees who work on or near de-energized electrical parts require training on how equipment is de-energized and locked out/tagged out, how to safely work on or near de-energized parts, and what safeguards to use.

How can it hurt me?

High-voltage shocks can cause serious injury or sometimes death. The effects of an electrical shock on the body can range from a tingle to immediate cardiac arrest. Severe shocking can cause more damage than can be seen with the naked eye.

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Electrical currents travel in closed circuits through conducting material. You can receive a shock when a part of your body comes into contact with:

- Both wires of an electrical circuit.
- One wire of an energized circuit and the ground.
- Part of a machine which is “hot” because it is contacting an energized wire and the ground.

What must my employer do?

Your employer will discuss what is expected of you in regards to working with electricity or electrical parts, and inform you of those “qualified persons” who are employed at your facility.

Electrical safety exercise

After concluding the training, have the participants report back at the end of the day any electrical problems located in the facility.

Personal protective equipment (PPE)

Perhaps the most useful type of activity for training on PPE is first demonstrating the proper way to put it on, use it, and take it off. Then, give participants time to work with the equipment themselves, to find out what fits best, and to ask any questions on how it is used.

Follow-up with individual employees after training to watch them work while wearing the PPE, and offer suggestions if they have any problems or questions.

Collect all the types of PPE that your workers will need while they use tools. Provide a variety of sizes so that workers can find PPE that fits.

Lockout/tagout

Lockout/tagout handout

OSHA statistics show that six percent of all deaths in the workplace result from the unexpected activation of a machine or other piece of equipment during maintenance or other servicing.

OSHA developed lockout/tagout regulations which require employers to develop procedures for isolating energy sources when servicing or maintaining equipment and machinery.

Two terms which relate directly to this system are:

Lockout — the placement of a device that blocks the flow of energy from a power source to a piece of equipment.

Tagout — the process of attaching a tag to a disconnect switch or other energy-isolating device to warn others not to restore energy to the tagged equipment.

Who is involved?

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Lockout/tagout involves three types of employees with different levels of responsibility:

- Authorized — employees who perform the servicing, maintenance, and set-up of equipment or machinery and apply the locks and tags to this equipment.
- Affected — employees who operate or use the equipment or machines which are locked/tagged out when servicing, maintained, or set-up.
- Other — employees who are neither affected nor authorized employees.

Lockout devices must:

- Be durable and substantial.
- Identify the person who applied it.
- Only be removed by the person who applied it.

What must my employer do?

Your employer will provide details about the company's lockout/tagout program.

Lockout/tagout exercise

Energy source location

Objectives: For this exercise, you will view slides, overheads, or the actual piece of equipment. Have the trainees locate all the energy sources. Give them several minutes to do this. Then, have a group discussion on the energy sources that they found. Make a list of these energy sources on an overhead, flipchart, or writing board. Make sure that vehicles are included as examples of equipment.

Isolation devices

Objectives: Using the list obtained for the energy source location, have a group discussion on how the energy may be isolated. Discuss the location of the isolating device and how it will be kept in place.

Lockout/tagout demonstration

Objectives: On a piece of equipment, show how to lock it out. Have the employees help with the procedure. First review the written lockout/tagout procedure for this piece of equipment. Then, follow the steps below(in order).

1. Inform affected employees.
2. Locate energy sources.
3. Shutdown equipment.
4. Isolate equipment from energy source.
5. Apply locks and tags.
6. Release stored energy.

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7. Verify isolation of equipment from energy source and release of stored energy.

Note: Consider modifying the lockout/tagout procedure used on shop equipment to include vehicles being repaired, and add the procedures to this training unit. Possible methods include:

- The control of the key switch or start button on vehicles with a mechanical device (lockout).
- The use of a device to not allow the connection of a power unit to a trailer being serviced (lockout).
- The use of tags on vehicles and trailers indicating the only party authorized to start/move the vehicle (tagout).

Machine guarding

Machine guarding handout

Machine guards are your first line of defense against injuries caused by machine operation. Each machine must have adequate safeguards to protect operators from the machine's hazards.

Having an understanding of how a machine works and how the guards can protect you will result in a reduced risk of injury.

All guards must:

- Prevent contact.
- Be secured in place or otherwise be tamper proof.
- Create no new hazard.
- Allow for lubrication with the guard still in place.
- Not interfere with the machine operation.

Types of safeguarding

Several types of safeguarding include:

- Guards — fixed, interlocking, adjustable, or self-adjusting.
- Devices — sensing, pullback, restraint, operational controls, or gates.
- Location or distance — locating the machine so that hazardous areas are not normally accessible.
- Automated feeding and ejection methods - eliminate operator exposure to the hazards.
- Miscellaneous aids — shields, feeding-tools, holding devices, or awareness barriers.

What must I do?

You should always report missing, damaged, or inoperative guards. It is not safe to operate machinery without properly working guards.

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If the guard is damaged or becomes inoperative while you are working, shut the machine down, and have the guard inspected by a qualified person. The guard may need to be repaired or replaced before work can safely proceed.

If unexpected machine start-up could cause injury, use the lockout/tagout program.

Machine guarding exercise

1. Review of operating instructions.

Objectives: As an exercise to reinforce the importance of using guards and following operating procedures, take the trainees on a tour of the machines they work with. Ask employees to identify the guards, operating controls, emergency stops, adjustment points for job set-up, and parts that need routine maintenance (lubrication, cleaning, etc.). Point out how the design of the guard fits the operation of the machine. Demonstrate any adjustments to the guard that may be needed. Have the trainees walk through the operating procedures that they follow to confirm that the machine is being operated properly.

This exercise will work best if it can be scheduled for a time when the machine is not running. Extra copies of the operating instructions should be available for the trainees.

2. Designing machine safeguards.

Objectives: Prepare a table-top exercise for your trainees. The exercise will present the trainees with a machine, and they are to outline how the machine needs to be guarded. Good source material would be one of your company's machines that is going to be modified, or a machine in the process of being built. You could also use plans for new equipment to describe the machine. You will need to describe what the machine is used for, and how it works. The trainees will also need to know where the operators stand and how materials are fed into the machine. Hand out pictures or diagrams of the machine to help the trainees get started.

Slips, trips and falls

Slips, trips, and falls handout

Slips

Slips can be caused by wet surfaces, spills, or weather hazards like ice or snow. Slips are more likely to occur when you hurry or run, wear the wrong kind of shoes, or don't pay attention to where you're walking.

You can help avoid slips by following these safety precautions:

- Practice safe walking skills. Take short steps on slippery surfaces to keep your center of balance under you, and point your feet slightly outward.
- Clean up or report spills right away. Even minor spills can be very dangerous.

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- Don't let grease accumulate at your work place.
- Be extra cautious on smooth surfaces, such as newly-waxed floors. Also, be careful walking on loose carpeting.
- Wear the right shoes for the surfaces being walked on. Increase the friction between shoes and the walking surface by putting down sand or using abrasive strips.
- Make sure to watch where you are going. Never carry loads that you cannot see over.
- Keep work areas well lit.
- Keep work areas clean and free of clutter. Store materials properly. Move, cover, or tape down electrical cords so they are not a hazard.
- Report loose or damaged stair treads, handrails, or carpeting.

Trips

Trips occur whenever your foot hits an object and you are moving with enough momentum to be thrown off balance. You can help avoid trips when you:

- Make sure you can see where you are walking. Don't carry loads that you cannot see over.
- Keep walking and working areas well lit, especially at night.
- Keep the workplace clean and tidy. Store materials and supplies in the appropriate storage areas.
- Arrange furniture and office equipment so that it doesn't interfere with walkways or pedestrian traffic in your area.
- Properly maintain walking areas, and alert appropriate authorities regarding potential maintenance related hazards.

Falls

To avoid falls consider the following measures:

- Don't jump off vehicles, landings, or loading docks. Use the stairs or steps provided.
- Repair or replace stairs, handrails, or steps that are loose or broken.
- Keep passageways and aisles clear of clutter and well-lit.
- Wear shoes with appropriate non-slip soles.

Slips, trips, and falls exercise

Demonstration

Show proper types of footwear for the types of flooring used in your facility. Pay special attention to the types of soles in regard to slip, trip, and fall hazards.

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Explain the ways in which participants can keep their work areas clean and clear of clutter to prevent tripping hazards. Show ways to cover or tape down electrical cords to prevent tripping hazards.

Exercise

Divide participants into small groups. Have them tour the facility and note slip, trip, or fall hazards. You may wish to set up some sample scenarios of unsafe or hazardous situations to allow them to practice (example: mounting and dismounting vehicles and trailers).

Portable tools

Portable tools handout

It's easy to pick up and use a tool without stopping to think about its hazards. It is difficult to remember that tools pose hazards, and sometimes accidents occur before steps can be taken to avoid or eliminate those hazards.

The employer is responsible for the safe condition of tools and equipment used by employees, including tools and equipment which may be furnished by employees.

How can I protect myself?

Choose tools made from good quality, durable materials. Metal tools must be able to resist bending, cracking, chipping, and excessive wear. Wear the appropriate personal protective equipment (PPE). Wear eye, hand, and foot protection.

Everyone has probably suffered a minor scrape, cut, or bruise while using hand- or portable-powered tools, but they can also cause more serious injuries. Saws can sever a nerve, tendon, or blood vessel. A screwdriver can cause a deep puncture wound.

Dropping a heavy tool on your foot could break a bone. Using an electric power tool that is not properly grounded can cause shocks or electrocution. Be aware of the tool's hazards and use appropriate types of protective equipment to help avoid injury.

Use the right tool for the job.

Sometimes using the wrong tool for the job causes an injury. Sometimes using the right tool, but using it incorrectly is the problem. Not inspecting a tool before you use it can lead to an injury if the tool breaks. Damaged tools don't work very well.

Portable tools exercise

Name that tool

You want your employees to use the right tool for the job. Use this exercise to help familiarize the trainees with proper hand- and powered-tool names and uses. This exercise can take three directions.

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If you don't have enough trainees to set up teams, the best approach would be to bring in examples of all the tools that the workers will be using. Have the trainees work together to identify each tool and its intended use. You can take this exercise a step further and ask the trainees to name the tool's parts, bits, blades, attachments, etc. Having the tools at the training session also provides you with an opportunity to demonstrate tool inspection. This may be the best approach for new or inexperienced employees.

A second approach would work with smaller groups. For this exercise you do not necessarily have to have the tools present. Tell the trainees that they are going to have to build or repair an item and ask them to work together to come up with a list of the tools that they would need for the project. Give them as much detail about the project as you can. Tell them what supplies are available, but don't suggest the types of tools that would be needed. When you go over the lists after everyone is finished, ask the trainees about any personal protective equipment that they would need for the job.

The third approach works best when you can have two or more teams. Each team should have at least two people, but no more than four. They will need a buzzer or other noisemaker to buzz in with their answers. For this exercise, describe how a tool is used, and describe the parts of the tool. The first team that can identify it should buzz in with the answer. Other teams get a chance if the answer is incorrect. Questions can count for less points as more description is given before a team has the answer. If you want to bring tools in for this exercise, keep them covered. Then, during a lightning round, uncover each tool and award points to the first team to identify it.

Welding safety program

Welding handout

Your employer will review the company welding safety program with you. Whenever working welding or working around welding and other hot work, you should know:

- The name and job title of the person responsible for safety in welding operations.
- The job hazards associated with welding such as: hazards from fumes and gases, radiation hazards, fire hazards, noise hazards, and electrical hazards.
- Any special procedures for the equipment being used, such as: care of compressed gas cylinders, the use of ventilation, and fire prevention methods.
- The use of engineering controls, such as flash screens and fire blankets.
- The necessary personal protective equipment required for the work being done.

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Welding hazards

Welding can cause a variety of hazards, including:

- Damage to skin and eyes from exposure to ultraviolet and infrared rays produced by welding.
- Welding and cutting operations.
- Fire hazards from welding or cutting near or on combustible or flammable materials, dust, vapor, or the environment.
- Explosion hazards from lack of ventilation.

How can I protect myself and others?

Here are a few practices for working safely that apply in welding situations.

When working above ground or floor level, use a platform with toeboards and standard railings or safety belt and life line. Also protect workers from stray sparks or slag in the area below an elevated surface where welding is taking place.

Aim the welding torch away from cement or stone surfaces. Moisture within these materials could cause them to explode when they reach a certain temperature.

When finished welding or cutting, warn other workers of hot metal by marking or putting up a sign. Keep floors clean by putting electrode or rod stubs in an appropriate container. Keep floors clear of tripping hazards; store tools safely.

Never use bare conductors, damaged regulators, torches, electrode holders, or other defective equipment.

Do not an arc or resistance welder while standing on damp surfaces.

Welding exercises

Hot work permit

Pass out samples of the company hot work permit. Explain when such hot work permits are required, who can issue them, and why they are necessary.

Using a blank hot work permit, have each participant fill it out, using information you have provided.

Using an overhead projector, or printed sample, provide trainees with an improperly filled out hot work permit. Have participants explain why the hot work permit is not properly filled out.

Compressed gas cylinder storage

Show participants where the welding gases are stored. Explain how the gases are stored, separation of empty and full cylinders, and how they are secured in storage.

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Demonstrate how to properly move and secure cylinders for use. Allow participants to handle a cylinder (possibly an empty one, with protective cap in place).

Fire watch exercise

Divide participants into small groups. Read the scenario to them, and allow them time to discuss the root causes of each. Discuss as a group.

“A fire occurred when a contractor was installing a new passenger elevator. During the process, a metal plate with predrilled holes was to be installed. Because the predrilled holes did not line up properly, the contractor had to cut new holes using an acetylene torch. No hot work permit was obtained for this modification, nor were safety personnel notified that a welding operation would be conducted.

When the cutting job had been completed, a worker posted as fire watch heard a hissing sound and discovered that stray hot slag had fallen near the oxygen-supply line. This line was located well beyond the area where slag would be expected to fall. The fire watch grabbed the line with a gloved hand to cover the leak. At this point, the oxygen-supply line ignited with a flash, causing second-degree burns to the worker’s hand. When other workers shut off the oxygen supply to the tanks, the fire subsided. The injured worker was taken immediately to the health unit, then to a local hospital for treatment. Safety personnel were promptly notified, and work on the project was stopped until an investigation could be completed.”

The discussion of safety violations should include failure to:

Obtain a hot work permit.

Notify host safety department of hot work.

Remove or guard hazards near the work area.

[illegible]

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provision says EPA can only enforce the standards in states that are not RCRA-authorized, until the states adopt the waste oil rules on their own.

- **Refrigerants** — Refrigerants containing chlorofluorocarbons (CFCs) have historically been used for refrigeration and air conditioning. When released into the air, CFCs rise into the upper layer of the earth's atmosphere. Scientific studies have concluded that the chemical reactions of CFCs and related chemicals in the atmosphere result in the depletion of the ozone layer, which protects the earth from the sun's radiation. Title VI of the Clean Air Act Amendments of 1990 requires a complete phase-out of CFCs. The specific requirements of Title VI restrict the production of ozone-depleting chemicals, and regulate their use, emissions, and disposal. Companies that sell or repair vehicle air conditioners are required to purchase and use equipment for recycling CFCs. In addition, persons using CFC recycling equipment must be certified. Title VI also requires warning labels to be placed on all containers of CFCs.
- **Used batteries** — While used lead-acid batteries — which contain lead, sulfuric acid, and plastic — may seem to be one of the most environmentally-unfriendly portions of a truck, they are in most cases successfully recycled. Estimates go as high as 95% of all spent batteries being recycled. Since there is inherent value in a spent battery, many battery manufacturers provide a "trade-in" service when new batteries are purchased, with the old battery's value being applied against the cost of the new one, and the manufacturer providing a haul-away service. However, used batteries may be considered "universal waste" per 40 CFR Part 279 in certain circumstances.
- **Underground storage tanks (UST) for fuel** — Since a 1986 RCRA amendment set up the Leaking Underground Storage Tank Trust Fund (LUST) which was to be financed through fuel taxes, and SARA established a program for UST leaks, overflows and other releases in the same year, underground storage tanks have been the focus of considerable attention. The Energy Policy Act of 2005 significantly increased the EPA's regulation of USTs. The UST provisions of the Energy Policy Act focus on preventing releases. Among other things, it expands eligible uses of the LUST Fund and includes provisions regarding inspections, operator training, delivery prohibition, secondary containment and financial responsibility, and cleanup of releases that contain oxygenated fuel additives. See the sections to follow for more specifics. EPA regulations in Parts 280 and 281 of 40 CFR deal with the subject. See the Compliance section of this manual.
- **Above ground storage tanks (AST)** — ASTs, which are an alternative to USTs, are also regulated by the EPA and/or the associated local or state agencies.
- **Wastewater** — If your business is discharging water into the municipal sewer system, into a septic field, or into local waters, there are regulations pertaining to the permitting of the facility,

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content of the water, and the pretreatment of the water before discharge. These regulations raise the issue of what to do with the waste water generated as part of their normal maintenance operations, such as washing of vehicles and parts.

- **Stormwater** — Stormwater runoff, a wastewater disposal issue — fleets have two separate concerns in the area of water — how to deal with stormwater runoff and minimization of contaminants leaving their maintenance site during storms of any kind. The EPA regs in Part 122 of 40CFR contain these requirements.
- **Emergency planning and preparation** — Emergency planning and preparation is a critical component in an EPA compliance program. This includes complying with the HazComm and SARA requirements.
- **Vehicle emissions and fuel standards** — The EPA has been progressively tightening the emission standards on vehicles. The emission standards for particulate discharge and other contaminants has been significantly reduced. This action will continue, with the next reduction in emission standards coming in 2010. All heavy trucks built in 2007 must meet the new emission standards and must be designed to use the ultra low sulfur diesel. The EPA also has regulations in place which require the vehicle to meet the emissions standards in place the year the vehicle was built. One “push” by the EPA in the emissions area has been programs to reduce idling of large vehicles. The agency has provided “model legislation” for use by state and local units of government, and has established the “Smartway Transportation Partnership” program to assist carriers with reducing idling. The Smartway program works with carriers by providing them with incentives and advice on idle-reducing systems and technologies, as well as policies. For more information on the Smartway program go to the EPA’s website at: <http://www.epa.gov/smartway/>. This topic is covered in the Vehicle Systems section of this manual.

The next several pages take a detailed look at the EPA programs listed above that have an impact on the operations of a maintenance facility. But first, let’s take a look at the EPA’s guiding principles when it comes to programs they operate.

As the nation’s environmental laws and regulations have developed over the past three decades, a new paradigm has shifted the approach to waste management. Initially, EPA focused on managing the pollution generated through treatment and disposal in an environmentally-safe manner. However, we have learned that conventional treatment and disposal can transfer pollutants from one medium to another with no net reduction.

Recognizing that source reduction is more desirable than treatment and disposal, EPA now emphasizes preventing or eliminating the generation of waste. The Pollution Prevention Act of 1990 (PPA) established pollution prevention (referred to as “P2”) as a national objective. In striving to meet the new and often more stringent environmental laws, industries have found ways to reduce or prevent pollution at the source.

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Pollution prevention is indirectly defined in the PPA as source reduction. Source reduction is any practice that reduces or eliminates the creation of pollutants. Thus, the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment is reduced prior to recycling, treatment, or disposal. Source reduction can be achieved through equipment or technology modifications, process or procedural modifications, reformulation or redesign of products, substitution of raw materials, or improvements in housekeeping, maintenance, training, or inventory control.

The PPA established a pollution prevention hierarchy as national policy, declaring that:

- Pollution should be prevented or reduced at the source.
- Pollution that cannot be prevented should be recycled in an environmentally-safe manner.
- Pollution that cannot be prevented or recycled should be treated in an environmentally-safe manner.
- Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally-safe manner.

Thus, under the PPA, recycling, energy recovery, treatment, and disposal are not included within the definition of pollution prevention. However, some practices commonly described as “inprocess recycling” may qualify as pollution prevention. Although recycling is not pollution prevention, as indicated in the hierarchy, it is the next desirable practice where pollution cannot be prevented or reduced. Recycling conducted in an environmentally-sound manner shares many of the advantages of prevention as it can reduce the need for treatment or disposal and conserve energy and resources.

EPA's Office of Pollution Prevention and Toxic Substances (OPPTS) developed a pollution prevention strategy for incorporating pollution prevention concepts into EPA's ongoing environmental protection efforts. The specific objectives of the strategy are to provide guidance and direction for efforts to incorporate pollution prevention within EPA's existing regulatory and nonregulatory programs, and to set forth an initiative to achieve specific objectives in pollution prevention within a reasonable time frame.

Specific EPA programs and requirements

Hazardous waste

While the majority of the EPA's programs have adopted this PPA philosophy, several of the programs the agency operates are still based on the older concepts of reclamation and recycling to minimize pollution. The hazardous waste program is one such program.

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What is hazardous waste? Do hazardous waste regulations apply to your operations? If so, where do you start, what must you do? These are the questions this section will answer.

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA) which directed the U.S. Environmental Protection Agency (EPA) to develop and implement a program to protect human health and the environment from improper hazardous waste management practices. The program is designed to control the management of hazardous waste from its generation to its ultimate disposal — from “cradle-to-grave.”

EPA first focused on large companies, which generate the greatest portion of hazardous waste. Business establishments producing less than 1,000 kilograms (2,200 pounds) of hazardous waste in a calendar month (known as small quantity generators) were exempted from most of the hazardous waste management regulations published by EPA in May 1980.

In recent years, however, public attention has been focused on the potential for environmental and health problems that may result from mismanaging even small quantities of hazardous waste. For example, small amounts of hazardous waste dumped on the land may seep into the earth and contaminate underground water that supplies drinking water wells.

In November 1984, the Hazardous and Solid Waste Amendments (HSWA) were signed into law, amending RCRA. With these amendments, Congress directed EPA to establish new requirements that would bring small quantity generators who generate between 100 and 1,000 kilograms (kg) of hazardous waste in a calendar month into the hazardous waste regulatory system.

EPA issued final regulations for these 100 to 1,000 kg/mo generators on March 24, 1986. Most of the requirements were effective September 22, 1986. However, certain storage requirements went into effect March 1987; exception reporting, March 1988.

The Toxicity Characteristic Rule became effective for small quantity generators on March 29, 1991. The rule added 25 organic chemicals (including regulatory levels) to the existing list of RCRA-regulated chemicals. The rule also replaced the Extraction Procedure leach test with the Toxicity Characteristic Leaching Procedure (TCLP).

What is a hazardous waste? A hazardous waste is a waste with properties that make it dangerous or potentially harmful to human health or the environment. The universe of hazardous wastes is large and diverse. Hazardous wastes can be liquids, solids, contained gases, or sludges. They can be the by-products of manufacturing processes or simply discarded commercial products, like cleaning fluids or pesticides.

In regulatory terms, a RCRA hazardous waste is a waste that appears on one of the four hazardous wastes lists (F-list, K-list, P-list, or U-list), or exhibits at least one of four characteristics — ignitability, corrosivity, reactivity, or toxicity. Hazardous waste is presently regulated under Subtitle C of the RCRA .

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Listed wastes. By definition, EPA determined that some specific wastes are hazardous. These wastes are incorporated into lists published by the Agency. These lists are organized into three categories:

- The F-list (non-specific source wastes) identifies wastes from common manufacturing and industrial processes, such as solvents that have been used in cleaning or degreasing operations. Because the processes producing these wastes can occur in different sectors of industry, the F-listed wastes are known as wastes from non-specific sources. Wastes included on the F-list can be found in the regulations at 40 CFR §261.31.
- The K-list (source-specific wastes) includes certain wastes from specific industries, such as petroleum refining or pesticide manufacturing. Certain sludges and wastewaters from treatment and production processes in these industries are examples of source-specific wastes. Wastes included on the K-list can be found in the regulations at 40 CFR §261.32.
- The P-list and the U-list (discarded commercial chemical products) include specific commercial chemical products in an unused form. Some pesticides and some pharmaceutical products become hazardous waste when discarded. Wastes included on the P- and U-lists can be found in the regulations at 40 CFR §261.33.

Wastes with specific characteristic. Waste that does not meet any of the listings explained above may still be considered a hazardous waste if exhibits one of the four characteristics defined in 40 CFR Part 261 Subpart C — ignitability (D001), corrosivity (D002), reactivity (D003), and toxicity (D004 - D043).

- **Ignitability** — Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60°C (140°F). Examples include waste oils and used solvents. For more details, see 40 CFR §261.21.
- **Corrosivity** — Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels. Battery acid is an example. For more details, see 40 CFR §261.22.
- **Reactivity** — Reactive wastes are unstable under normal conditions. They can cause explosions, toxic fumes, gases, or vapors when heated, compressed, or mixed with water. Examples include lithium-sulfur batteries and explosives. For more details, see 40 CFR §261.23.
- **Toxicity** — Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.). When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute ground water. Toxicity is defined through a laboratory procedure called the Toxicity Characteristic Leaching Procedure (TCLP). The TCLP helps identify wastes likely to leach concentrations of contaminants that may be harmful to human health or the environment. For more details, see 40 CFR §261.24.

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As a business, it is your responsibility to determine if your wastes are considered hazardous. The EPA regulations in the next section includes a list of hazardous wastes and the methodology for deciding if a waste is indeed a hazardous waste.

Three of the most common wastes of concern that are generated in vehicle maintenance shops (tires, waste oil, and batteries) are not handled as hazardous waste, unless they have been contaminated by a waster that meets the hazardous waste definition (batteries may or may not be classified as hazardous waste, depending on the recycling intent and content of the battery). However, they are addressed in other EPA regulations. These items are covered as separate topics later in this chapter.

What is a “generator” — Hazardous waste is created by what the EPA refers to as “generators.” A generator is any person, or site, whose processes and actions create hazardous waste. There are now three categories of generators:

- Large Quantity Generators, who generate over 1,000 kilograms of hazardous waste per month.
- Small Quantity Generators, who generate 100-1,000 kilograms of hazardous waste per month.
- Conditionally Exempt Small Quantity Generators (CESQG) generate 100 kilograms or less per month of hazardous waste, or 1 kilogram or less per month of acutely hazardous waste.

As the volume of hazardous waste increases, so does the number of government regulations. Here is an explanation of the three categories of generators:

Large Quantity Generators (LQG) generate 1,000 kilograms per month or more of hazardous waste, or more than 1 kilogram per month of acutely hazardous waste. Requirements for LQGs include:

- LQGs may only accumulate waste on site for 90 days. Certain exceptions apply.
- LQGs do not have a limit on the amount of hazardous waste accumulated on site.
- There must always be at least one employee available to respond to an emergency.
- This employee is the emergency coordinator responsible for coordinating all emergency response measures.
- LQGs must have detailed, written contingency plans for handling emergencies.
- LQGs must submit a biennial hazardous waste report.

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Small Quantity Generators (SQG) generate more than 100 kilograms, but less than 1,000 kilograms, of hazardous waste per month. Requirements for SQGs include:

- SQGs may accumulate hazardous waste on site for 180 days without a permit (or 270 days if shipping a distance greater than 200 miles).
- The quantity of hazardous waste on site must never exceed 6,000 kilograms.
- There must always be at least one employee available to respond to an emergency.
- This employee is the emergency coordinator responsible for coordinating all emergency response measures.
- SQGs are not required to have detailed, written contingency plans for handling emergencies.

Conditionally Exempt Small Quantity Generators (CESQG) generate 100 kilograms or less per month of hazardous waste, or 1 kilogram or less per month of acutely hazardous waste. Requirements for CESQGs include (see also 40 CFR 261.5):

- CESQGs must identify all the hazardous waste generated.
- CESQGs may not accumulate more than 1,000 kilograms of hazardous waste at any time.
- CESQGs must ensure that hazardous waste is delivered to a person or facility who is authorized to manage it.

All large and small quantity generators are required to (see also 40 CFR 262):

- Obtain an EPA Identification number (available from your state environmental office).
- Comply with the uniform hazardous waste manifest system.
- Handle wastes properly before shipment (packaging, labeling, marking, placarding, accumulation time, etc.).
- Comply with record keeping and reporting requirements.

Regulatory reminder. Note that some states may have additional requirements in the area of hazardous waste. You should contact your state environmental control office, the regional EPA office, or a national trade association (or its local chapter) to familiarize yourself with any state/local requirements that may apply to you.

EPA Identification Number. A LQG or SQG must not treat, store, dispose of, transport, or offer for transportation, hazardous waste without having received an EPA Identification Number issued by the EPA. Transporters and facilities that store, treat, or dispose of hazardous waste must also have an EPA Identification Number.

These twelve character identification numbers, used by both EPA and the states, are part of a national data base to track hazardous waste activities. The application for the number serves the purpose of notifying

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the state and federal government that your company is involved in hazardous waste activity. The ID number that you receive is used on all documents relating to hazardous waste: manifests, biennial reports, labels.

To get your U.S. EPA Identification Number call or write your state hazardous waste management agency or your EPA regional office and ask for a copy of EPA Form 8700-12. Note: A few states use a form that is different from the federal form shown in the sample. Your state will send you the appropriate form to complete.

OMB#: 2050-0028 Expires 06/30/2009

SEND COMPLETED FORM TO: The Appropriate State or EPA Regional Office.	United States Environmental Protection Agency RCRA SUBTITLE C SITE IDENTIFICATION FORM		
1. Reason for Submittal (See instructions on page 13.) MARK ALL BOX(ES) THAT APPLY	Reason for Submittal: ☐ To provide Initial Notification of Regulated Waste Activity (to obtain an EPA ID Number for hazardous waste, universal waste, or used oil activities) ☐ To provide Subsequent Notification of Regulated Waste Activity (to update site identification information) ☐ As a component of a First RCRA Hazardous Waste Part A Permit Application ☐ As a component of a Revised RCRA Hazardous Waste Part A Permit Application (Amendment # ____) ☐ As a component of the Hazardous Waste Report		
2. Site EPA ID Number (page 14)	EPA ID Number | | | | | | | | | | | | | | | |		
3. Site Name (page 14)	Name:		
4. Site Location Information (page 14)	Street Address:		
	City, Town, or Village:	State:	
	County Name:	Zip Code:	
5. Site Land Type (page 14)	Site Land Type: ☐ Private ☐ County ☐ District ☐ Federal ☐ Indian ☐ Municipal ☐ State ☐ Other		
6. North American Industry Classification System (NAICS) Code(s) for the Site (page 14)	A. | | | | | | | |	B. | | | | | | | |	
	C. | | | | | | | |	D. | | | | | | | |	
7. Site Mailing Address (page 15)	Street or P. O. Box:		
	City, Town, or Village:		
	State:		
	Country:	Zip Code:	
8. Site Contact Person (page 15)	First Name:	MI:	Last Name:
	Phone Number:	Extension:	Email address:
9. Operator and Legal Owner of the Site (pages 15 and 16)	A. Name of Site's Operator:		Date Became Operator (mm/dd/yyyy):
	Operator Type: ☐ Private ☐ County ☐ District ☐ Federal ☐ Indian ☐ Municipal ☐ State ☐ Other		
	B. Name of Site's Legal Owner:		Date Became Owner (mm/dd/yyyy):
	Owner Type: ☐ Private ☐ County ☐ District ☐ Federal ☐ Indian ☐ Municipal ☐ State ☐ Other		

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EPA ID NO: | | | | | | | | | | | | | | | |

OMB#: 2050-0028 Expires 06/30/2009

9. Legal Owner (Continued) Address	Street or P. O. Box:	
	City, Town, or Village:	
	State:	
	Country:	Zip Code:

10. Type of Regulated Waste Activity

Mark "Yes" or "No" for all activities; complete any additional boxes as instructed. (See instructions on pages 17 to 20.)

A. Hazardous Waste Activities

Complete all parts for 1 through 6.

Y ☐ N ☐ 1. Generator of Hazardous Waste

If "Yes", choose only one of the following - a, b, or c.

- ☐ a. LQG: Greater than 1,000 kg/mo (2,200 lbs./mo.) of non-acute hazardous waste; or
- ☐ b. SQG: 100 to 1,000 kg/mo (220 - 2,200 lbs./mo.) of non-acute hazardous waste; or
- ☐ c. CESQG: Less than 100 kg/mo (220 lbs./mo.) of non-acute hazardous waste

In addition, indicate other generator activities.

Y ☐ N ☐ d. United States Importer of Hazardous WasteY ☐ N ☐ e. Mixed Waste (hazardous and radioactive) Generator**Y ☐ N ☐ 2. Transporter of Hazardous Waste****Y ☐ N ☐ 3. Treater, Storer, or Disposer of Hazardous Waste (at your site)** Note: A hazardous waste permit is required for this activity.**Y ☐ N ☐ 4. Recycler of Hazardous Waste (at your site)****Y ☐ N ☐ 5. Exempt Boiler and/or Industrial Furnace**

If "Yes", mark each that applies.

- ☐ a. Small Quantity On-site Burner Exemption
- ☐ b. Smelting, Melting, and Refining

Y ☐ N ☐ 6. Underground Injection Control**B. Universal Waste Activities****Y ☐ N ☐ 1. Large Quantity Handler of Universal Waste (accumulate 5,000 kg or more) [refer to your State regulations to determine what is regulated]. Indicate types of universal waste that apply:**Manage

- a. Batteries ☐
- b. Pesticides ☐
- c. Mercury containing equipment ☐
- d. Lamps ☐
- e. Other (specify) ☐
- f. Other (specify) ☐
- g. Other (specify) ☐

Y ☐ N ☐ 2. Destination Facility for Universal Waste

Note: A hazardous waste permit may be required for this activity.

C. Used Oil Activities

Mark all boxes that apply.

Y ☐ N ☐ 1. Used Oil Transporter If "Yes", mark each that applies.

- ☐ a. Transporter
- ☐ b. Transfer Facility

Y ☐ N ☐ 2. Used Oil Processor and/or Re-refiner If "Yes", mark each that applies.

- ☐ a. Processor
- ☐ b. Re-refiner

Y ☐ N ☐ 3. Off-Specification Used Oil Burner**Y ☐ N ☐ 4. Used Oil Fuel Marketer**

If "Yes", mark each that applies.

- ☐ a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner
- ☐ b. Marketer Who First Claims the Used Oil Meets the Specifications

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EPA ID NO: _____	OMB#: 2050-0028 Expires 06/30/2009

11. Description of Hazardous Wastes (See instructions on page 21.)						
A. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g., D001, D003, F007, U112). Use an additional page if more spaces are needed.						
B. Waste Codes for State-Regulated (i.e., non-Federal) Hazardous Wastes. Please list the waste codes of the State-regulated hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed for waste codes.						
12. Comments (See instructions on page 21.)						
13. Certification. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. For the RCRA Hazardous Waste Part A Permit Application, all operator(s) and owner(s) must sign (see 40 CFR 270.10 (b) and 270.11). (See instructions on page 21.)						
Signature of operator, owner, or an authorized representative	Name and Official Title (type or print)				Date Signed (mm/dd/yyyy)	

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waste numbers, check in the EPA Regulations under §261.32-.33. If you do not understand the information in the Appendix, or if you cannot match your wastes with those listed, seek help from one of the previously-mentioned sources.

One site — One number. If you have several sites or business locations where you produce or handle hazardous wastes, you will need to complete one copy of the form for each site. Each site will receive its own EPA Identification Number.

Once you make sure your form is filled out completely and correctly, sign the certification in Item 13. Send the form to the state hazardous waste agency or if your state requires it, to the appropriate regional EPA office. Be sure to check with either the regional EPA office or the state environmental office for the proper mailing address.

The information on the form will be recorded by both EPA and the state. You will then be assigned an EPA Identification Number. This number will be unique to the site identified on your form. Use this number on all hazardous waste paperwork requiring an EPA Identification Number. The hazardous waste manifest, for instance, in space 1, requires you to list your EPA Identification Number.

The EPA Identification Number will stay with the business site or location that you registered. If you move to another location, you must notify EPA or the state and submit a new form. If the new location previously handled hazardous waste, and already had an ID number, you will be assigned that number for the site after you have notified EPA.

If you store, treat, or dispose of your hazardous waste on site in any manner (other than the permissible recycling and reclamation described in the regulations), you must obtain a permit. This step should not be taken lightly.

TSD permitting — Obtaining a permit to store, treat, or dispose of your hazardous wastes on your site can be a costly and very time-consuming process. This process is described in 40 CFR Part 270. To obtain such a permit you must:

- Notify the EPA regional office or your state office of environmental control of your hazardous waste activity.
- Apply for a Hazardous Waste Permit (this is a different credential than an EPA Identification Number). The forms are available through the EPA regional office or your state office of environmental control.
- Complete Part 10A of the 8700-12 correctly (you will need to refile the 8700-12 to reflect your new activity).
- Comply with the standards described in 40 CFR Parts 264, 265, 266, and 270.

Remember, as long as you do not exceed the limitations discussed earlier in the generator discussion, you are only considered a generator. If you exceed the limitation for your type of generator, then you will have to apply for a TSD permit as a storer.

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If you are not sure whether you qualify as a storer or transporter of hazardous waste, or if you are interested in finding out more about the subject, call your state hazardous waste management agency or EPA regional office for help.

Hazardous waste transportation — The next step involved in hazardous waste normally involves getting it hauled away. Bear in mind the phrase “cradle-to-grave” responsibility. This means that if you produce the waste, it is your responsibility forever. You must ensure that it is hauled properly, and disposed of or treated properly.

Therefore, carefully choosing a hauler and designating a waste management facility is very important. You want to make sure that you are dealing with reputable haulers and disposers. The hauler will be handling your wastes beyond your control while you are still responsible for their proper management. Similarly, the waste management facility will be the final destination of your hazardous waste for treatment, storage, or disposal.

If your transporter takes your drums of hazardous waste and dumps them out on some back road, he will be fined, but YOU will have to help pay for the cleanup. Cleanup costs for a simple spill of several drums of hazardous waste that have soaked into the ground can be hundreds of thousands of dollars.

Therefore, before choosing a hauler and/or designating a facility, check with the following sources, if possible:

- Associates in the same business as you who may have used a specific hazardous waste hauler or designated facility in the past and were satisfied.
- Trade associations, which may keep a file on companies that have a good reputation for handling hazardous wastes.
- Your Better Business Bureau or Chamber of Commerce to find out if any complaints have been registered against a hauler or facility.
- Your state hazardous waste management agency or EPA regional office, which can tell you whether or not the company has a U.S. EPA ID number, and may know whether or not the company has had any problems.

Also, make sure that they have the necessary permits and insurance, and that the hauler’s vehicles are in good condition.

After checking these sources, make your selection of a hauler and a disposal site. Contact both the transporter and the designated disposal facility directly to verify that they have EPA Identification Numbers, and that they can and will handle your waste.

This process can be time-consuming, so start checking well ahead of the time that you will need to ship your waste. Careful selection is very important.

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Vehicle Maintenance Pro

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To prepare a hazardous waste for treatment you must:

- Package the waste in accordance with the applicable Department of Transportation regulations on packaging under 49 CFR Parts 173, 178, and 179.
- Label each package in accordance with the applicable Department of Transportation regulations on hazardous materials under 49 CFR Part 172.
- Mark each package of hazardous waste in accordance with the applicable Department of Transportation regulations on hazardous materials under 49 CFR Part 172.
- Mark each container of 119 gallons or less used in such transportation with the following words and information in accordance with the requirements of 49 CFR 172.304:

HAZARDOUS WASTE — Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.

Generator's Name and Address _____.

Generator's EPA Identification Number _____.

Manifest Tracking Number _____.

Finally, as the generator you must complete a hazardous waste manifest.

The hazardous waste manifesting system is designed to seamlessly track hazardous waste from the time it leaves the generator facility where it was produced, until it reaches the off-site waste management facility that will store, treat, or dispose of the hazardous waste.

The system allows the waste generator to verify that its waste has been properly delivered, and that no waste has been lost or unaccounted for in the process. The key component of this system is the Uniform Hazardous Waste Manifest (UHW). This form is prepared by all generators who transport, or offer for transport, hazardous waste for off-site treatment, recycling, storage, or disposal.

The manifest is required by both Department of Transportation and EPA. Each party that handles the waste signs the manifest and retains a copy for themselves. This ensures critical accountability in the transportation and disposal processes. Once the waste reaches its destination, the receiving facility returns a signed copy of the manifest to the generator, confirming that the waste has been received by the designated facility.

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On the following pages you will find a sample copy of a uniform hazardous waste manifest. Look this over. When you sign the certification in ITEM 15 you are personally confirming that:

- The manifest is complete and accurately describes the shipment.
- The shipment is ready for transport.
- You have considered whether, given your budget, your waste management arrangements are the best to reduce the amount and hazardous nature of your wastes.

REMEMBER: Just because you have shipped the hazardous waste off your site and it is no longer in your possession, your liability has not ended. You are potentially liable for any mismanagement of your hazardous waste.

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Please print or type. (Form designed for use on elite (12-pitch) typewriter.) Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Manifest Tracking Number	
5. Generator's Name and Mailing Address		Generator's Site Address (if different than mailing address)				
Generator's Phone:						
6. Transporter 1 Company Name		U.S. EPA ID Number				
7. Transporter 2 Company Name		U.S. EPA ID Number				
8. Designated Facility Name and Site Address		U.S. EPA ID Number				
Facility's Phone:						
9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
1.						
2.						
3.						
4.						
14. Special Handling Instructions and Additional Information						
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.						
Generator's/Offeror's Printed/Typed Name		Signature		Month Day Year		
16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit: _____ Date leaving U.S.: _____						
17. Transporter Acknowledgment of Receipt of Materials						
Transporter 1 Printed/Typed Name		Signature		Month Day Year		
Transporter 2 Printed/Typed Name		Signature		Month Day Year		
18. Discrepancy						
18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection						
18b. Alternate Facility (or Generator) Manifest Reference Number: _____ U.S. EPA ID Number _____						
Facility's Phone: _____						
18c. Signature of Alternate Facility (or Generator) _____ Month Day Year						
19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)						
1.	2.	3.	4.			
20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a						
Printed/Typed Name		Signature		Month Day Year		

EPA Form 8700-22 (Rev. 3-05) Previous editions are obsolete. DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

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[illegible]

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Waste tires

The Environmental Protection Agency (EPA) has compiled a summary of each state's scrap tire management legislation and programs in a publication, *State Scrap Tire Programs, A Quick Reference Guide (updated last in 1999)*. This guide is intended to provide state regulators, as well as members of industry, with a quick reference on state scrap tire programs across the country.

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The guide contains eight sections for each state program:

- The State Contact section provides the name, address, phone number, and fax number of the scrap tire program manager for the state. Websites and e-mail information are given when available.
- The Legislation and Regulations section briefly outlines the history of scrap tire legislation for the state.
- The Funding Sources/Fees section addresses the state funds and collection fees authorized by the state.
- The Collector, Seller, and Hauler Regulations section summarizes the regulations that apply to these entities.
- The Storage and Processor Regulations and the Disposal Restrictions sections outline relevant regulatory requirements.
- The Financial/Market Incentives section discusses grants and other programs that foster better scrap tire disposal/recycling waste management and reduction.
- The Additional Information section provides information about activities of interest related to scrap tires in a particular state, such as special field tests or studies, and innovative uses for scrap tires.

The guide can be accessed on EPA's website at www.epa.gov/epaoswer/non-hw/tires/scrapti.pdf or obtained from the RCRA/Superfund Hotline at (800) 424-9346.

Even with all of the reuse and recycling efforts, almost one-quarter of scrap tires end up in landfills each year. Landfilling scrap tires can cause problems due to their uneven settlement and tendency to rise to the surface, which can harm landfill covers. To minimize these problems, many states require chipping or grinding of tires prior to disposal. Sometimes scrap tires are also incorporated into the landfill itself as part of daily cover, or in a landfill cap.

In recent years, the placement of shredded scrap tires in monofills — a landfill, or portion of a landfill, that is dedicated to one type of material — has become more common. Monofills may be used where no other markets are available and municipal solid waste landfills do not accept tires. Monofills are preferable to above ground storage of tires in piles, due to fire hazards and human health hazards. State landfill regulations:

- 38 states ban whole tires from landfills.
- 35 states allow shredded tires to be placed in landfills.
- 11 states ban all tires from landfills.
- 17 states allow processed tires to be placed into monofills.
- 8 states have no restrictions on placing scrap tires in landfills.

Because waste tires are managed at the state level, and there is a wide variation in the state regulations, a maintenance pro will need to use the EPA materials to locate the correct state contact to determine what is necessary to comply.

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Waste oil

EPA issued a final rule on May 20, 1992, which effectively was a decision not to decide, at least for the time being. Waste oil (used oil) destined for disposal will not be specifically listed as a hazardous waste, according to the agency. The non-decision was made, based on the fact that all used oils do not always meet the technical criteria for being listed as a hazardous waste. Therefore, the regulatory status quo was preserved in the case of used oil.

This section summarizes the EPA's used oil management standards — a set of “good housekeeping” requirements for used oil handlers. These requirements are detailed in Title 40 CFR Part 279.

Why does the EPA take used oil so seriously? It is the main pollutant found in drinking water. In very graphic terms, a single gallon of waste oil can ruin a million gallons of fresh water, and make it unsuitable for drinking. To make matters worse, a great deal of used oil finds its way into the water table because various people pour it down sewers or onto the ground at the rate of more than 100 million gallons per year.

Why is it so dangerous? First of all, oil is insoluble, it won't dissolve in water. Second, it is persistent — in other words, it doesn't break down easily. Finally, used oil contains a mixture of chemicals and heavy metals (particularly lead) which are hazardous to health.

EPA's regulatory definition of used oil is as follows: Used oil is any oil that has been refined from crude oil or any synthetic oil that has been used and as a result of such use is contaminated by physical or chemical impurities.

Simply put, used oil is exactly what its name implies — any petroleum-based or synthetic oil that has been used. During normal use, impurities such as dirt, metal scrapings, water, or chemicals can get mixed in with the oil, so that in time the oil no longer performs well. Eventually, this used oil must be replaced with virgin or re-refined oil to do the job at hand. EPA's used oil management standards include a three-pronged approach to determine if a substance meets the definition of used oil. To meet EPA's definition of used oil, a substance must meet each of the following three criteria:

- **Origin** — The first criterion for identifying used oil is based on the origin of the oil. Used oil must have been refined from crude oil or made from synthetic materials. Animal and vegetable oils are excluded from EPA's definition of used oil.
- **Use** — The second criterion is based on whether and how the oil is used. Oils used as lubricants, hydraulic liquids, heat transfer fluids, buoyants, and for other similar purposes are considered used oil. Unused oil such as bottom clean-out waste from virgin fuel oil storage tanks or virgin fuel oil recovered from a spill, do not meet EPA's definition of used oil because these oils have never been “used.” EPA's definition also excludes products used as cleaning agents or solely for their solvent properties, as well as certain petroleum-derived products like antifreeze and kerosene.

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- **Contaminants** — The third criterion is based on whether or not the oil is contaminated with either physical or chemical impurities. In other words, to meet EPA's definition, used oil must become contaminated as a result of being used. This aspect of EPA's definition includes residues and contaminants generated from handling, storing, and processing used oil. Physical contaminants could include metal shavings, sawdust, or dirt. Chemical contaminants could include solvents, halogens, or saltwater.

Here are four quick definitions of the parties involved in used oil production and movement that are important to know when discussing used oil:

- **Generators** are businesses that handle used oil through commercial or industrial operations or from the maintenance of vehicles and equipment. Generators are the largest segment of the used oil industry. Examples of common generators are car repair shops, service stations, quick lube shops, government motor pools, grocery stores, metal working industries, and boat marinas. Farmers who produce less than an average of 25 gallons of used oil per month are excluded from generator status. Individuals who generate used oil through the maintenance of their personal vehicles and equipment are not subject to regulation under the used oil management standards.
- **Collection centers** and aggregation points are facilities that accept small amounts of used oil and store it until enough is collected to ship it elsewhere for recycling. Collection centers typically accept used oil from multiple sources that include both businesses and individuals. Aggregation points collect oil only from places run by the same owner or operator and from individuals.
- **Transporters** are companies that pick up used oil from all sources and deliver it to re-refiners, processors, or burners. Transfer facilities include any structure or area where used oil is held for longer than 24 hours, but not longer than 35 days. Examples of transfer facilities are loading docks and parking areas.
- **Burners** burn used oil for energy recovery in boilers, industrial furnaces, or in hazardous waste incinerators. Generators are allowed to burn used oil in space heaters provided they burn only their own used oil and used oil provided by household do-it-yourself generators, the waste oil is not contaminated, the space heater has a capacity of less than 500,000 BTUs per hour, and the combustion gases are correctly vented.

If your facility generates used oil, there are certain good housekeeping practices that you must follow. These management standards are common sense, good business practices designed to ensure the safe handling of used oil, to maximize recycling, and to minimize disposal. The standards apply to all used oil handlers, regardless of the amount of the oil they handle. Although different used oil handlers may have specific requirements, the following requirements are common to all types of handlers. These requirements relate to storage and to cleaning up leaks and spills, as follows:

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- Label all containers and tanks as Used Oil.
- Keep containers and tanks in good condition.
- Don't allow tanks to rust, leak, or deteriorate.
- Fix structural defects immediately.
- Never store used oil in anything other than tanks and storage containers.

Used oil may also be stored in units that are permitted to store regulated hazardous waste. Tanks and containers storing used oil do not need to be RCRA-permitted, however, as long as they are labeled and in good condition. Storage of used oil in lagoons, pits, or surface impoundments that are not permitted under RCRA is prohibited.

Collectors and transporters are required to have secondary containment on any of their storage tanks. Secondary containment is not required for generators, but it is highly recommended (you are responsible for spills at your facility).

Take steps to prevent leaks and spills. Keep machinery, equipment containers, and tanks in good working condition and be careful when transferring used oil. Have sorbent materials available on site.

If a spill or leak occurs, stop the oil from flowing at the source. If a leak from a container or tank can't be stopped, put the oil in another holding container or tank.

Next, contain any spilled oil. For example, containment can be accomplished by erecting sorbent berms or by spreading a sorbent over the oil and surrounding area. Clean up the oil and recycle the used oil as you would have before it was spilled. If recycling is not possible, you first must make sure the used oil is not a hazardous waste and dispose of it appropriately.

All used cleanup materials, from rags to sorbent booms, that contain free-flowing used oil also must be handled according to the used oil management standards. Remember, all leaked and spilled oil collected during cleanup must be handled as used oil.

The EPA does have licensing, identification, or recordkeeping requirements on used oil generators. The EPA regulations begin with the transporter. Transporters hauling used oil must have a valid EPA ID number, and generators, collection centers, and aggregation points must use transporters with EPA ID numbers for shipping used oil off site.

To sum this requirement up, tracking the used oil from "cradle to grave" is the transporter's job. As the "generator" you just have to be sure the company that is doing the transporting is a licensed transporter.

Generators, collection centers, aggregation points, and any handler that transports used oil in shipments of less than 55 gallons do not need an ID number, but may need a state or local permit. You can transport limited amounts of used oil yourself, up to one 55-gallon drum, to a central fleet location, if you want to do that.

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So what do you do with the used oil that is produced as a byproduct of your maintenance operations? There are a couple of options for a maintenance pro to consider:

Use as heating oil — The technology involved in the space heaters which burn the used oil has made great strides toward clean and efficient performance. It may not be possible to completely heat a facility with used oil, but used oil can be used to supplement the primary heating system.

As was mentioned earlier, waste oil generators are allowed to burn used oil in space heaters provided they burn only their own used oil and used oil provided by household do-it-yourself generators, the waste oil is not contaminated, the space heater has a capacity of less than 500,000 BTUs per hour, and the combustion gases are correctly vented.

Arrange for recycling/disposal — No maintenance pro should let used oil leave the facility without knowing exactly where it's going and with whom. Particularly if your used oil falls in the hazardous waste column, you need to keep in mind the "cradle-to-grave" rule about hazardous waste and who's responsible for it.

Even with recycling vendors though, how do you know if the guy is reputable? You can make a personal visit to some vendors you consider to be possibilities, or you can go with a "brand-name" company you can check out easily, or you could join an industry cooperative group to take advantage of group expertise (WAG is an example — Waste Audit Group sponsored by the American Trucking Associations). At the very least, make sure the transporter involved with the recycling vendor has a valid EPA ID number.

Be aware of state variances — Generators, processors, transporters, and burners of used oil should keep in mind that individual states have the option of creating used oil regulations that are more stringent than the federal or that impose additional management controls. A review of pertinent state regulations is always suggested to insure your compliance with them, as well as the federal regulations. For example, California, Connecticut and New Jersey are among about 15 states that consider used oil a hazardous or special waste and consequently have additional used oil management standards.

In addition to EPA's used oil management standards, your business may be required to comply with federal and state hazardous waste regulations if your used oil becomes contaminated from mixing it with hazardous waste. If used oil is mixed with hazardous waste, it probably will have to be managed as a hazardous waste.

Refrigerants

EPA regulatory requirements have been put in place to try to keep refrigerant chemicals from being introduced into the atmosphere. Two of these are commonly used in vehicle cooling and refrigeration systems, CFC-12 and HCFC-134a. One of the largest uses of CFC-12 in the U.S. is as a refrigerant in motor vehicle air conditioners (MVACs).

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Section 609 of the Act gives EPA the authority to establish requirements to prevent the release of refrigerants during the servicing of MVACs and to require recycling of refrigerants. Widespread refrigerant recycling reduces the demand for virgin CFC-12 and thus extends the time that it will be available. The following sections describe the requirements of the law and its potential impact on the service facilities.

Recycling vs. Reclamation.In the discussion below, recycling means the use of a machine to remove impurities and oil and then recharge the refrigerant into either the same car or a different car. Recycled refrigerant is not as pure as reclaimed refrigerant. Recycling occurs in the service shop.

Reclamation means the removal of all oil and impurities beyond that provided by on-site recycling equipment, and reclaimed refrigerant is essentially identical to new, unused refrigerant. Reclamation cannot be performed in the service shop. Rather, the shop generally sends refrigerant back to either the manufacturer or directly to a reclamation facility.

CFC 12

Handling CFC-12 — CFC-12, also known as R-12 or freon, has been determined to be an ozone-depleting chemical and is being phased out.

Venting — Section 608 of the Clean Air Act prohibits releasing CFC-12 into the atmosphere. The prohibition on venting CFC-12 has been in effect since 1992.

Section 609 Regulatory History — The original regulation promulgated under section 609 was published in July 1992. That regulation established standards for equipment that recovers and recycles CFC-12 refrigerant from motor vehicle air conditioners, rules for training and testing technicians to handle this equipment, and recordkeeping requirements for service facilities and for refrigerant retailers.

A supplemental final rule published in May 1995 established a standard for equipment that recovers, but does not recycle CFC-12, and training and testing technicians to handle this equipment.

Approved equipment technicians repairing or servicing CFC-12 MVACs must use either recover/recycle or recover-only equipment approved by EPA. Recover/recycle equipment cleans the refrigerant so that oil, air, and moisture contaminants reach acceptably low levels.

Technician training and certification — Technicians who repair or service CFC-12 and HFC-134a motor vehicle air conditioners must be trained and certified by an EPA-approved organization. Training programs must include information on the proper use of equipment, the regulatory requirements, the importance of refrigerant recovery, and the effects of ozone depletion. To be certified, technicians must pass a test demonstrating their knowledge in these areas. A list of approved testing programs is available from the EPA Hotline and the EPA website.

Recordkeeping requirements — Service shops must maintain records of the name and address of any facility to which refrigerant is

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sent. If refrigerant is recovered and sent to a reclamation facility, the name and address of that facility must be kept on file.

Service shops are also required to maintain records (on-site) showing that all service technicians are properly certified.

Certification requirements — Service shops must certify to EPA that they have acquired and are properly using approved refrigerant recovery equipment, and that each person using the equipment has been properly trained and certified. The certification statement shall include the name and address of the service establishment, the name of the equipment manufacturer, equipment model and serial number, and equipment date of manufacture. A sample certification form available at the EPA website shows the information that should be included in the signed statement.

Sales restrictions — Section 609 has long prohibited the sale of small cans of ozone-depleting refrigerants to anyone other than a certified technician. The sale of any size container of CFC-12 to anyone other than certified technicians was prohibited under section 608 of the Act beginning on November 14, 1994. This provision is intended to discourage “do-it-yourselfers” who recharge their own systems. Such individuals often release refrigerant because they typically do not have access to recovery/recycling equipment.

The EPA’s goal with the prohibition on public sale of CFC-12 is to encourage “do-it-yourselfers” to bring their cars and trucks to certified technicians who can properly fix air conditioners using approved equipment.

Retrofitting vehicles to alternative refrigerants — Although section 609 of the Act does not govern retrofitting, section 612 of the Act, which describes the Agency’s Significant New Alternatives Policy (SNAP) program, does require that when retrofitting a CFC-12 vehicle for use with another refrigerant, the technician must first extract the CFC-12, must cover the CFC-12 label with a label that indicates the new refrigerant in the system and other information, and must affix new fittings unique to that refrigerant.

In addition, if a technician is retrofitting a vehicle to a refrigerant that contains CFC-12, the technician must ensure that only barrier hoses are used in the A/C system. Finally, if the system includes a pressure-relief device, the technician must install a high-pressure compressor shutoff switch to prevent the compressor from increasing pressure until the refrigerant is vented.

HFC-134a

Handling HFC-134a — HFC-134a, also known as R-134a, is the most common replacement for CFC-12. It is still in production and available, but has some restrictions.

Venting — As is the case with CFC-12, section 608 of the Clean Air Act prohibits releasing HFC-134a refrigerant into the atmosphere. The prohibition on venting HFC-134a has been in effect since November 1995.

Section 609 Regulatory History — In March, 1996, EPA proposed a rule to require recycling of HFC-134a. The rule proposed standards for

Compliance Management

recover-only and recover/recycle equipment and rules for training and testing technicians to handle this equipment. EPA requested comments from the public about this proposed rule, and, after reviewing the comments, published a final rule on December 30, 1997. This final rule went into effect in 1998.

Technicians who repair or service HFC-134a MVACs must recover the refrigerant and either recycle it on-site, or send it off-site to a reclamation facility so that it may be purified according to ARI Standard 700. Technicians must use EPA-approved equipment to perform the refrigerant recovery and recycling. A list of approved recover/recycle and recover-only equipment is available from the Hotline and the EPA website.

Note that certain EPA-approved models can recycle both CFC-12 and HFC-134a refrigerants.

What about converting CFC-12 equipment for use with HFC-134a systems? EPA regulations prohibit technicians from changing fittings on the same unit back and forth so that the unit is used for CFC-12 in the morning, HFC-134a in the afternoon, then back to CFC-12 again, etc. The EPA regulations specify that when equipment is converted for use with a new refrigerant, the converted unit must be able to meet the applicable equipment standard set forth in the regulations for the refrigerant it is reclaiming or recycling.

The EPA intends to issue regulations placing certain restrictions on these retrofits in the future. Those restrictions may require that the manufacturer's service representative, rather than the automotive service technician, perform the retrofit, that a unit may only be retrofitted if retrofit procedures have been certified by an independent testing laboratory such as Underwriters Laboratories, and that an appropriate label is affixed to the unit.

In addition, the retrofitted unit must meet the technical specifications of SAE standard J2210 and must have the capacity to purify used refrigerant to SAE standard J2099 for safe and direct return to the air conditioner following repairs.

Currently, however, in the absence of any EPA regulations, a service facility may perform such a retrofit, or may have the equipment manufacturer's service representative perform the retrofit, as long as the fittings are changed in accordance with EPA's Significant New Alternative Policy (SNAP) program regulations.

The Agency cautions technicians, however, that even though recovering a given refrigerant using permanently-converted equipment is legal, it may not be technically desirable. The equipment is designed to be compatible with specific refrigerants, and incompatible materials may cause short circuits, damage to seals, and compressor failure.

Technicians should check with the recovery equipment manufacturer for recommendations about the recovery of refrigerants other than the refrigerant the equipment was originally intended to recover. Conversion of recovery equipment for use with other refrigerants may also invalidate any warranties offered by the equipment manufacturer.

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Technician training and certification — Technicians who repair or service HFC-134a MVACs must be trained and certified by an EPA-approved organization. If a technician is already trained and certified to handle CFC-12, he/she does not need to be recertified to handle HFC-134a.

Recordkeeping requirements — Service shops must certify to EPA that they own approved HFC-134a equipment. Note that this certification is a one-time requirement, so that if a shop purchased a piece of CFC-12 recycling equipment in the past, and sent the certification to EPA, the shop does not need to send a second certification to EPA when it purchases a second piece of equipment, no matter what refrigerant that equipment is designed to handle.

If refrigerant is recovered and sent to a reclamation facility, the shop must retain the name and address of that reclaimer.

Sales restrictions — Right now, there is no restriction on the sale or purchase of HFC-134a, so anyone may purchase it.

Other refrigerants

Handling other refrigerants that substitute for CFC-12 — The EPA has issued a list of approved replacements for CFC-12 (provided below). Section 608 of the Clean Air Act prohibits venting any of the substitutes into the atmosphere. As with CFC-12 and HFC-134a, technicians working on MVAC systems containing these alternatives must have been trained in accordance with Section 609. If the technician has been trained on either CFC-12 or HFC 134a, the technician does not need to be retrained. Here is a list of the approved replacements:

Refrigerant Name	Date Approved	Manufacturer
HFC-134a	3/18/94	Several
FRIGC FR-12	6/13/95	Intercool Distribution
Free Zone/RB-276	5/22/96	Hi Tech Refrigerants, LLC
Ikon-12	5/22/96	Ikon Corp.
R-406A/GHG	10/16/96	People's Welding
GHG-HP	10/16/96	People's Welding
GHG-X4/Autofrost/Chill-It	10/16/96	People's Welding and McMullen Oil Products
Hot Shot/Kar Kool	10/16/96	ICOR
Freeze 12	10/16/96	Technical Chemical
GHG-X5	6/3/97	People's Welding
SP34E	12/18/00	Solpower
RS-24	12/20/02	Refrigerant Products Ltd
R-420A	3/29/06	RMS of Georgia

Using older equipment to recover blended refrigerants — Technicians have a number of choices in recovering new refrigerants. One option is that a technician may permanently dedicate an older piece of equipment the shop owns to recovering one or more blend refrigerants. The technician may also use this equipment to recover contaminated CFC-12 and HFC-134a and other “mystery mixtures.” This equipment,

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however, may not be used to recover uncontaminated CFC-12 or HFC-134a. Refrigerant recovered using this kind of “junk” tank must then be shipped off-site for reclamation or destruction.

Using new equipment to recover blends — Another option for recovering blended refrigerant is to use a new piece of EPA-approved equipment designed to recover, but not recycle, any single, specific refrigerant. The EPA regulation published in December 1997, includes an appendix that describes the standards that this new equipment must meet. In addition, EPA is currently working with independent testing laboratories and equipment manufacturers to devise a standard for new equipment that can recover, but not recycle, multiple refrigerants and contaminated CFC-12 and HFC-134a.

Equipment used for specific refrigerant — All of the EPA approved substitute refrigerants listed above have had equipment specifications assigned to them. These specifications include connection sizes and color coding. Here is a table showing the specifications:

Refrigerant	High Side Service Port			Low Side Service Port		
	Diameter (inches)	Pitch (threads/inch)	Thread Direction	Diameter (inches)	Pitch (threads/inch)	Thread Direction
CFC-12 (post-1987)	9/16"	24	Right	7/16"	20	Right
CFC-12 (pre-1987)	7/16"	20	Right	7/16"	20	Right
HFC-134a	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect
Freeze 12	7/16	14	Left	8/16	18	Right
Free Zone/ RB-276	8/16	13	Right	9/16	18	Right
Hot Shot	10/16	18	Left	10/16	18	Right
McCool Chill-It	6/16	24	Left	7/16	20	Left
GHG-X4/ Autofrost	.305	32	Right	.368	26	Right
GHG-X5	8/16	20	Left	9/16	18	Left
R-406A	.305	32	Left	.368	26	Left
GHG-HP	not yet developed (NYD)	NYD	NYD	NYD	NYD	NYD
Ikon-12/ Ikon A	NYD	NYD	NYD	NYD	NYD	NYD
FRIGC FR-12	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect
SP34E	7/16	14	Right	8/16	18	Left
R-426A (RS-24, new formulation)	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect	Unique quick-connect
R-420A	0.5625 (9/16)	18	Right	0.5625 (9/16)	18	Left

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Recycling blends as of June 1, 1998 — The EPA allows recycling of refrigerant blends used in motor vehicle air conditioning systems (MVACs), provided that recycling equipment meets the Underwriters Laboratories (UL) requirements and the refrigerant is returned to the vehicle from which it was removed. The only exception is for fleets of vehicles with a common owner; recycled blend refrigerant may be moved among vehicles within such a fleet. EPA detailed this policy in a June 1, 1998 open letter to the industry.

Recover/recycle equipment for use with substitutes — EPA currently prohibits the conversion of existing CFC-12 or HFC-134a recycling equipment for either temporary or permanent use with a blend refrigerant, unless the equipment is used only to recover, but not to recycle, the specific refrigerant.

Recordkeeping Requirements — Service facilities that work on vehicles that use substitutes must certify to EPA that they own approved equipment designed to service these refrigerants. Note that this certification is a one-time requirement, so that if a shop purchased a piece of CFC-12 or HFC-134a recycling equipment in the past, and sent the certification to EPA, the shop does not need to send a second certification to EPA when it purchases a second piece of equipment, no matter what refrigerant that equipment is designed to handle.

If refrigerant is recovered and sent to a reclamation facility, the shop must retain the name and address of that reclaimer.

One final word on refrigerants. As of 2010 HCFC-22 (which is also referred to as R-22 or by one of its trade names, Freon® 22 and HCFC-142b) will begin to be phased out. Starting January 1, 2010, the production and import of HCFC-22 for newly manufactured equipment will stop in the United States. The production/import limit will be set at a level that is suitable for servicing existing equipment.

Between 2010 and 2020, HCFC-22 and HCFC-142b will be produced or imported for the exclusive purpose of servicing existing equipment.

As of January 1, 2015, as part of the phaseout of all HCFCs, the sale and use of HCFC-22 will be banned except for transformation or servicing refrigeration and air-conditioning applications. EPA will not permit newly manufactured HCFC-22 to be used for charging new equipment.

Starting January 1, 2020, the production and import of HCFC-22 will be banned entirely in the United States. Once this happens, only recycled/reclaimed or stockpiled quantities of HCFC-22 will be available for servicing existing equipment.

Used batteries

If you generate, collect, transport, store, or regenerate lead-acid batteries for reclamation purposes, you may be exempt from certain hazardous waste management requirements. Use the following table to determine which requirements apply to you. Alternatively, you may choose to manage your spent lead-acid batteries under the Universal Waste rule in 40 CFR Part 273.

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If your batteries * * *	And if you * * *	Then you * * *	And you * * *
(1) Will be reclaimed through regeneration (such as by electrolyte replacement).		are exempt from 40 CFR Parts 262 (except for §262.11), 263, 264, 265, 266, 268, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR Parts 261 and 262.11 of this chapter.
(2) Will be reclaimed other than through regeneration.	generate , collect, and/or transport these batteries.	are exempt from 40 CFR Parts 262 (except for §262.11), 63, 264, 265, 266, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR Parts 261 and 262.11, and applicable provisions under Part 268.
(3) Will be reclaimed other than through regeneration.	store these batteries but you aren't the reclaimer.	are exempt from 40 CFR Parts 262 (except for §262.11), 263, 264, 265, 266, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR Parts 261, 262.11, and applicable provisions under Part 268.
(4) Will be reclaimed other than through regeneration.	store these batteries before you reclaim them.	must comply with 40 CFR 266.80(b) and as appropriate other regulatory provisions described in 266.80(b).	are subject to 40 CFR Parts 261, 262.11, and applicable provisions under.
(5) Will be reclaimed other than through regeneration.	don't store these batteries before you reclaim them.	are exempt from 40 CFR Parts 262 (except for §262.11), 263, 264, 265, 266, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR 262 (except for §262.11) Parts 261, 262.11, and applicable provisions under Part 268.

Remember, you may not be able to treat lead-acid batteries as Universal Waste. This is because the electrolyte contained inside the battery will disallow classifying them as Universal Waste in some cases!

EPA regs specifically set out procedures for recycling lead-acid batteries. The batteries are only “green” as long as they stay in one piece from the time they leave your shop until they reach an approved recycler for breakdown in a safe environment.

“Junkers” will break up the batteries they buy with a sledge hammer and haul the lead plates to a smelter. Since the battery electrolyte contains sulfuric acid, in addition to the lead plates, you are obviously dealing with a hazardous waste if the battery is broken open before it reaches a proper recycling point.

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If you risk using a “junker” you could be held responsible for his actions under Superfund “cradle-to-grave” waste legislation. A current horror story has 20 or more potentially responsible parties (PRPs) being held accountable for cleanup and legal fees attached to a Superfund site in Virginia, after a battery-breaking operation declared bankruptcy and disappeared when the operation was closed down by regulators in 1985. Research and business records helped identify the 20 PRPs who are now being held responsible for more than \$20 million. This case is only an example of what can happen to a fleet or shop manager caught in the web of an unscrupulous junker. Don’t let it happen to you.

Be sure your employees know how to handle batteries correctly, along with storing them. If you are careful, you can avoid most breakage and acid spills. Keep these tips in mind:

- Store batteries right-side up, preferably on a skid so they are raised off the ground and away from potential damage by water, rain, etc.
- Store batteries in a dry area away from any source of flame or spark.
- Don’t try to move batteries alone — they should be lifted by two people, using a carrier.
- Don’t put excess pressure on the ends of a lead-acid battery.
- Always use PPE that will protect from the effects of the acid.

The best practice with used batteries is to establish a recycling system with a reputable supplier or recycler. This keeps them classified as Universal Waste and avoids many of the problems associated with the disposal of batteries.

Underground storage tanks

Not all UST systems are federally regulated, although they may be regulated by the state or local agency that implements an UST program, and you should first check with them.

A federally-regulated UST is defined as “any one or combination of tanks (including underground pipes connected thereto) that is used to contain an accumulation of regulated substances, and the volume of which (including underground pipes connected thereto) is 10 percent or more beneath the surface of the ground.” Federally-regulated USTs meet one or more of the following criteria:

- Have a capacity of more than 110 gallons.
- Contain regulated substances as defined as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act (with exceptions).
- Do not contain hazardous wastes regulated (i.e., listed or identified) under Subtitle C of the Solid Waste Disposal Act or a mixture of such hazardous waste and another regulated substance.

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- Are not part of a wastewater treatment system that is part of a wastewater treatment facility regulated under Section 402 or 307(b) of the Clean Water Act.

Under 40 CFR Part 280.11, the following groups of tanks are not included in the definition of an UST:

- Farm or residential tanks of 1,100 gallons or less capacity used for storing motor fuel for noncommercial purposes.
- Tanks used for storing heating oil for consumptive use on the premises where stored.
- Septic tanks.
- Tank systems in pipeline facilities (including gathering lines) regulated under the Natural Gas Pipeline Safety Act of 1968 (49 U.S.C. App. 1671 et seq.), the Hazardous Liquid Pipeline Safety Act of 1979 (49 U.S.C. App. 2001, et seq.), or in an intrastate pipeline facility regulated under State laws comparable to the provisions of law referred to in the two previous clauses.
- Surface impoundments, pits, ponds, or lagoons.
- Storm water or wastewater collection systems.
- Flow-through process tanks.
- Liquid trap or associated gathering lines directly related to oil or gas production and gathering operations.
- Tanks in underground areas such as basements, cellars, and mineworking drifts, shafts or tunnels, if they are located on or above the surface of the floor.

You should refer to 40 CFR Part 280 for a complete definition. For general questions about the federal UST program, you can contact EPA's RCRA, Superfund, and EPCRA Hotline at (800) 424-9346.

Requirements for USTs installed after December 22, 1988

The following requirements apply to USTs installed after December 22, 1988:

- The tank and piping must be certified as being properly installed according to industry codes.
- The tank must be equipped with spill and overfill prevention equipment.
- Correct tank filling practices must be followed.
- The tank and piping must be protected from corrosion.
- The tank and piping must be equipped with leak detection.

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Requirements for USTs installed before December 22, 1988

USTs installed before December 22, 1988, must comply with the following by December 1998:

- Steel USTs and piping must have corrosion protection; and
- USTs must have spill and overfill prevention equipment.

USTs that are not upgraded to meet the new UST requirements must be removed from service.

Requirements on USTs and UST operators as a result of the Energy Policy of 2005

On August 8, 2005, President Bush signed the Energy Policy Act of 2005. Title XV, Subtitle B of this act (entitled the Underground Storage Tank Compliance Act) contains amendments to Subtitle I of the Solid Waste Disposal Act — the original legislation that created the underground storage tank (UST) program. This new law significantly affects federal and state underground storage tank programs, will require major changes to the programs, and is aimed at reducing underground storage tank releases to our environment.

The underground storage tank provisions of the Energy Policy Act focus on preventing releases. Among other things, it expands eligible uses of the Leaking Underground Storage Tank (LUST) Trust Fund and includes provisions regarding inspections, operator training, delivery prohibition, secondary containment and financial responsibility, and cleanup of releases that contain oxygenated fuel additives.

Leaking USTs

40 Part CFR 280 describes the response required upon discovering that an UST is leaking. In general, an UST owner or operator is required to perform the following:

- Immediately mitigate fire and explosion hazards by containing the leak or spill;
- Within 24 hours, report the release to the appropriate regulatory authority;
- Determine the extent of soil or groundwater contamination present;
- Within 20 days of discovering the release, report cleanup progress to the appropriate regulatory authority;
- Perform a full-site investigation to determine whether the release has impacted the environment;
- Develop a plan for removing the released substance from the groundwater, if applicable; and
- Within 45 days of discovering the release, report the results of the site investigation and the plan for remediating groundwater to the appropriate regulatory authority.

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Depending upon the results of the site investigation, further remediation, monitoring, or reporting may be required by the regulatory authority.

Closing USTs

USTs may be closed temporarily or permanently. Temporary closure of an UST is required for USTs that are not used for 3 to 12 months. An UST may be permanently closed by either removing the UST from the ground or by filling the UST in the ground with an inert solid material such as sand.

Notification forms

On November 8, 1985, EPA published a notification form to be used to provide information about underground storage tanks. This form can be found in Appendix I to Section 280.

However, the regulation specifies that designated state or local agencies, not EPA, receive the notification. EPA has provided in Part 280, Appendix II a list of these agencies. Owners of underground storage tanks are advised to consult this list to determine:

1. To whom the notification must be sent, and
2. Whether the state in which the underground tank is located requires the use of the EPA form or an alternate state form for notification purposes.

Notification requirements

On or before May 8, 1986, every owner of an underground storage tank was required to submit notice of the existence of the tank to the appropriate agency.

Tanks taken out of service after January 1, 1974, must have a notice sent by May 8, 1986 (unless the tank has been removed from the ground).

Any owner who brings into use an underground tank after May 8, 1986, has 30 days to submit a notice of the tank's existence.

To ensure that the UST requirements become as widely known as possible, there is a non-owner obligation. After October 24, 1988, any person who sells a UST must notify the purchaser of the owner's notification obligations under this regulation. The form provided in Part 280, Appendix III may be used to comply with this requirement.

Interim prohibitions for deferred UST systems

No underground storage tanks under deferral (wastewater treatment systems, holding radioactive material, etc.) may be installed for the purpose of storing regulated substances unless such tank:

1. Will prevent releases due to corrosion or structural failure for the life of the tank.

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2. Is designed to prevent the release of any stored substance (e.g., is cathodically protected, constructed of noncorrosive material, or steel clad with a noncorrosive material).

3. The material used in the construction or lining of the tank is compatible with the substance to be stored.

Performance standards for new UST systems

In order to prevent releases due to structural failure, corrosion, or spills and overfills, new UST systems must meet the following requirements.

Tanks: Each tank must be properly designed and constructed, and meet national standards in one of the following construction methods.

1. Fiberglass-reinforced plastic.
2. Steel construction and cathodically protected.
3. Steel-fiberglass-reinforced-plastic composite.
4. Metal without additional corrosion protection measures, when feasible.

Pipings: Similar to tanks, pipings must be properly designed and constructed, and meet national standards, using one of the following methods of construction.

1. Fiberglass-reinforced plastic.
2. Steel construction and cathodically protected.
3. Metal without additional corrosion protection measures, when feasible.

Spill and overfill prevention equipment: Equipment must be used that will prevent spilling and overfilling when a product is transferred to the UST system. Alternatives to this may be used if they can be shown to be as effective at protecting human health and the environment.

All tanks and pipings must be properly installed. Owners/operators must ensure that one of the six methods of certification, testing, or inspection (found in Section 280.20(e)) is used to demonstrate compliance by providing a certificate of compliance on the UST notification form.

Release detection

Owners and operators of new and existing UST systems must provide a method of release detection that:

1. Can detect a release from any portion of the tank and the connected underground piping that routinely contains product.
2. Is installed, calibrated, operated, and maintained in accordance with the manufacturer's instructions, including routine maintenance and service checks for operability or running condition.
3. Meets the established performance requirements with any performance claims and their manner of determination described in writing by the equipment manufacturer or installer.

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When a release detection method operated in accordance with the performance standards indicates a release may have occurred, owners and operators must notify the implementing agency.

Any existing UST system that cannot apply a method of release detection that complies with these requirements must complete the closure procedures by the date on which release detection is required for that UST system.

Financial responsibility for petroleum USTs

EPA's financial responsibility rule for petroleum USTs became effective January 24, 1989 except for certain specified petroleum UST owners/operators. All petroleum marketing firms owning 1-12 USTs at more than one facility or fewer than 100 USTs at a single facility, and non-marketers with net worth of less than \$20 million have until December 31, 1993, according to the EPA final rule. That is a year after the date by which local governments must be in compliance. More than 40 states have already created assurance funds to help UST owners, according to the EPA. For information on the final rule and financial responsibility call the EPA/RCRA/Superfund Hotline at 800-424-9348. These financial responsibility requirements are applicable to owners or operators of "petroleum UST systems" with the following exceptions:

- Federal or state entities that own or operate USTs containing petroleum.
- Owners and operators of USTs excluded from the technical standards.

All owners or operators must maintain an annual aggregate of \$1 million or \$2 million depending on the number of USTs owned or operated.

In order to cover costs of corrective action and third party liability, all owners and operators of USTs must obtain financial assurance in the following amounts.

\$1,000,000 per occurrence for facilities:

- that produce, refine or market petroleum; and
- whose USTs have an average monthly throughput of 10,000 gallons.

\$500,000 per occurrence for facilities:

- that do not produce, refine or market petroleum; and
- whose USTs have an average monthly throughput of less than 10,000 gallons.

UST owners or operators may satisfy the requirements using the following mechanisms: insurance or risk retention group coverage, surety bond, guarantee, letter of credit, financial test of self-insurance, trust fund, a state-required mechanism, or a state fund or other state assurance.

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Aboveground storage tanks

What about aboveground storage?

An aboveground storage tank (AST) is a tank whose entire surface area is completely aboveground. Also, the entire surface area of the tank (including the tank bottom) can be visually inspected (40 CFR §260.10). An underground storage tank (UST), on the other hand, is a “tank” whose entire surface area is totally below the surface of and covered by the ground (40 CFR §260.10).

A “tank” is a stationary device which is constructed primarily of non-earthen materials (e.g., wood, concrete, steel, plastic) which provide structural support (40 CFR §260.10).

Replacing underground storage tanks with aboveground storage is one option that some fleets are taking, but it is not an automatic cure-all for the environmental problems attached to USTs. You may just be trading one set of problems for another. What kind of environmental risk can be posed by aboveground storage tank systems (ASTs)?

Federal AST requirements under 40 CFR Part 112

All ASTs should have a secondary containment area that contains spills and allows leaks to be more easily detected. The containment area surrounding the tank should hold 110 percent of the contents of the largest tank plus freeboard for precipitation. Secondary containment for ASTs must be impermeable to the materials being stored. Methods include berms, dikes, liners, vaults, and double-walled tanks. A manually controlled sump pump should be used to collect rain water that may accumulate in the secondary containment area. Any discharge should be inspected for petroleum or chemicals prior to being dispensed.

Routinely monitor ASTs to ensure they are not leaking. An audit of a newly-installed tank system by a professional engineer can identify and correct problems such as loose fittings, poor welding, and poorly-fit gaskets. After installation, inspect the tank system periodically to ensure it is in good condition. Depending on the permeability of the secondary containment area, more frequent containment area checks may be necessary. Areas to inspect include tank foundations, connections, coatings, tank walls, and the piping system. Integrity testing should be done periodically by a qualified professional and in accordance to applicable standards. Another method is tracking gallons removed from the tank, checking tank outage to determine how much is in the tanks, and tracking filling. This accounting system can be set up by a professional engineer familiar with the tank.

If an AST has remained out of service for a year or more, many States require owners to continue to maintain and monitor the tank, declare the tank inactive, or remove it. If the tank is declared inactive, remove all substances from the AST system (including pipes) and completely clean the inside. Secure tanks by bolting and locking all valves, as well as capping all gauge openings and fill lines. Clearly label tanks with the date and the words “Out of Service.” Samples may be required when removing tanks to determine if any contamination has occurred. Most

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States require out-of-service tanks to be inspected and meet leak detection requirements before they are put back into service.

Additional AST prevention measures

The following prevention measures go beyond the Federal regulations under 40 CFR Part 112, but are highly recommended.

The location of the facility must be considered in relation to drinking water wells, streams, ponds and ditches (perennial or intermittent), storm or sanitary sewers, wetlands, mudflats, sandflats, farm drain tiles, or other navigable waters. The distance to drinking water wells and surface water, volume of material stored, worst-case weather conditions, drainage patterns, land contours, and soil conditions must also be taken into account.

ASTs should have corrosion protection for the tank. Options include elevating tanks, resting tanks on continuous concrete slabs, installing double-walled tanks, cathodically protecting the tanks, internally lining tanks, inspecting tanks according to American Petroleum Institute standard, or a combination of the options listed above. All underground piping to the tank should be double-walled or located above ground or cathodically protected so you can inspect it when it fails.

To maximize system safety, seal the floors, containment area, and sump pump pit with an appropriate coating (e.g., petroleum-resistant coating). Any accumulated water should be inspected for petroleum or chemicals prior to discharge

Accumulated minor spillage, over time, may result in a film or sheen on collected rain water, making it unsuitable for discharge to the soil or drains. Periodic cleanup of the containment areas (e.g., sweeping with a broom and using limited absorbent) can prevent unnecessary dirt and contaminant buildup.

While not a preventative measure for source-water protection, preventing evaporation has economic and air-quality benefits. To keep out rain and reduce evaporation losses and moisture condensation, paint tanks a reflective color, install them in an east-west direction, install a low-pressure valve on top of the tank, and cover the structure. A roof structure covering a 10,000 gallon tank will conserve 600 to 1,000 gallons of gasoline per year, which would have escaped by evaporation without the shade cover.

Some potential problems with ASTs are:

- spillage,
- failure of tank bottoms,
- ground surface contamination, and
- ground water contamination because of migration from the tanks.

Concerning the storage of hazardous waste in ASTs, you must look in the hazardous waste regulations (Parts 260 through 268) to determine what is required. Parts 262, 264 and 265 of the Resource Conservation and

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Recovery Act (RCRA), Subtitle C, also impact ASTs as these requirements apply to hazardous waste generators and treatment, storage, and disposal facilities.

Some ASTs fall under OSHA requirements (29 CFR §1910.106) if they contain flammable or combustible liquids. The rules apply to liquids with flashpoints below 200°F. In this case, the objective of the regulations is to protect workers from fires, rather than protecting the environment from spills.

Be aware, the majority of regulations affecting ASTs are found at the state and local level.

Check with your state and local agencies to see if there are more stringent AST requirements that you need to know about.

Still interested?

If you are considering a move to an AST, keep these considerations in mind: cost (be sure to include any required secondary containment), deliveries (because an AST requires a pumping system, there could be more system problems), climate conditions (ASTs are more susceptible to extremes of heat and cold), safety (ASTs are more likely to catch fire), space availability and accessibility (remember to figure in sufficient space for the tank and all the secondary containment equipment, as well as piping), aesthetics and security (be sure to consider how the tank is going to look in the community — it does make a difference in how it's accepted).

Spill Prevention, Control and Countermeasure Plan

If you store oil you may be regulated under the Spill Prevention, Control and Countermeasure (SPCC) regulations contained in 40 CFR Part 112. The SPCC regulations establish procedures to prevent the discharge of oil into navigable waters.

Any entity that stores more than 42,000 gallons in a below-ground tank, and more than 1,320 gallons in an aboveground storage tank, and that is in a location where a spill may affect a navigable water, is subject to this requirement.

The SPCC Plan rule includes requirements for oil spill prevention, preparedness, and response to prevent oil discharges to navigable waters and adjoining shorelines. The rule requires specific facilities to prepare, amend, and implement SPCC Plans.

The SPCC plan must detail the equipment, workforce, procedures, and steps to prevent, control, and provide adequate countermeasures to a discharge.

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Wastewater

Clean Water Act and NPDES

Water pollution degrades surface waters making them unsafe for drinking, fishing, swimming, and other activities. As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality.

Wastewater discharges from industrial sources may contain pollutants at levels that could affect the quality of receiving waters. The NPDES permit program establishes specific requirements for discharges from industrial sources. Depending on the type of industrial or commercial facility you operate, more than one NPDES program may apply. For example, the stormwater that runs off from the property of an industrial facility or from a construction site may require a NPDES permit under the stormwater program. An industrial facility may also discharge wastewater to a municipal sewer system and be covered under the NPDES pretreatment program. The industrial facility may also discharge wastewater directly to a surface water and require an individual or general NPDES permit. Finally, many industrial facilities, whether they discharge directly to surface water or to a municipal sewer system, are covered by effluent limitation guidelines and standards.

Pretreatment program

Publicly-owned treatment works (POTWs) collect wastewater from homes, commercial buildings, and industrial facilities and transport it via a series of pipes, known as a collection system, to the treatment plant. Here, the POTW removes harmful organisms and other contaminants from the sewage so it can be discharged safely into the receiving stream. Generally, POTWs are designed to treat domestic sewage only.

However, POTWs also receive wastewater from nonresidential users. The General Pretreatment Regulations establish responsibilities of Federal, State, and local government, industry and the public to implement Pretreatment Standards to control pollutants from the industrial users (IUs) which may pass through or interfere with POTW treatment processes or which may contaminate sewage sludge.

All IUs, whether or not subject to any other National, State, or local pretreatment requirements, are subject to the general and specific prohibitions identified in 40 CFR §§403.5(a) and (b), respectively (the Pretreatment Regulations).

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Basically, IUs are responsible for the prevention of indirect discharge of pollutants (so called because the discharge of pollutants is into a POTW, not directly in the water stream).

The National Pretreatment Program is charged with controlling 126 specific Priority Pollutants. These pollutants are restricted from discharge into sewer systems. Here is a list of these pollutants:

001 Acenaphthene	067 Butyl benzyl phthalate
002 Acrolein	068 Di-N-Butyl Phthalate
003 Acrylonitrile	069 Di-n-octyl phthalate
004 Benzene	070 Diethyl Phthalate
005 Benzidine	071 Dimethyl phthalate
006 Carbon tetrachloride	072 benzo(a) anthracene
007 Chlorobenzene	073 Benzo(a)pyrene
008 1,2,4-trichlorobenzene	074 Benzo(b) fluoranthene
009 Hexachlorobenzene	075 Benzo(b) fluoranthene
010 1,2-dichloroethane	076 Chrysene
011 1,1,1-trichloroethane	077 Acenaphthylene
012 Hexachloroethane	078 Anthracene
013 1,1-dichloroethane	079 Benzo(ghi) perylene
014 1,1,2-trichloroethane	080 Fluorene
015 1,1,2,2-tetrachloroethane	081 Phenanthrene
016 Chloroethane	082 Dibenzo(h) anthracene
018 Bis(2-chloroethyl) ether	083 Indeno (1,2,3-cd) pyrene
019 2-chloroethyl vinyl ethers	084 Pyrene
020 2-chloronaphthalene	085 Tetrachloroethylene
021 2,4,6-trichlorophenol	086 Toluene
022 Parachlorometa cresol	087 Trichloroethylene
023 Chloroform	088 Vinyl chloride
024 2-chlorophenol	089 Aldrin
025 1,2-dichlorobenzene	090 Dieldrin
026 1,3-dichlorobenzene	091 Chlordane
027 1,4-dichlorobenzene	092 4,4-DDT
028 3,3-dichlorobenzidine	093 4,4-DDE
029 1,1-dichloroethylene	094 4,4-DDD
030 1,2-trans-dichloroethylene	095 Alpha-endosulfan
031 2,4-dichlorophenol	096 Beta-endosulfan
032 1,2-dichloropropane	097 Endosulfan sulfate
033 1,2-dichloropropylene	098 Endrin
034 2,4-dimethylphenol	099 Endrin aldehyde
035 2,4-dinitrotoluene	100 Heptachlor
036 2,6-dinitrotoluene	101 Heptachlor epoxide
037 1,2-diphenylhydrazine	102 Alpha-BHC
038 Ethylbenzene	103 Beta-BHC
039 Fluoranthene	104 Gamma-BHC
040 4-chlorophenyl phenyl ether	105 Delta-BHC
041 4-bromophenyl phenyl ether	106 PCB-1242
042 Bis(2-chloroisopropyl) ether	107 PCB-1254
043 Bis(2-chloroethoxy) methane	108 PCB-1221
044 Methylene chloride	109 PCB-1232
045 Methyl chloride	110 PCB-1248
046 Methyl bromide	111 PCB-1260
047 Bromoform	112 PCB-1016
048 Dichlorobromomethane	113 Toxaphene

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051 Chlorodibromomethane	114 Antimony
052 Hexachlorobutadiene	115 Arsenic
053 Hexachlorocyclopentadiene	116 Asbestos
054 Isophorone	117 Beryllium
055 Naphthalene	118 Cadmium
056 Nitrobenzene	119 Chromium
057 2-nitrophenol	120 Copper
058 4-nitrophenol	121 Cyanide, Total
059 2,4-dinitrophenol	122 Lead
060 4,6-dinitro-o-cresol	123 Mercury
061 N-nitrosodimethylamine	124 Nickel
062 N-nitrosodiphenylamine	125 Selenium
063 N-nitrosodi-n-propylamine	126 Silver
064 Pentachlorophenol	127 Thallium
065 Phenol	128 Zinc
066 Bis(2-ethylhexyl) phthalate	129 2,3,7,8-TCDD

As well as regulating these 126 pollutants, the Pretreatment program also protects POTW from materials that may pass through, interfere with the operation of, or damage the POTW or the collection system (sewer piping). This is referred to as the general Pretreatment Requirement.

General prohibitions forbid IUs from discharging any pollutant to a POTW that causes pass-through of a toxin or interferes with the function of the POTW. Specific prohibitions forbid eight categories of pollutant discharges as follows:

- Discharges containing pollutants which create a fire or explosion hazard in the POTW, including but not limited to, wastestreams with a closed-cup flashpoint of less than 140°F (60°C) using the test methods specified in 40 CFR §261.21.
- Discharges containing pollutants causing corrosive structural damage to the POTW, but in no case discharges with a pH lower than 5.0, unless the POTW is specifically designed to accommodate such discharges.
- Discharges containing pollutants in amounts causing obstruction to the flow in the POTW resulting in interference.
- Discharges of any pollutants released at a flow rate and/or concentration which will cause interference with the POTW.
- Discharges of heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40°C (104°F) unless the Approval Authority, upon request of the POTW, approves alternative temperature limits.
- Discharges of petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass-through.

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- Discharges which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems.
- Discharges of trucked or hauled pollutants, except at discharge points designated by the POTW.

These prohibited discharge standards are intended to provide general protection for POTWs and the water stream in the area. However, their lack of specific pollutant limitations creates the need for additional controls, namely categorical pretreatment standards and local limits.

Category (CIU) pretreatment standard

Industries identified as major sources of toxic pollutants are typically targeted for effluent guideline and categorical standard development. IUs that are in one of 51 categories that are referred to as “category industrial users,” or CIUs, and are subject to more stringent permitting and pretreatment procedures than regular IUs.

Categorical pretreatment standards (i.e., categorical standards) are national, uniform, technology-based standards that apply to discharges to POTWs from CIUs and limit the indirect discharge of specific pollutants.

Effluent limitations guidelines (ELGs) are similar and are discussed later. The ELGs were developed in conjunction with categorical standards to limit the discharge of pollutants from facilities that discharge directly to waters of the U.S. (i.e., direct dischargers) as well as to POTWs.

SIUs

IUs that have a significant output (an IU that discharges an average of 25,000 gallons per day or more; an IU that contributes 5 percent or more of the average input of the POTW treatment plant; an IU designated by the Control Authority as such because of its reasonable potential to adversely affect the POTW’s operation or violate any pretreatment standard or requirement; or an IU subject to Federal categorical pretreatment standards) are referred to as significant industrial users (SIUs).

SIUs are not the same as CIUs (the CIU standards are based on industry, not volume) but they also have more stringent permitting and pretreatment requirements than the normal IUs.

Effluent limitations guidelines (ELGs)

ELGs not only dictate the indirect discharge of wastewater into a POTW (the pretreatment program and permits), but also mandate standards for the direct discharge of wastewater. If an industrial facility will be discharging wastewater from its facility directly into the waters of the U.S., the discharge must meet the ELGs.

Any facility that is going to directly discharge any wastewater must meet the ELG for the industry. The only segment of the transportation industry identified in the ELGs is the transport washout industry. Facilities

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that are involved in washing out tank vehicles are subject to the ELG regulations.

Groundwater protection

Septic systems are commonly found in rural and suburban areas where populations also rely on ground water for drinking water. Many septic systems are located in close proximity to private drinking water wells or public water systems that use ground water sources. When septic systems are properly sited, designed, constructed, and operated, they pose a minimal threat to drinking water sources. Alternatively, poorly designed, maintained, and operated septic systems can contaminate ground water and surface water with nutrients, toxic chemicals, and pathogens.

Septic systems are designed solely to treat domestic sanitary waste. The disposal of industrial or commercial waste into a septic system can seriously inhibit wastewater treatment and cause the system to fail. More important, chemicals can pass through the system, enter the ground water, and pose a serious contamination threat.

EPA is directed by the Safe Drinking Water Act (SDWA) to establish minimum federal requirements for state and tribal Underground Injection Control (UIC) Programs to protect underground sources of drinking water from contamination caused by underground injection activities. Protection includes the oversight of construction, operation, and closure of injection wells. A septic system is required to meet UIC Program requirements and is considered a Class V injection well if either one of the following conditions is met:

- The septic system, regardless of size, receives any amount of industrial or commercial wastewater (also known as industrial waste disposal wells or motor vehicle waste disposal wells); or
- The septic system receives solely sanitary waste from multiple-family residences or a non-residential establishment and has the capacity to serve 20 or more persons per day (also known as large-capacity septic systems).

Owners or operators of industrial waste disposal wells and large-capacity septic systems must meet state and federal requirements. The minimum federal requirements for Class V injection wells are:

- Obey the non-endangerment performance standard prohibiting injection that allows the movement of fluids containing *any* contaminant into underground sources of drinking water, and
- Provide inventory information (including facility name and location, legal contact name and address, ownership information, nature and type of injection wells, and operating status of the injection wells) to the state or EPA regional UIC Program.

A motor vehicle waste disposal well (MVWD) is a shallow disposal system that receives fluids from vehicle repair or maintenance activities in motor vehicle repair shops. MVWD wells are regulated as Class V injection wells (the same as septic systems).

Typical MVWD wells are connected to floor drains or sinks in service bays and can be a septic system or drywell. However, any underground

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system that receives motor vehicle waste is considered to be a motor vehicle waste disposal well. For example, cesspools, catchbasins, and sink holes are considered MVWD wells if they receive motor vehicle waste.

During normal vehicle repair and maintenance, fluids such as engine oil or solvents may drip or spill into floor drains or sinks in service areas. Motor vehicle wastes include engine oil, transmission fluid, power steering fluid, brake fluid, antifreeze, solvents, and degreasers. If you dispose of these fluids through a MVWD well, they may contaminate ground water. Therefore, EPA regulates these wells to prevent ground water contamination.

In 1999, EPA published the Class V rule, which requires owners and operators of MVWD wells to meet the following additional requirements:

- New MVWD wells are banned as of April 2000. Therefore, motor vehicle maintenance and repair facilities can no longer construct or install wastewater disposal devices that allow service wastewater to enter sinks and floor drains connected to septic systems.
- Existing wells in regulated areas are banned and are required to be closed by January 2007 if they are in a sensitive ground water area. States and EPA regions may allow some MVWD wells to continue operating under a UIC permit or, in limited cases, to allow the owner to convert them to another type of well. Contact the appropriate EPA regional or state UIC Program to determine what areas are regulated in your state.

Any MVWD well that is allowed to keep functioning must meet:

- maximum contaminant levels (MCL) and other health-based standards at point of injection,
- best management practices must be specified, and
- monitoring requirements specified to characterize the quality of the injectate and sludge, both initially and on an ongoing basis.

States are typically the governmental body (normally the Department of Environmental Quality or the state's equivalent) given enforcement powers over Class V wells. At the minimum, states require that all Class V injection wells be listed in the state inventory through a UIC permitting system. Once the well is added to the state inventory the operator may be required to meet additional requirements (sampling, additional permitting requirements, sanitary permit renewals, etc.).

One alternative to discharging shop wastewater to a Class V system or a MVWD is going to a dry shop. Minimize the use of water to clean service bays. Use absorbents and vacuums to pick up spills and drips rather than washing down. Dispose of these materials as solid wastes according to state guidelines and regulations. Place all used vehicle fluids in individual containers for proper off-site management.

Another alternative is the use of holding tanks. Store the motor vehicle waste in a service bay wastewater holding tank. The tank can be periodically pumped out for proper disposal. You may minimize the amount

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of wastewater that has to be stored by separating shop wastewater from sanitary and vehicle washing wastewater and by cutting back on the amount of water used in your shop.

Contacting the local sewer authority about the possibility of connecting floor drains to the sewer system is another possibility. Often, system hook-up may be available even though it was not an option when the service bays were built. Sewer hookups can be expensive, however, and you may have to pre-treat wastewater coming out of the shop. If connecting to a sanitary sewer will take time to complete, you may be able to extend the deadline for closing your well for up to one year. However, you must get special permission to do this, and you probably will need a temporary operating permit.

Conversion is also an option. In some cases, you may be allowed to convert a motor vehicle waste disposal well to another type of Class V well or pre-treat to convert the wastewater. This option requires that all motor vehicle fluids be kept away from the normal drains using physical barriers that prevent the waste from entering the normal septic system or the old MVWD well.

Stormwater

Stormwater discharge from industrial facilities

Activities that take place at industrial facilities, such as material handling and storage, are often exposed to the weather. As runoff from rain or snowmelt comes into contact with these materials, it picks up pollutants and transports them to nearby storm sewer systems, rivers, lakes, or coastal waters. Stormwater pollution is a significant source of water quality problems for the nation's waters. Of the 11 pollution source categories listed in EPA's *National Water Quality Inventory: 2000 Report to Congress*, urban runoff/storm sewers was ranked as the fourth leading source of impairment in rivers, third in lakes, and second in estuaries.

In order to minimize the impact of stormwater discharges from industrial facilities, the NPDES program includes an industrial stormwater permitting component. Operators of industrial facilities included in one of the 11 categories of stormwater discharges associated with industrial activity that discharge or have the potential to discharge stormwater to a municipal separate storm sewer system (MS4) or directly to waters of the United States require authorization under a NPDES industrial stormwater permit. (Construction activity is one of these 11 categories, but because of the nature of its operations, it's discussed separately from the other 10 categories.)

Most states are authorized to implement the Stormwater NPDES permitting program. EPA remains the permitting authority in a few states, territories, and on most land in Indian country.

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On December 1, 2005, EPA proposed an NPDES Stormwater Multi-Sector General Permit for Industrial Activities (MSGP). This proposed permit will replace the MSGP-2000 that expired on October 30, 2005. EPA asked for comments on the proposed permit and accompanying fact sheet. The comment period closed on February 16, 2006. Please note: EPA is continuing to work on a final MSGP and plans to reissue it in the near future. The reissued MSGP will be announced widely.

Most states have been authorized to implement the NPDES stormwater program. The stormwater programs are normally administered by the state's Department of Environmental Quality (or the equivalent). The EPA Construction General Permit and Multi-Sector General Permit apply only in areas where EPA is the permitting authority. This information can also be found in Appendix B of the CGP and Part 1 of the MSGP-2000.

The MSGP-2000 (or the state equivalent form) covers 30 industrial sectors that fall into one or more of the 11 categories of stormwater discharges associated with industrial activity described in 40 CFR §122.26(b)(14)(i)-(xi). The 30 categories are listed below and are defined by either the facility's Standard Industrial Classification (SIC) code or a general description of the facility's industrial activities. The North American Industry Classification System (NAICS) will eventually replace the SIC system. The U.S. Census Bureau has a conversion table to bridge the two systems.

Operators of industrial facilities or sites with activities included in one of these 11 categories must obtain coverage under a NPDES industrial stormwater permit, unless conditionally excluded. The list provided below describes the types of industrial activities within each category.

- Category One (i): Facilities with effluent limitations
- Category Two (ii): Manufacturing
- Category Three (iii): Mineral, Metal, Oil and Gas
- Category Four (iv): Hazardous Waste, Treatment, or Disposal Facilities
- Category Five (v): Landfills
- Category Six (vi): Recycling Facilities
- Category Seven (vii): Steam Electric Plants
- **Category Eight (viii): Transportation Facilities**
- Category Nine (ix): Treatment Works
- Category Ten (x): Construction Activity
- Category Eleven (xi): Light Industrial Activity

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PM PLAYS MAJOR ROLE IN STORM WATER RUNOFF PROTECTION — Your preventive maintenance approach should play a major role in the stormwater runoff prevention plan your facility may be required to develop if it classifies as an “industrial facility” in EPA’s eyes. The whole plan requires companies to develop storm water pollution prevention plans that cover:

- preventive maintenance,
- spill prevention and response procedures,
- inspections, and
- training.

Responsibilities include inspection and maintenance of stormwater management devices (translate that to mean cleaning oil/water separators, catch basins, etc.). Testing equipment and systems to uncover conditions that could result in discharges of pollutants to surface waters are also included in the program.

If your company uses any of about 200 Section 313 chemicals under SARA Title III, more specific plans are required to be submitted.

Summary of the basic framework of the stormwater regulations

Nonmunicipal permit applications will need to provide the following information:

- A site map showing the topography of the facility and surrounding land owned by the permit applicant, locations of stormwater outfalls, paved areas and buildings, material storage areas, hazardous waste treatment, storage, or disposal areas and surface water bodies receiving stormwater runoff.
- An estimate of the area of impervious surfaces, total area drained by each outfall, a historical description of any materials stored or used on site including spills, descriptions of stormwater controls, and a description of treatment of stormwater runoff including controls for illicit discharges to the system.
- Monitoring data for any pollutants suspected to be in the stormwater based on the activities performed on site. This includes flow rates and date and duration of the storm events during which sampling occurred.
- Group permit information may vary somewhat from individual permits.

What will a permit require?

Permit requirements will include best management practices to prevent pollutants from entering stormwater. These could range from performing as many manufacturing activities indoors or under cover as possible, using good spill prevention programs, installing detention basins, education efforts, increased street sweeping, fertilizer and pesticide control

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ordinances, pet waste control ordinances, and reducing air pollutant emissions. There may also be some numeric limits imposed on certain pollutants found in stormwater.

A copy of the regulations may be obtained from your local library. They were originally published in the November 16, 1990, *Federal Register* and were entitled 40 CFR Part 122.

Information on the stormwater program is available at:

Industrial Stormwater Program US EPA Headquarters / Office of Water / Office of Wastewater Management / Water Permits Division 1200 Pennsylvania Ave NW (4203M) Washington, DC 20460 Phone: (202) 564-0577 Fax: (202) 564-6431.

Community right to know and emergency planning

Community right to know

A related area of regulation (generically called community right to know) is briefly described below.

Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 is one of EPA's most complex set of regulations. The following is a brief explanation of the regulation.

The latest environmental regulation is a confusing aggregation dealing with the community's right to know what is being produced and stored in its midst. On October 17, 1986, the President signed into law the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Title III of SARA establishes new authorities for emergency planning and preparedness, emergency release notification, community right-to-know reporting, and toxic chemical release reporting.

Title III of SARA, also known as the Emergency Planning and Community Right-to-Know Act of 1986, is intended to encourage and support emergency planning efforts at the state and local levels. It also aims to provide the public and local governments with information concerning potential chemical hazards present in their communities.

Industries are required to report what hazardous substances they have in-house and to provide safety and health information related to these substances. This data is intended to help communities focus on the substances and facilities of the most immediate concern for emergency planning and response.

There is a lot of confusion as to which companies are regulated, which chemicals are covered, and exactly what information must be transmitted and to whom. Your company may be covered under the regulations in one section, but not the next.

There are three separate ways that your facility might be regulated under SARA's Title III community right to know requirements. There are many confusing and seemingly contradictory details to sort out under each of the three aspects. The following is a breakdown of the three areas

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(Emergency Planning and Release Notification, Community Right To Know Programs, and Toxic Chemical Release Reporting):

Emergency Planning and Release Notification

These regulations are found in the Act — Title III, Sections 301-305, and in the regulations as 40 CFR Part 355.

What facilities are regulated under this part?

Any facility which has present a regulated amount of any one of EPA's designated Extremely Hazardous Substances or a CERCLA hazardous substance must comply with the requirements of this section.

What list of chemicals is used and where do I find it?

The chemicals under this section are on EPA's List of Extremely Hazardous Substances and Their Threshold Planning Quantities. This list is found in Part 355, Appendix A and Appendix B.

Also cited in this section is the CERCLA list. This is called the Hazardous Substances and Their Reportable Quantities List and is found in Section 302.4.

Both of these lists can be found in the REGULATIONS section of this guide.

Are there minimum threshold levels for emergency notification?

Each chemical on the list of Extremely Hazardous Substances has a Threshold Planning Quantity assigned to it. This value was determined based on the relative potential hazards posed by the individual substances. Notification is triggered by the presence of amounts in excess of these listed quantities.

"Amount" means the total amount of an extremely hazardous substance present at any one time at concentrations greater than one percent by weight, regardless of location, number of containers, or method of storage.

Similarly, the CERCLA list has a Reportable Quantity assigned to each substance. The release of a Reportable Quantity of a substance triggers notification requirements.

How are amounts of extremely hazardous substances determined for solids and mixtures?

For mixtures: If you have a mixture or a solution that contains more than one percent of a listed substance, you must multiply the concentration of the extremely hazardous substance (in weight percent) by the weight of the total quantity of mixture in the container.

For example: If you have 200 pounds of Mixture ABC, which is 25% sulfuric acid, then the actual quantity of regulated substance is 200 pounds $\times$ 25%, or 50 pounds.

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For solids: There are two threshold planning quantities shown for solids on the Extremely Hazardous Substance lists in Part 355 (i.e., 500/10,000 pounds). The solid is subject to the higher amount (10,000 pounds), unless one of the following applies:

- The solid exists in powdered form and has a particle size less than 100 microns;
- The solid is handled in solution or in molten form; or
- The solid meets the criteria for a National Fire Protection Association (NFPA) rating of 2, 3, or 4 for reactivity.

If the solid meets any of these three criteria, then the lower amount (500 pounds) applies.

What must a regulated facility do to comply with this requirement?

The facility must comply with the Emergency Planning Notification and Emergency Release Notification requirements.

Emergency Planning Notification (§355.30)

If you start using, producing, or storing an extremely hazardous substance, you must report to the commission within 60 days that your facility is now subject to these requirements:

- “Commission” means the emergency response commission for the State in which the facility is located. In the absence of an emergency response commission, the Governor and the chief executive officer, respectively, shall be the commission. Where there is a cooperative agreement between a State and a Tribe, the commission shall be the entity identified in the agreement.
- A facility emergency coordinator must be designated for all regulated companies. The owner/operator of each company must appoint a coordinator who will cooperate with local committees. Local emergency response committees should be notified as to who the coordinator is.
- Local committees must be informed of any changes occurring at your facility which may be relevant to emergency planning. Any request by the local committees for information necessary for the development of the local emergency plan should be promptly complied with.

Emergency Release Notification (§355.40)

Facilities must provide emergency notification whenever there is a release of a Reportable Quantity of any Extremely Hazardous Substance or CERCLA hazardous substance.

“Release” is defined as any spilling, leaking, pumping, pouring, emptying, discharging, or disposing into the environment. This includes the abandonment or discarding of barrels or other closed receptacles.

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Any release which results in exposure to persons solely within the boundaries of your facility does not require notification under this regulation.

Immediate notification must be made to the community emergency coordinator of the local committee, and the State commission for any area which may be affected by the release. This notification should be oral (via telephone, radio, or in person).

This notification should include:

- Chemical name or identity of substance released.
- Whether the substance is an Extremely Hazardous Substance.
- Estimate of quantity released.
- Time and duration of release.
- Media into which release occurred.
- Any known or anticipated acute or chronic health risks.
- Medical advice for exposed individuals, where appropriate.
- Precautions to take and evacuation procedures.
- Names and telephone numbers of contact person.

As soon as possible, a written followup notice should be submitted. Included in this written notice should be additional information with respect to:

- Actions taken to respond to and contain the release.
- Any known or anticipated acute or chronic health risks.
- Medical advice for exposed individuals, where appropriate.

Exceptions:

For a transportation-related release, the owner/operator of a facility can provide the emergency notification information to the 911 operator.

“Transportation-related release” means a release during transportation or storage, when the substance is moving under active shipping papers and has not reached the final consignee.

CERCLA releases — If a Reportable Quantity of any hazardous substance is released in a 24-hour period, immediately notify the National Response Center (800) 424-8802; in Washington D.C. (202) 426-2675. (See 302.6)

What are the possible penalties for noncompliance?

Civil penalties - \$25,000-\$75,000 for each day during which the violation continues.

Criminal penalties - \$25,000-\$50,000 in fines, 2-5 years in jail.

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Right to know reporting

These requirements are covered in the Act — Title III, Sections 311-312, and in the regulations at 40 CFR Part 370.

What facilities are regulated under this part?

Any facility which must prepare or have available material safety data sheets under OSHA's Hazard Communication Standard must comply with the requirements. Also, facilities with chemicals in quantities that equal or exceed the following thresholds must report:

- For Extremely Hazardous Substances (EHSs), either 500 pounds or the Threshold Planning Quantity (TPQ), whichever is lower.
- For all other hazardous chemicals, 10,000 pounds.

The minimum threshold for reporting in response to requests for submission of an MSDS or a Tier II form shall be zero. To sum this requirement up, if you receive a request from an authority having jurisdiction, you need to provide the MSDS or the Tier II.

What is a hazardous substance under this regulation?

Hazardous substances are any substances for which a facility must maintain a Material Safety Data Sheet (MSDS) under the OSHA Hazard Communication Standard, which lists the criteria used to identify a hazardous substance. MSDSs are detailed information sheets that provide data on health hazards and physical hazards of chemicals along with associated protective measures. Over 500,000 products have MSDSs which are normally obtained from the chemical manufacturer.

What are facilities required to do?

Under the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 311, facilities must submit the same MSDSs they maintain for OSHA to their SERC, LEPC, and local fire department. Or, facilities may choose to submit a detailed list of the same chemicals instead. This is a one-time submittal; facilities have three months after becoming subject to the OSHA regulations to submit their material.

Facilities that need to submit MSDSs or chemical lists under Section 311, also need to submit an annual inventory report for the same chemicals (EPCRA Section 312). This inventory report must be submitted to the SERC, LEPC and local fire department by March 1 of each year.

How do I submit an Inventory Report?

Facilities covered by these requirements must submit an emergency and hazardous chemical inventory form to the LEPC, the SERC and the local fire department annually. Facilities provide either a Tier I or Tier II form. Most States require the Tier II form. Tier II forms require basic facility identification information, employee contact information for both emergencies and non-emergencies, and information about chemicals stored or used at the facility:

- The chemical name or the common name as indicated on the MSDS.

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- An estimate of the maximum amount of the chemical present at any time during the preceding calendar year and the average daily amount.
- A brief description of the manner of storage of the chemical.
- The location of the chemical at the facility.
- An indication of whether the owner of the facility elects to withhold location information from disclosure to the public.

Check with your state agency for details.

You must allow onsite inspection by the fire department, upon request, and shall provide specific location information regarding the hazardous chemicals at the facility.

What are the possible penalties for noncompliance?

Violation of the MSDS reporting requirements can result in \$10,000 in fines per violation.

Violation of the inventory reporting requirements can result in \$25,000 in fines per violation.

Each day that a violation continues is considered a separate violation.

Toxic Chemical Release Reporting

These requirements are found in the Act at Title III, Section 313, and in the regulations at 40 CFR Part 372.

What facilities are covered under this part?

If a facility meets all of the following criteria, it is a covered facility for that calendar year:

- The facility has 10 or more full-time employees.
- The facility falls in SIC major group codes 10 (except 1011, 1081, and 1094), 12 (except 1241), or 20 through 39; industry codes 4911, 4931, or 4939 (limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce); or 4953 (limited to facilities regulated under RCRA, subtitle C), 5169, 5171, or 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis) by virtue of the fact that it meets one of certain criteria (see 40 CFR 372.22(b)).
- The facility handles a statutory quantity of a toxic chemical as defined in 40 CFR §372.65.

What facilities are covered under the new “alternate threshold” rule?

The Alternate Threshold Rule is for facilities with low annual reportable amounts of a listed chemical. If a facility meets the current section 313 reporting thresholds, but estimates that the total annual reportable amount of the chemical does not exceed 500 pounds per year, then it can

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apply a threshold of 1 million pounds per year, provided that certain conditions are met. See §372.27 Alternate Threshold Certification and Instructions if you believe this rule may apply to you.

What facilities are covered under the Supplier Notification Requirements of this part?

If the facility meets the following criteria, it is regulated:

- Falls within SIC Codes 20-39,
- Manufactures or processes a toxic chemical, and
- Sells this toxic chemical to a facility regulated under Subpart A and B.

Are there minimum threshold levels for toxic chemicals before reporting is required?

Reporting must be done for toxic chemicals **manufactured** or **processed** in the following amounts:

- 25,000 pounds of the chemical for the year.
- Reporting must be done if a facility **otherwise uses** 10,000 pounds of a designated chemical during the calendar year.

How do manufacturing, processing, and otherwise uses differ?

“Manufacturing” means to produce, prepare, import, or compound a toxic chemical. This includes the coincidental production of a toxic chemical (e.g., as a byproduct or impurity) resulting from the manufacture, processing, use, or disposal of other chemical substances.

“Processing” means the preparation of a toxic chemical after its manufacture for distribution in commerce. In general, processing includes making mixtures, repackaging, or use of a chemical as a feedstock, raw material, or starting material for making another chemical. It also includes incorporating a chemical into an article.

“Otherwise used” means any use of a toxic chemical, including a toxic chemical contained in a mixture or other trade name product or waste, that is not covered by the terms manufacture or process. Otherwise use of a toxic chemical does not include disposal, stabilization (without subsequent distribution in commerce), or treatment for destruction unless:

(1) The toxic chemical that was disposed, stabilized, or treated for destruction was received from off-site for the purposes of further waste management; or

(2) The toxic chemical that was disposed, stabilized, or treated for destruction was manufactured as a result of waste management activities on materials received from off-site for the purposes of further waste management activities. Relabeling or redistributing of the toxic chemical where no repackaging of the toxic chemical occurs does not constitute otherwise use or processing of the toxic chemical.

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What must a regulated facility do under this section?

Submit EPA Form R, The Toxic Chemical Release Inventory Reporting Form (See Section 372.85)

This form serves two purposes: a toxic chemical inventory form, and a form to report chemical releases to the environment.

Every covered facility must annually submit a completed EPA Form R (EPA Form 9350-1) both to the EPA and the State indicating inventory and releases of each toxic chemical handled in excess of the threshold quantity for a calendar year.

If the facility is owned by one person but operated by another then either person may report. However, if a report is not submitted for a covered facility, EPA would hold both persons liable for any applicable penalties.

Where is Form R to be sent upon completion?

Submissions must be sent to both EPA and the State (or the designated official of an Indian tribe). If a report is not received by both EPA and the State (or the designated official of an Indian tribe), the submitter is considered out of compliance and subject to enforcement action.

Facilities located on Indian land should send a copy to the Chief Executive Officer of the applicable Indian tribe. Some tribes have entered into a cooperative agreement with States; in this case, report submissions should be sent to the entity designated in the cooperative agreement.

If the alternate threshold applies, then a **certification** is submitted instead of the Form R.

What is the Form A?

Reporting facilities are allowed to use Form A, a simpler and easier to complete form, for non-PBT (Persistent, Bioaccumulative, and Toxic) chemicals, so long as releases or other disposal is not greater than 2,000 pounds as part of the total waste management limit for the chemical, which is not more than 5,000 pounds.

Form A may be used for certain chemicals of greater concern, i.e., PBT chemicals, when there are no releases or other disposal and no more than 500 pounds of other waste management (e.g., recycling or treatment).

“Non-production related waste,” i.e., waste from one-time events such as facility cleanups or extraordinary weather events must be counted when determining eligibility to use Form A.

What is the difference between Form R and Form A?

Form R provides details about releases and other waste management (e.g., total quantity of releases to air, water, and land; and on- and off-site recycling, treatment, and combustion for energy recovery). Form A provides the name of the chemical and certain facility identification information.

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Form A can be used by the public as a “range report,” i.e., an indication that the facility manages as waste between 0 and 500 pounds of a PBT chemical as waste and has no releases or other disposal.

For a non-PBT chemical, a facility manages between 0 and 5,000 pounds of the chemical as waste, of which no more than 2,000 pounds is released or otherwise disposed. Four chemicals may be reported on each Form A; only one chemical may be reported on a Form R.

Recordkeeping

Form R

A copy of each report (Form R) submitted must be retained for 3 years. All supporting materials and documentation used to complete the report must also be retained for 3 years.

Supplier notifications

If you are subject to the notification requirements, a copy of each supplier notice must be retained for 3 years, along with all supporting materials and documentation used to determine whether a notice is required and what it must contain.

Alternate threshold certification

If you are subject to the alternate threshold, a copy of each certification submitted must be retained for 3 years. All supporting materials and documentation used to complete the report must also be retained for 3 years.

Support Documentation

Facilities must also maintain those documents, calculations, worksheets, and other forms upon which they relied to gather information for prior Form R reports. In the event of a problem with data elements on a facility’s Form R, EPA may request documentation from the facility that supports the information reported. In the future, EPA may conduct data quality reviews of past Form R submissions. An essential component of this process would be to review a facility’s records for accuracy and reliability.

Suggested records to keep to prove EPA compliance

Here is a partial list of records, organized by year, that a facility should maintain:

- Previous years’ Form Rs;
- Section 313 Reporting Threshold Worksheets;
- Engineering calculations and other notes;
- Purchase records from suppliers;
- Inventory data;

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- EPA (NPDES) permits;
- EPCRA Section 312, Tier II Reports
- Monitoring records;
- Flowmeter data;
- RCRA Hazardous Waste Generator's Report;
- Pretreatment reports filed by the facility with the local government;
- Invoices from waste management companies;
- Manufacturer's estimates of treatment efficiencies;
- RCRA Manifests;
- Process diagrams that indicate emissions and releases; and
- Spill prevention, control, and countermeasures (SPCC) plans.

All records must be kept at the reporting facility and available for inspection by EPA. If the facility is closed permanently, the records must be kept by the owner or operator of the facility, or sent to EPA.

What are the possible penalties for noncompliance?

Civil penalties - \$25,000 for each day for each violation

Notes

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Reserved

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Compliance Management Self Audits	Notes
DOT Self Audit — Calculating factor rating for the Vehicle Factor portion of a Compliance Review Determining the Vehicle Factor rating during a DOT compliance review (audit) is a two-step process. The first step involves checking the carrier’s performance in roadside inspections (calculating the carrier’s out-of-service rate). The second step involves verifying compliance with the inspection and maintenance regulations found in Part 396. These two steps are then combined to generate the carrier’s rating for the Vehicle Factor. While the maintenance pro may be peripherally involved in the other five factors that make up a Compliance Review, the Vehicle Factor is the one that the maintenance pro is directly responsible for. Determine the vehicle out-of-service rate for the company: - Number of roadside inspections in which the vehicle received an out-of-service violation _____ (“a” in formula). Total number of vehicle inspections _____ (“b” in formula) Divide “a” by “b” (a/b). This gives you the percentage of inspections in which a vehicle was issued an out-of-service violation. $\frac{\text{_____}}{\text{_____}} = \text{_____} \times 100 = \text{out-of-service percentage (rate)}.$ If the rate is below 34 percent, it is considered “Satisfactory.” If the out-of-service rate is 34 percent or higher, this is considered “Conditional.” Out-of-Service rate is considered _____ Determining regulatory compliance with the Vehicle Factor Below is each regulation checked during a compliance review. The regulation number is listed first, followed by a statement (or series of statements). After each is a location to record the score for each regulation. All regulations and interpretations are listed in the regulations portion of this manual.	

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§396.3 — We systematically maintain records of systematic inspection and vehicle maintenance for each vehicle controlled over 30 days including:

- Vehicle identification (company number, make, serial number, year, tire size, and vehicle owner's name, if not company owned).
- Nature and due date of inspections and maintenance (a maintenance schedule).
- Record of inspections, maintenance, and repairs (including date and nature).
- Record of tests on push-out windows, emergency doors, and door-marking lights (for buses only).
- Company retains all maintenance, repair, and inspection records for 1 year, and for 6 months after vehicle leaves company control.
- Company has procedures for systematic inspection, maintenance, and repair of vehicles (check for maintenance schedules, and policies and procedures).

Check vehicle files. Each missing component counts as one violation. If more than 10 percent of the files checked are not in compliance, one point must be assigned to the audit score.

_____ **Score for this regulation.**

§396.9(c)(2) — We have not required or permitted the operation of a motor vehicle declared out of service before repairs were made (and documented) in the previous year.

Check vehicle files. If one vehicle was operated after being placed out of service without proof of repairs, one point must be assigned to the audit score.

_____ **Score for this regulation.**

396.9(d)(2) — Drivers submit inspection reports within 24 hours, upon arrival at next company location, or immediately mail reports to the company. The company reviews all inspection reports and notes and corrects violations or defects thereon. Within 15 days following the date of the inspection, the company:

- Corrects any violations noted (out-of-service violations were repaired before the vehicle was operated), can document that the repairs were completed, and signs the report certifying all violations noted on the report have been corrected.
- The "Signature of Carrier Official, Title, and Date Signed" portion of the form has been completed by a responsible company official.
- The roadside inspection form is returned to the issuing agency, *even if no violations were noted*.
- The company maintains copies of reports and proof of repairs for one year.

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Check vehicle files. If one report was not completed by a carrier official and/or was not sent in to the correct authority, or you cannot document the repair of a violation, one point must be assigned to the audit score.

_____ **Score for this regulation.**

396.11(a) —We require driver to prepare driver vehicle inspection report upon the completion of each workday. This report includes:

- A written (DVIR) report is completed each day for every vehicle operated.
- List of defects (or comments indicating no defects found).
- Driver's signature of the driver completing the DVIR.
- If defect noted, certification of repair (or comments indicating no repairs needed) signed by a carrier official or person performing repairs.

We retain the completed DVIRs for 3 months.

Check vehicle files. Each missing component counts as one violation. If more than 10 percent of the files checked are not in compliance, one point must be assigned to the audit score.

_____ **Score for this regulation.**

396.11(c) —We correct out-of-service defects listed by driver in a driver vehicle inspection report before the vehicle is operated again, and have documentation in the vehicle file to prove it.

Check vehicle files. If one vehicle was operated after the driver noted an out-of-service defect without proof of repairs, one point must be assigned to the audit score.

_____ **Score for this regulation.**

396.17(c) —Each company-operated commercial vehicle is inspected every 12 months, the annual inspection reports (original or copy) are retained by the company for 14 months, the inspections and associated forms meet criteria as found in Part 396 and Appendix G, and the inspectors' certifications (to perform annual inspections and brake service) are on file at the company.

Check vehicle files. Each missing component counts as one violation. If more than 10 percent of the files checked are not in compliance, one point must be assigned to the audit score.

_____ **Score for this regulation.**

396.17(g) —We promptly repair parts and accessories not meeting minimum periodic inspection standards during an annual inspection before operating the vehicle and document the repairs.

Check vehicle files. If one vehicle was operated without proof of repairs, one point must be assigned to the audit score.

_____ **Score for this regulation.**

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Determining the Vehicle Factor score and rating

Assign a point value to out-of-service rating. If rating was satisfactory, score 0. If conditional, score 1. Then total scores from regulations. Add these together to determine Vehicle Factor score.

_____ Out-of-service rating score

_____ Regulator compliance score

_____ **Vehicle Factor score**

Next, use the table below to convert the score to a rating.

0 points	Satisfactory
1 point	Conditional
2 or more points	Unsatisfactory

Vehicle Factor Rating _____

Determining your CSA Vehicle Maintenance BASIC Measure

Determining your CSA Vehicle Maintenance BASIC Measure

Step 1

Locate all roadside inspection reports from the past two years that involved a vehicle inspection, or vehicle or cargo securement violation (do not use vehicle violations that appeared on a "Driver Only" inspection or securement violations cited under the hazardous material regulations). Write in the date of the inspection in the "date" column on the table below.

Step 2

Time weight all the inspections, good and bad as you enter them onto the table. An inspection that occurred in the last 6 months is given a time weight of 3, 6 to 12 months ago 2, and more than a year ago 1. Write the date in the date column and the time weight in the "time weight" column.

Step 3

Locate all vehicle and cargo securement violations on the inspection report. Locate the severity weight in the table provided in the Compliance Management Chapter for each vehicle violation on the inspection report. If the violation led to an out-of-service order, increase the violation severity by 2. If the same violation is repeated on an inspection report, only use it once. Write this violation and the related value in the "violation and violation severity" columns for each inspection. If an inspection has more than 4 vehicle violations, use the violation area in the next inspection area on the table.

Step 4

Add up the severity weights for all violations on each inspection. If the severity weights add up to more than 30, stop at 30. If the inspection had no violations, its severity weighting is 0. Write this total in the box next to "Total S and T weighted for entire inspection" in the correct column.

Compliance Management

Step 5

Time weight the total severity weight total for each inspection. This is done by multiplying the severity weight by the appropriate time weight. The time weight is based on the date of inspection. The time weight for an inspection that took place in the last 6 months is 3, 6 to 12 months ago 2, and more than a year ago 1. Write this total in the "S and T Weighted Value" column.

Step 6

Add the severity and time weighted total for all inspections together. Enter the total at the bottom of the table. Then add up all of the inspection time weights and enter this total at the bottom of the "Time Weight" column.

Step 7

To get the BASIC Measure, divide the total of all time and severity weighted violations by the time weighted inspections total. Record BASIC Measure at the very bottom of the table.

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Sample					
Date	Time weight	Violation	Violation Severity	Totals	Total S and T weighted for entire inspection
1/5/10	3	393.11	6	18	
		393.48	4	12	
				Total S and T weighted for entire inspection	30
1/7/10	3	No violations			
				Total S and T weighted for entire inspection	0
				Total S and T weighted for entire inspection	
				Total S and T weighted for entire inspection	
Total:	6			Total:	30
					30/6 = 5
				BASIC Measure	5

Compliance Management

Date	Time weight	Violation	Violation Severity	Totals	Total S and T weighted for entire inspection
				Total S and T weighted for entire inspection	
				Total S and T weighted for entire inspection	
				Total S and T weighted for entire inspection	
				Total S and T weighted for entire inspection	
				Total S and T weighted for entire inspection	
Total:				Total:	
					/ =
				BASIC Measure	

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Vehicle Maintenance Pro

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OSHA

Worker Right to Know self-audit checklist

- ☐ Is your chemical inventory list still up-to-date?
- ☐ Do you periodically review and update the chemical inventory list?
- ☐ Are all containers labeled appropriately?
- ☐ Are your SDSs systematically reviewed?
- ☐ Is your employee training program really effective?
- ☐ Can employees answer relevant questions about the chemicals they work with?
- ☐ Do your employees receive periodic refresher training and training upon the introduction of new chemicals into the workplace?
- ☐ Do you maintain documentation of the training conducted?
- ☐ Have policies and procedures been documented in a written program?
- ☐ Do you periodically review and update the written program?
- ☐ Is the written program readily available for employees to read upon request?
- ☐ Have you identified all contractors and exchanged information on hazardous chemicals with them?
- ☐ Is special training provided for chemicals used on non-routine jobs?

Compliance Management

OSHA SDS self-audit checklist

- ☐ Do chemical manufacturers and importers provide an SDS for each hazardous chemical you have on site?
- ☐ Do employees have access to an SDS for each hazardous chemical used?
- ☐ Does each SDS contain the identity used on the label?
- ☐ Does each SDS contain the chemical name and common names for single-substance hazardous chemicals?
- ☐ For mixtures tested as a whole, does each SDS contain the chemical and common names of the ingredients that contribute to these known hazards? Does each SDS contain the common names of the mixture itself?
- ☐ For mixtures not tested as a whole, does each SDS contain the chemical and common names of all ingredients that are health hazards (1 percent concentration or greater)?
- ☐ Does each SDS contain the chemical and common names of all ingredients that are health hazards and present a risk to employees in concentrations of less than 1 percent or 0.1 percent for carcinogens?
- ☐ Does each SDS contain the chemical and common names of all ingredients that have been determined to present a physical hazard when present in the mixture?
- ☐ Does each SDS contain the physical and chemical characteristics of the hazardous chemical (vapor pressure, flash point, etc.)?
- ☐ Does each SDS contain the primary routes of entry?
- ☐ Does each SDS contain the OSHA permissible exposure limit (PEL), the ACGIH threshold limit value (TLV), and other exposure limits?
- ☐ Does each SDS contain information on carcinogen listings?
- ☐ Is each SDS written in English?
- ☐ Does each SDS contain generally applicable procedures and precautions for the safe handling and use of the chemical (hygienic practices, maintenance and spill procedures, etc.)?
- ☐ Does each SDS contain applicable control measures (engineering controls, work practices, or personal protective equipment)?
- ☐ Does each SDS contain emergency and first-aid procedures?
- ☐ Does each SDS contain the date of preparation or last change?
- ☐ Does each SDS contain the name, address, and telephone number of the responsible party?

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HAZWOPER Audit Checklist

Following you will find an Audit Checklist to see how you measure up with HAZWOPER preparations, if that regulation applies to you.

- ☐ Do your employees clean up at uncontrolled hazardous waste sites or at EPA-licensed waste treatment, storage, and disposal facilities?
- ☐ Do you have employees assigned to respond to emergencies involving hazardous materials?
- ☐ Do you need to have the written program that identifies, evaluates, and controls safety and health hazards and provides emergency response procedures for each hazardous waste site or treatment, storage, and disposal facility?
- ☐ Does the written program include the following:
 - ☐ An organizational workplan
 - ☐ Site evaluation and control
 - ☐ A site-specific program
 - ☐ Monitoring
 - ☐ Medical surveillance program
 - ☐ Decontamination procedures
 - ☐ Emergency response program?
 - ☐ Is it periodically updated?
 - ☐ Is it made available to all affected employees, contractors, and subcontractors?
- ☐ Do you have a workplan that establishes a chain of command and employer and employee responsibilities?
- ☐ Have you carried out a site evaluation and established a control plan?
- ☐ Have employees been provided with the requisite information and training for their respective positions?
- ☐ Is there a Personal Protective Equipment Program?
- ☐ Is the requisite monitoring carried out?
- ☐ Is the required medical surveillance of employees carried out?
- ☐ Are emergency response procedures developed?
- ☐ Has your facility implemented feasible and useful engineering controls and work practices?
- ☐ Are employee exposure and medical records kept for 30 years and made available to the employee upon request?

Compliance Management

Workplace Chemical Audit Checklist

Notes

WORKPLACE AUDIT / INSPECTION REPORT Chemical Storage Area

Location: _____

Audited by: _____ Date: _____

Audit Item/Practice Check (✓) if item/practice not in compliance

LP Gas

- ☐ Is liquified petroleum gas stored, handled, and used in accordance with safe practices and standards? 29 CFR 1910.110(e)(2)(iv); 178(f)(2)
- ☐ Are "No Smoking" signs posted on liquified petroleum gas tanks? 29 CFR 1910.106(d)(7)(iii), (e)(6)(i)
- ☐ Are liquified petroleum storage tanks guarded to prevent damage from vehicles? 29 CFR 1910.110(f)(2)(i)&(ii)

Flammable/Combustible Containers

- ☐ Are approved containers and portable tanks used for the storage and handling of flammable and combustible liquids? 29 CFR 1910.106(d)(2)
- ☐ Are all connections on drums and combustible liquid piping, vapor and liquid tight? 29 CFR 1910.106(c)(3)
- ☐ Are all flammable liquids kept in closed containers when not in use (e.g., parts cleaning tanks, pans, etc.)? 29 CFR 1910.22(c); 106(e)(2)(iv)(a)
- ☐ Are bulk drums of flammable liquids grounded and bonded to containers during dispensing? 29 CFR 1910.106(e)(6)(ii)
- ☐ Are safety cans used for dispensing flammable or combustible liquids at a point of use? 29 CFR 1910.106(d)(5)(iii)
- ☐ Are storage tanks adequately vented to prevent the development of excessive vacuum or pressure as a result of filling, emptying, or atmosphere temperature changes? 29 CFR 1910.106(b)(4)(ii)
- ☐ Are portable storage tanks equipped with emergency venting that will relieve excessive internal pressure caused by fire exposure? 29 CFR 1910.106(d)(2)(ii)
- ☐ Are storage cabinets used to hold flammable liquids, labeled "Flammable — Keep Fire Away"? 29 CFR 1910.106(d)(3)(ii)
- ☐ Are flammable liquids, such as gasoline, kept in an approved safety can? 29 CFR 1910.106(d)(2); 144(a)(1)

Flammable/Combustible Handling

- ☐ Are firm separators placed between containers of combustibles or flammables, when stacked one upon another, to assure their support and stability? 29 CFR 1910.106(f)(1)(iii)
- ☐ Are all containers over 30 gallons in inside storage rooms stacked individually? 29 CFR 1910.106(d)(4)(v)

Flammable/Combustible Storage

- ☐ Is proper storage of flammable or combustible materials practiced to minimize the risk of fire including spontaneous combustion?
- ☐ Are all solvent wastes, and flammable liquids kept in fire-resistant, covered containers until they are removed from the worksite? 29 CFR 1910.22(c)
- ☐ Is vacuuming used whenever possible rather than blowing or sweeping combustible dust? 29 CFR 1910.141(a)(4)(ii)
- ☐ Are combustible scrap, debris, and waste materials (oil rags, etc.) stored in covered metal receptacles and removed from the worksite promptly? 29 CFR 1910.106(e)(9)(iii)
- ☐ Are all spills of flammable or combustible liquids cleaned up promptly? 29 CFR 1910.106(e)(9)(i)

- ☐ Are "No Smoking" rules enforced in areas involving storage and use of hazardous materials? 29 CFR 1910.106(e)(9)

Hazard Communication Labels

- ☐ Are all chemical containers marked with contents name and hazards? 29 CFR 1910.1200(f)(5)
- ☐ Are storage cabinets used to hold flammable liquids labeled "Flammable—Keep Fire Away"? 29 CFR 1910.106(d)(3)(ii)
- ☐ For a fixed extinguishing system, is a sign posted warning of the hazards presented by the extinguishing medium? 29 CFR 1910.160(b)(5)

First Aid

- ☐ Do you have emergency eye wash and shower facilities within the immediate work area where employees are exposed to injurious corrosive materials? 29 CFR 1910.151(c), 124(g)(2), 1048(i)(3)

Housekeeping

- ☐ Are work areas clean? 29 CFR 1910.22(a)
- ☐ Are all spilled materials or liquids cleaned up immediately? 29 CFR 1910.141(a)(3)(ii)

Aisles

- ☐ Are aisles marked? 29 CFR 1910.22(b)(2)
- ☐ Are aisle widths maintained? 29 CFR 1910.22(b)(1)
- ☐ Are aisles in good condition? 29 CFR 1910.22(b)(1)
- ☐ Is there one clear aisle at least 3 feet wide? 29 CFR 1910.106(d)(4)(v), (5)(vi)(f), (e)(9)(ii)

Exits

- ☐ Are exits properly marked? 29 CFR 1910.37(q)
- ☐ Does lighting in hallways and exit signs conform to government standards (5 foot-candles)? 29 CFR 1910.37(q)(6)
- ☐ Any emergency power supply? 29 CFR 1910.37(q)(6)
- ☐ Are exits kept free of obstructions? 29 CFR 1910.36(d)(1)

Fire Alarm Systems

- ☐ If you have a non-supervised fire alarm system, is it tested bimonthly? 29 CFR 1910.165(d)(2)
- ☐ If you have a supervised employee alarm system (that is, does the alarm have a device that indicates system malfunction), is it tested yearly? 29 CFR 1910.165(d)(4)

Fire Extinguishers

- ☐ Are appropriate fire extinguishers mounted, located, and identified so that they are readily accessible to employees? 29 CFR 1910.157(c)(1)
- ☐ Are all fire extinguishers inspected and recharged regularly, and noted on the inspection tag? 29 CFR 1910.157(e)
- ☐ Are portable fire extinguishers provided in adequate number and type? 29 CFR 1910.157(d)
- ☐ For a fixed extinguishing system, is a sign posted warning of the hazards presented by the extinguishing medium? 29 CFR 1910.160(b)(5)

Repairs/corrections must be completed by (date) _____

Routed to _____ Date _____

Repairs/corrections from above have been done.

Supervisor _____ Date _____ Page _____ of _____

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ORIGINAL

FORM NO. 250-FS-C4
(Rev. 3/01)

Vehicle Maintenance Pro

Notes

WORKPLACE AUDIT / INSPECTION REPORT SUMMARY SHEET Chemical Storage Area

Location: _____
Audited by: _____ Date: _____

Commentary on Repairs/Corrections:

Repairs/corrections must be completed by (date) _____
Routed to _____ Date _____
Repairs/corrections from above have been done.
Supervisor _____ Date _____ Page _____ of _____

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SUMMARY SHEET

FORM NO. 250-PS-C4
(Rev. 5/01)

Compliance Management

EPA

Hazardous waste audit

- ☐ Does your facility generate less than 100 kilograms per month of hazardous waste?
- ☐ Does your facility have an EPA Identification Number?
- ☐ Does your facility generate solid wastes that exhibit hazardous characteristics?
- ☐ Are there any other solid wastes generated?
- ☐ Does your company test all wastes to determine which wastes are non-hazardous?
- ☐ Are the people in your facility who are responsible for shipping hazardous waste familiar with DOT regulations?
- ☐ Is each container marked in accordance with DOT requirements?
- ☐ Does your facility store wastes for more than 90 days?
- ☐ Is there an effort or a program to prevent storage for more than 90 days?
- ☐ Are there containers you use to store waste temporarily before transport?
- ☐ Is each container marked with an approved hazardous waste label?
- ☐ Is each container clearly dated?
- ☐ Do you inspect containers for leakage and/or corrosion at least weekly?
- ☐ Does your facility ensure that containers holding ignitable or reactive waste are at least 50 feet from the facility's property line?
- ☐ Does your storage area provide secondary containment?
- ☐ Does your facility receive waste from off-site?
- ☐ Do you have sufficient aisle space to allow unobstructed movement of personnel and equipment?
- ☐ Does your facility maintain personnel training records at the facility?
- ☐ Do the training records include a job title and written job description of each position and a description of type and amount of training?
- ☐ Are the records of training given to operations' personnel?
- ☐ Does your facility have a contingency plan?
- ☐ Is the plan maintained at your facility?
- ☐ Does the plan include a current SPCC plan?

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- ☐ Is there an emergency coordinator on site or on call at all times?
- ☐ Have arrangements been made with local authorities to familiarize them with your facility, its layout, and possible hazards?
- ☐ Has your facility arranged to familiarize local hospitals with the properties of hazardous waste handled and types of injuries that could result from fires, explosions, or releases at the facility?
- ☐ Does your facility handle ignitable or reactive wastes?
- ☐ Are ignitable wastes handled and stored in such a manner that fires and/or explosions are prevented?
- ☐ Is there any evidence of heat generation from incompatible wastes?
- ☐ Is your facility equipped with adequate communication and safety equipment?
- ☐ Does your facility store any hazardous materials in underground storage tanks (USTs)?
- ☐ Has your facility notified the appropriate state agency of its USTs?
- ☐ Has your facility initiated a program to minimize the amount and toxicity of waste generated?
- ☐ Does the owner or operator keep a written operating record at the facility?
- ☐ Do records include :
 - ☐ A description and quantity of each hazardous waste received?
 - ☐ The location and quantity of each hazardous waste at each location?
 - ☐ The records and results of waste analyses?
 - ☐ The records of incidents involving implementation of a contingency plan?
 - ☐ The records and results of required inspections?
 - ☐ Any monitoring, testing or analytical data?
 - ☐ A closure plan and cost estimate?
- ☐ Does the owner or operator maintain a written inspection schedule at the facility?
- ☐ Does the inspection schedule include:
 - ☐ Monitoring equipment?
 - ☐ Safety and emergency equipment?
 - ☐ Security devices?
 - ☐ Operating and structural equipment?

Compliance Management

- ☐ Types of problems with equipment, such as malfunctions and operator error?
- ☐ Does your facility maintain a copy of a waste analysis plan?
- ☐ Does the plan include:
 - ☐ The parameters for which waste will be analyzed?
 - ☐ The test methods used to test for these parameters?
 - ☐ The sampling method used to obtain the sample?
 - ☐ The frequency with which the initial analyses will be reviewed or repeated?
- ☐ Does the owner or operator maintain an inspection log?
- ☐ Does the log include:
 - ☐ The date and time of inspection?
 - ☐ The name of the inspector(s)?
 - ☐ A notation of observations?
 - ☐ The date and nature of repairs or remedial actions?
- ☐ Does your facility provide adequate security?
- ☐ Does your facility use the Uniform Hazardous Waste Manifest for each off-site shipment?
- ☐ Does your facility have a system to maintain these reports for 3 years:
 - ☐ Manifests and signed copies from designated facilities?
 - ☐ Biennial reports?
 - ☐ Exception reports?
 - ☐ Test results?
- ☐ Has the facility ever been inspected by a state agency or EPA for RCRA compliance?
- ☐ Was a Notice of Violation received as a result of the inspection?
- ☐ Have all off-site hazardous waste disposal facilities been inspected and approved by representatives of your Company?

Notes

Vehicle Maintenance Pro

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UST audit checklist

- ☐ Does your facility have any old unused USTs on the premises?
- ☐ Does your facility store only non-hazardous materials in USTs?
- ☐ Does your facility store any hazardous materials in USTs?
- ☐ Does your facility store any petroleum products in USTs?
- ☐ Has your facility notified the appropriate state agency about its USTs?
- ☐ Have you determined and used the proper EPA or state notification form?
- ☐ Are the USTs on your premises visually inspected on a regular basis?
- ☐ Has your company instituted a method of release detection for all new and existing USTs?
- ☐ Do you know and follow release reporting, investigation, and confirmation procedures?
- ☐ Do you follow proper release response and corrective action procedures?
- ☐ Are you aware of and have you begun to prepare for the financial responsibility provisions for petroleum USTs?
- ☐ Have you established a record keeping procedure and files for general operating requirements, release detection, closure of USTs, and financial responsibility provisions?
- ☐ Are you aware of and do you follow required reporting procedures for UST systems, general operating requirements, releases, closure, and financial responsibility?

Clean water NPDES permits audit checklist

- ☐ Are there any storm water point sources outfalls at this facility?
- ☐ Does this facility have an NPDES PERMIT?
- ☐ If yes, who is the issuing authority (EPA, state, or both)?
- ☐ What is the NPDES permit expiration date? _____
- ☐ How many and what kind of outfalls are listed on the permit?
 - ☐ Process wastewater
 - ☐ Utility wastewater
 - ☐ Sanitary wastewater
 - ☐ Storm water
 - ☐ Combination

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- ☐ Are there special NPDES restrictions (i.e., priority pollutant analysis, bio-monitoring, etc.) and/or reporting requirements?
- ☐ Is this facility under any permit compliance schedule?
- ☐ Has this facility filed any noncompliance reports within the last three years?
- ☐ Is there a procedure for handling permit excursions?
- ☐ Are noncompliance incidents reported within five working days?
- ☐ Are there any outstanding Notices of Violation or Administrative Orders?
- ☐ Are all on-site treatment systems properly operated, maintained and fully functional?
- ☐ Does this facility have or use any of the priority pollutants?
- ☐ Has the facility's effluent been analyzed for any priority pollutants?
- ☐ How are required samples taken and by whom?
_____?
- ☐ Does this facility have a formalized and documented training program for samplers?
- ☐ Are the samples properly labeled, i.e., time, date, sampler, outfall?
- ☐ Are the samples preserved?
- ☐ Is the time lapse between sampling and analyses kept to a minimum?
- ☐ Does this facility analyze for any permit parameters in its own laboratory?
- ☐ Are your analytical records pertaining to the permit parameters kept a minimum of three years?
- ☐ Is the analyzer and date of analysis identified for each analysis?
- ☐ Are EPA analytical methods used for all permit parameter analysis?
- ☐ Does the lab have an analytical audit/quality control program?
- ☐ Are lab personnel periodically trained and checked for accuracy?
- ☐ Are any outside labs used for the required permit analyses?
- ☐ Is the time lapse between sampling and analyses kept to a minimum?
- ☐ Are quality control and outside analytical records kept a minimum of 3 years?
- ☐ Are the analyzer and date and method of analysis identified for each analysis and part of the documentation record?
- ☐ Are EPA analytical methods used for all quality control analyses?

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- ☐ Is the lab certified by a state or federal agency?
- ☐ Have you reviewed the lab's last agency inspection report?
- ☐ Do you have a copy of the outside laboratory's quality assurance and audit program results?
- ☐ Are discharge monitoring reports (DMR) submitted?
- ☐ Are the DMRs submitted on time?
- ☐ Is there a designated person who signs the DMRs?
- ☐ Does the facility have a letter of signature authorization?
- ☐ Are samples saved until results are available?
- ☐ Are all monitoring/laboratory equipment maintenance documented?
- ☐ Are procedures in place to notify EPA when a change in activity has occurred causing discharge of toxic pollutants significantly (10 times) above or not in permit limits?

Community Right to Know Audit

- ☐ Does the SIC Code of your facility fall under the requirements of SARA Title III?
- ☐ Are you aware of the Threshold Planning Quantities for hazardous substances on your site?
- ☐ Has your facility notified the State Emergency Response Commission that it is subject to SARA Section 302?
- ☐ Did you retain a copy of the notification document?
- ☐ Has your facility expanded its release reporting procedures?
- ☐ Has your facility reported the identity, listing, quantity, time and duration, environmental media, risks and precautions to the relevant agencies and departments relative to releases of hazardous substances at this site?
- ☐ Have you provided the Local Emergency Planning Committee with the identity and ways to contact your facility's emergency coordinator(s)?
- ☐ Do you provide all of the required information about your facility's Emergency Coordinator(s)?
- ☐ Are Material Safety Data Sheets (MSDSs) for toxic and hazardous substances imported, manufactured, processed, used, handled, treated, or stored at the site kept on file?
- ☐ Have you appointed a person who is responsible for maintaining the MSDSs?
- ☐ Has your facility submitted MSDSs and a listing of extremely hazardous substances to the SERC, LEPC and local fire department?

Compliance Management

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☐ Have you kept a record of this transmittal?	
☐ Have you prepared and submitted an inventory of hazardous chemical substances at this facility to the SERC and/or LEPC?	
☐ Did you include a signed certification statement, technical contact, chemical activity, facility's and chemical's identity, chemical's use, quantity, and location?	
☐ Do you have a record of this transmittal?	
☐ Has your facility prepared and submitted its toxic chemical release information to the EPA, SERC, and LEPC for all non-federally permitted releases?	
☐ Does your facility have an existing community awareness and emergency response program?	
☐ Has your facility developed and implemented an environmental spill prevention, control, and countermeasures (SPCC) plan as part of its community awareness and emergency response program?	
☐ Has the SERC and LEPC been presented with a copy of your facility's SPCC plan?	
☐ Does your SPCC plan provide general facility information?	
☐ Does it include information on the following:	
☐ Facility description with number of employees?	
☐ Storage tanks and process vessels?	
☐ Hazardous waste storage?	
☐ Loading and unloading facilities?	
☐ Piping?	
☐ Facility security?	
☐ Lighting?	
☐ Does your SPCC plan address release prevention programs?	
☐ Are the following parts included in your SPCC plan?	
☐ Relief valve inspection and maintenance program?	
☐ Preventive maintenance?	
☐ Corrosion protection?	
☐ Tank integrity, inspection, and leak detection?	
☐ Emission and discharge monitoring?	
☐ Drum control program?	
☐ Personnel training?	
☐ Does your SPCC plan address atmospheric release control and countermeasures?	

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- ☐ Does your SPCC plan include the following atmospheric release control and countermeasures aspects?
 - ☐ Air pollution abatement systems?
 - ☐ Alarm and alert systems?
 - ☐ Containment measures?
 - ☐ Special precautions against uncontrolled releases?
- ☐ Does your SPCC plan address release control for hazardous waste as well as other hazardous substances?
- ☐ Does your SPCC plan address the following aspects of the hazardous substances and waste release control:
 - ☐ Containment and diversionary structures?
 - ☐ Release potential, prediction, and impact models?
 - ☐ Commitment of manpower and equipment?
 - ☐ Facility drainage?
 - ☐ Hazardous waste storage?
 - ☐ Personnel training?
 - ☐ High-level alarms and other special precautions?
 - ☐ Inspections?
 - ☐ Release history?
- ☐ Does your SPCC plan address emergency response and control?
- ☐ Does your plan have an internal emergency response notification list?
- ☐ Does the emergency response and control section of the facility's plan have an evacuation plan?
- ☐ Does your SPCC plan detail the responsibilities and actions of those responding to the emergency?
- ☐ Does your SPCC plan include other relevant emergency control and response parts such as:
 - ☐ Release and emergency response equipment?
 - ☐ Arrangements with local authorities?
- ☐ Does your plan have the most current federal, state, and local reporting requirements?
- ☐ Does your plan include a list of the most recent reportable quantities of hazardous substances on your site or at your facility?
- ☐ Does your plan include the following forms and tables:
 - ☐ Storage tank inspection form

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☐ Drum area inspection form	
☐ Environmental incident report form	
☐ SPCC, hazardous substances, and waste management training program schedules	
☐ Environmental and emergency agency contact form	
☐ Hazardous chemicals inventory form	
☐ Environmental inspection form	
☐ Air pollution abatement equipment work order log	
☐ Facility layout and area map	
☐ Job titles and descriptions	
☐ Release response equipment list	
☐ Emergency equipment list	
☐ Personal protection equipment list	
☐ Emergency notification list	
☐ Outside emergency contacts	
☐ Medical emergency information	
☐ Material Safety Data Sheets	
☐ Waste analysis plan	
☐ Release decision tree	
☐ Release decision scenarios	
☐ Do you have the facility's management approval of and commitment to your plan?	
☐ Do you have professional certifications attesting to the accuracy and functional effectiveness of your plan?	

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Reserved

Regulations

Selected FMCSA regulations

This section includes selected sections of the Federal Motor Carrier Administration (FMCSA) regulations that pertain to the operation of a transportation maintenance facility. If you are interested in other FMCSA regulations that are not in this section, please contact J. J. Keller & Associates, Inc. We have several other products that specialize in FMCSA regulations.

Part 393—Parts and accessories necessary for safe operation

Subpart A—General

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393.1	Scope of the rules in this part.
393.3	Additional equipment and accessories.
393.5	Definitions.
393.7	Matter incorporated by reference.

Subpart B—Lamps, Reflective Devices, and Electrical Wiring

393.9	Lamps operable, prohibition of obstructions of lamps and reflectors.
393.11	Lamps and reflective devices.
393.13	Retroreflective sheeting and reflex reflectors, requirements for semitrailers and trailers manufactured before December 1, 1993.
393.17	Lamps and reflectors - combinations in driveaway-tow-away operation.
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393.22	Combination of lighting devices and reflectors.
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393.24	Requirements for head lamps, auxiliary driving lamps and front fog lamps.
393.25	Requirements for lamps other than head lamps.
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Subpart C—Brakes

393.40	Required brake systems.
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393.48	Brakes to be operative.
393.49	Single valve to operate all brakes.

393.50	Reservoirs required.
393.51	Warning signals, air pressure and vacuum gauges.
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Subpart F—Coupling Devices and Towing Methods

393.70	Coupling devices and towing methods, except for drive-away-towaway operations.
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Subpart G—Miscellaneous Parts and Accessories

393.75	Tires.
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393.78	Windshield wiping and washing systems.
393.79	Windshield defrosting and defogging systems.
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393.81	Horn.
393.82	Speedometer.
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393.84	Floors.
393.85	[Reserved]
393.86	Rear impact guards and rear end protection.
393.87	Warning flags on projecting loads.
393.88	Television receivers.
393.89	Buses, driveshaft protection.
393.90	Buses, standee line or bar.
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393.93	Seats, seat belt assemblies and seat belt assembly anchorages.
393.94	Interior noise levels in power units.

Subpart H—Emergency Equipment

393.95	Emergency equipment on all power units.

Subpart I—Protection Against Shifting and Falling Cargo

393.100	Which types of commercial motor vehicles are subject to the cargo securement standards of this subpart, and what general requirements apply?
393.102	What are the minimum performance criteria for cargo securement devices and systems?
393.104	What standards must cargo securement devices and systems meet in order to satisfy the requirements of this subpart?
393.106	What are the general requirements for securing articles of cargo?

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- 393.108 How is the working load limit of a tiedown, or the load restraining value of a friction mat, determined?
- 393.110 What else do I have to do to determine the minimum number of tiedowns?
- 393.112 Must a tiedown be adjustable?
- 393.114 What are the requirements for front end structures used as part of a cargo securement system?

Specific securement requirements by commodity type

- 393.116 What are the rules for securing logs?
- 393.118 What are the rules for securing dressed lumber or similar building products?
- 393.120 What are the rules for securing metal coils?
- 393.122 What are the rules for securing paper rolls?
- 393.124 What are the rules for securing concrete pipe?
- 393.126 What are the rules for securing intermodal containers?
- 393.128 What are the rules for securing automobiles, light trucks and vans?
- 393.130 What are the rules for securing heavy vehicles, equipment and machinery?
- 393.132 What are the rules for securing flattened or crushed vehicles?
- 393.134 What are the rules for securing roll-on/roll-off or hook lift containers?
- 393.136 What are the rules for securing large boulders?

Subpart J—Frames, Cab and Body Components, Wheels, Steering, and Suspension Systems

- 393.201 Frames.
- 393.203 Cab and body components.
- 393.205 Wheels.
- 393.207 Suspension systems.
- 393.209 Steering wheel systems.

Subpart A—General

§393.1 Scope of the rules in this part.

(a) The rules in this part establish minimum standards for commercial motor vehicles as defined in §390.5 of this title. Only motor vehicles (as defined in §390.5) and combinations of motor vehicles which meet the definition of a commercial motor vehicle are subject to the requirements of this part. All requirements that refer to motor vehicles with a GVWR below 4,536 kg (10,001 pounds) are applicable only when the motor vehicle or combination of motor vehicles meets the definition of a commercial motor vehicle.

(b)(1) Every motor carrier and its employees must be knowledgeable of and comply with the requirements and specifications of this part.

(2) Every intermodal equipment provider and its employees or agents responsible for the inspection, repair, and maintenance of intermodal equipment interchanged to motor carriers must be knowledgeable of and comply with the applicable requirements and specifications of this part.

(c) No motor carrier may operate a commercial motor vehicle, or cause or permit such vehicle to be operated, unless it is equipped in accordance with the requirements and specifications of this part.

(d) No intermodal equipment provider may operate intermodal equipment, or cause or permit such equipment to be operated, unless it is equipped in accordance with the requirements and specifications of this part.

§393.3 Additional equipment and accessories.

The use of additional equipment or accessories in a manner that decreases the safety of operation of a commercial motor vehicle in interstate commerce is prohibited. Nothing contained in this subchapter shall be construed to prohibit the use of additional equipment and accessories, not inconsistent with or prohibited by this subchapter, provided such equipment and accessories do not decrease the safety of operation of the motor vehicles on which they are used.

§393.5 Definitions.

As used in this part, the following words and terms are construed to mean:

Aggregate working load limit. The summation of the working load limits or restraining capacity of all devices used to secure an article of cargo on a vehicle.

Agricultural commodity trailer. A trailer that is designed to transport bulk agricultural commodities in off road harvesting sites and to a processing plant or storage location, as evidenced by skeletal construction that accommodates harvest containers, a maximum length of 28 feet, and an arrangement of air control lines and reservoirs that minimizes damage in field operations.

Air brake system. A system, including an air-over-hydraulic brake subsystem, that uses air as a medium for transmitting pressure or force from the driver control to the service brake, but does not include a system that uses compressed air or vacuum only to assist the driver in applying muscular force to hydraulic or mechanical components.

Air-over-hydraulic brake subsystem. A subsystem of the air brake system that uses compressed air to transmit a force from the driver control to a hydraulic brake system to actuate the service brakes.

Anchor point. Part of the structure, fitting or attachment on a vehicle or article of cargo to which a tiedown is attached.

Antilock Brake System or ABS. Means a portion of a service brake system that automatically controls the degree of rotational wheel slip during braking by:

- (1) Sensing the rate of angular rotation of the wheels;
- (2) Transmitting signals regarding the rate of wheel angular rotation to one or more controlling devices which

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interpret those signals and generate responsive controlling output signals; and

(3) Transmitting those controlling signals to one or more modulators which adjust brake actuating forces in response to those signals.

Article of cargo. A unit of cargo, other than a liquid, gas, or aggregate that lacks physical structure (e.g., grain, gravel, etc.) including articles grouped together so that they can be handled as a single unit or unitized by wrapping, strapping, banding or edge protection device(s).

Auxiliary driving lamp. A lighting device mounted to provide illumination forward of the vehicle which supplements the upper beam of a standard headlighting system. It is not intended for use alone or with the lower beam of a standard headlamp system.

Bell pipe concrete. Pipe whose flanged end is of larger diameter than its barrel.

Blocking. A structure, device or another substantial article placed against or around an article of cargo to prevent horizontal movement of the article of cargo.

Boat trailer. A trailer designed with cradle-type mountings to transport a boat and configured to permit launching of the boat from the rear of the trailer.

Bracing. A structure, device, or another substantial article placed against an article of cargo to prevent it from tipping, that may also prevent it from shifting.

Brake. An energy conversion mechanism used to stop, or hold a vehicle stationary.

Brake power assist unit. A device installed in a hydraulic brake system that reduces the operator effort required to actuate the system, but which if inoperative does not prevent the operator from braking the vehicle by a continued application of muscular force on the service brake control.

Brake power unit. A device installed in a brake system that provides the energy required to actuate the brakes, either directly or indirectly through an auxiliary device, with the operator action consisting only of modulating the energy application level.

Brake tubing/hose. Metallic brake tubing, nonmetallic brake tubing and brake hose are conduits or lines used in a brake system to transmit or contain the medium (fluid or vacuum) used to apply the motor vehicle's brakes.

Chassis. The load-supporting frame of a commercial motor vehicle, exclusive of any appurtenances which might be added to accommodate cargo.

Clearance lamps. Lamps that provide light to the front or rear, mounted on the permanent structure of the vehicle, such that they indicate the overall width of the vehicle.

Container chassis trailer. A semitrailer of skeleton construction limited to a bottom frame, one or more axles, specially built and fitted with locking devices for the transport of intermodal cargo containers, so that when the chassis and container are assembled, the units serve the same function as an over the road trailer.

Converter dolly. A motor vehicle consisting of a chassis equipped with one or more axles, a fifth wheel and/or equivalent mechanism, and drawbar, the attachment of which converts a semitrailer to a full trailer.

Crib-type log trailer. Means a trailer equipped with stakes, bunks, a front-end structure, and a rear structure to restrain logs. The stakes prevent movement of

the logs from side to side on the vehicle while the front-end and rear structures prevent movement of the logs from front to back on the vehicle.

Curb weight. The weight of a motor vehicle with standard equipment, maximum capacity of fuel, oil, and coolant; and, if so equipped, air conditioning and additional weight of optional engine. Curb weight does not include the driver.

Dunnage. All loose materials used to support and protect cargo.

Dunnage bag. An inflatable bag intended to fill otherwise empty space between articles of cargo, or between articles of cargo and the wall of the vehicle.

Edge protector. A device placed on the exposed edge of an article to distribute tiedown forces over a larger area of cargo than the tiedown itself, to protect the tiedown and/or cargo from damage, and to allow the tiedown to slide freely when being tensioned.

Electric brake system. A system that uses electric current to actuate the service brake.

Emergency brake. A mechanism designed to stop a motor vehicle after a failure of the service brake system.

Emergency brake system. A mechanism designed to stop a vehicle after a single failure occurs in the service brake system of a part designed to contain compressed air or brake fluid or vacuum (except failure of a common valve, manifold brake fluid housing or brake chamber housing).

Fifth wheel. A device mounted on a truck tractor or similar towing vehicle (e.g., converter dolly) which interfaces with and couples to the upper coupler assembly of a semitrailer.

Frame vehicle. A vehicle with skeletal structure fitted with one or more bunk units for transporting logs. A bunk unit consists of U-shaped front and rear bunks that together cradle logs. The bunks are welded, gusseted or otherwise firmly fastened to the vehicle's main beams, and are an integral part of the vehicle.

Friction mat. A device placed between the deck of a vehicle and article of cargo, or between articles of cargo, intended to provide greater friction than exists naturally between these surfaces.

Front fog lamp. A lighting device whose beam provides downward illumination forward of the vehicle and close to the ground, and is to be used only under conditions of rain, snow, dust, smoke or fog. A pair of fog lamps may be used alone, with parking, tail, side, marker, clearance and identification lamps, or with a lower beam headlamp at the driver's discretion in accordance with state and local use law.

Fuel tank fitting. Any removable device affixed to an opening in the fuel tank with the exception of the filler cap.

g. The acceleration due to gravity, 32.2 ft/sec² (9.81 m/sec²).

Grommet. A device that serves as a support and protection to that which passes through it.

Hazard warning signal. Lamps that flash simultaneously to the front and rear, on both the right and left sides of a commercial motor vehicle, to indicate to an approaching driver the presence of a vehicular hazard.

Head lamps. Lamps used to provide general illumination ahead of a motor vehicle.

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Heater. Any device or assembly of devices or appliances used to heat the interior of any motor vehicle. This includes a catalytic heater which must meet the requirements of §177.834(1)(2) of this title when Class 3 (flammable liquid) or Division 2.1 (flammable gas) is transported.

Heavy hauler trailer. A trailer which has one or more of the following characteristics, but which is not a container chassis trailer:

(1) Its brake lines are designed to adapt to separation or extension of the vehicle frame; or

(2) Its body consists only of a platform whose primary cargo-carrying surface is not more than 1,016 mm (40 inches) above the ground in an unloaded condition, except that it may include sides that are designed to be easily removable and a permanent “front-end structure” as that term is used in §393.106 of this title.

Hook-lift container. A specialized container, primarily used to contain and transport materials in the waste, recycling, construction/demolition and scrap industries, which is used in conjunction with specialized vehicles, in which the container is loaded and unloaded onto a tilt frame body by an articulating hook-arm.

Hydraulic brake system. A system that uses hydraulic fluid as a medium for transmitting force from a service brake control to the service brake, and that may incorporate a brake power assist unit, or a brake power unit.

Identification lamps. Lamps used to identify certain types of commercial motor vehicles.

Integral securement system. A system on certain roll-on/roll-off containers and hook-lift containers and their related transport vehicles in which compatible front and rear hold down devices are mated to provide securement of the complete vehicle and its articles of cargo.

Lamp. A device used to produce artificial light.

Length of a manufactured home. The largest exterior length in the traveling mode, including any projections which contain interior space. Length does not include bay windows, roof projections, overhangs, or eaves under which there is no interior space, nor does it include drawbars, couplings or hitches.

License plate lamp. A lamp used to illuminate the license plate on the rear of a motor vehicle.

Longwood. Means all logs, including utility poles, that are not shortwood, i.e., that are over 4.9 m (16 feet) long. Such logs are usually described as long logs or treelength.

Low chassis vehicle. (1) A trailer or semitrailer manufactured on or after January 26, 1998, having a chassis which extends behind the rearmost point of the rearmost tires and which has a lower rear surface that meets the guard width, height, and rear surface requirements of §571.224 in effect on the date of manufacture, or a subsequent edition.

(2) A motor vehicle, not described by paragraph (1) of this definition, having a chassis which extends behind the rearmost point of the rearmost tires and which has a lower rear surface that meets the guard configuration requirements of §393.86(b)(1).

Manufactured home. Means a structure, transportable in one or more sections, which in the traveling mode, is eight body feet or more in width or forty body feet or

more in length, or, when erected on site, is three hundred twenty or more square feet, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning, and electrical systems contained therein. Calculations used to determine the number of square feet in a structure will be based on the structure's exterior dimensions measured at the largest horizontal projections when erected on site. These dimensions will include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows. This term includes all structures which meet the above requirements except the size requirements and with respect to which the manufacturer voluntarily files a certification pursuant to 24 CFR 3282.13 and complies with the standards set forth in 24 CFR part 3280.

Metal coil. Means an article of cargo comprised of elements, mixtures, compounds, or alloys commonly known as metal, metal foil, metal leaf, forged metal, stamped metal, metal wire, metal rod, or metal chain that are packaged as a roll, coil, spool, wind, or wrap, including plastic or rubber coated electrical wire and communications cable.

Multi-piece windshield. A windshield consisting of two or more windshield glazing surface areas.

Parking brake system. A mechanism designed to prevent the movement of a stationary motor vehicle.

Play. Any free movement of components.

Pulpwood trailer. A trailer or semitrailer that is designed exclusively for harvesting logs or pulpwood and constructed with a skeletal frame with no means for attachment of a solid bed, body, or container.

Rail vehicle. A vehicle whose skeletal structure is fitted with stakes at the front and rear to contain logs loaded crosswise.

Rear extremity. The rearmost point on a motor vehicle that falls above a horizontal plane located 560 mm (22 inches) above the ground and below a horizontal plane located 1,900 mm (75 inches) above the ground when the motor vehicle is stopped on level ground; unloaded; its fuel tanks are full; the tires (and air suspension, if so equipped) are inflated in accordance with the manufacturer's recommendations; and the motor vehicle's cargo doors, tailgate, or other permanent structures are positioned as they normally are when the vehicle is in motion. Nonstructural protrusions such as taillamps, rubber bumpers, hinges and latches are excluded from the determination of the rearmost point.

Reflective material. A material conforming to Federal Specification LS 300, “Sheeting and Tape, Reflective; Non exposed Lens, Adhesive Backing,” (September 7, 1965) meeting the performance standard in either Table 1 or Table 1A of SAE Standard J594f, “Reflex Reflectors” (January, 1977).

Reflex reflector. A device which is used on a vehicle to give an indication to an approaching driver by reflected light from the lamps on the approaching vehicle.

Saddle-mount. A device, designed and constructed as to be readily demountable, used in driveaway-towaway operations to perform the functions of a conventional fifth wheel:

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(1) Upper-half. "Upper-half" of a "saddle-mount" means that part of the device which is securely attached to the towed vehicle and maintains a fixed position relative thereto, but does not include the "king-pin;"

(2) Lower-half. "Lower-half" of a "saddle-mount" means that part of the device which is securely attached to the towing vehicle and maintains a fixed position relative thereto but does not include the "king-pin;" and

(3) King pin. "King-pin" means that device which is used to connect the "upper-half" to the "lower-half" in such manner as to permit relative movement in a horizontal plane between the towed and towing vehicles.

Service brake system. A primary brake system used for slowing and stopping a vehicle.

Shoring bar. A device placed transversely between the walls of a vehicle and cargo to prevent cargo from tipping or shifting.

Shortwood. All logs typically up to 4.9 m (16 feet) long. Such logs are often described as cut-up logs, cut-to-length logs, bolts or pulpwood. Shortwood may be loaded lengthwise or crosswise, though that loaded crosswise is usually no more than 2.6 m (102 inches) long.

Side extremity. The outermost point on a side of the motor vehicle that is above a horizontal plane located 560 mm (22 inches) above the ground, below a horizontal plane located 1,900 mm (75 inches) above the ground, and between a transverse vertical plane tangent to the rear extremity of the vehicle and a transverse vertical plane located 305 mm (12 inches) forward of that plane when the vehicle is unloaded; its fuel tanks are full; and the tires (and air suspension, if so equipped) are inflated in accordance with the manufacturer's recommendations. Non-structural protrusions such as taillights, hinges and latches are excluded from the determination of the outermost point.

Side marker lamp (Intermediate). A lamp mounted on the side, on the permanent structure of the motor vehicle that provides light to the side to indicate the approximate middle of the vehicle, when the motor vehicle is 9.14 meters (30 feet) or more in length.

Side marker lamps. Lamps mounted on the side, on the permanent structure of the motor vehicle as near as practicable to the front and rear of the vehicle, that provide light to the side to indicate the overall length of the motor vehicle.

Sided vehicle. A vehicle whose cargo compartment is enclosed on all four sides by walls of sufficient strength to contain articles of cargo, where the walls may include latched openings for loading and unloading, and includes vans, dump bodies, and a sided intermodal container carried by a vehicle.

Special purpose vehicle. (1) A trailer or semitrailer manufactured on or after January 26, 1998, having work-performing equipment that, while the motor vehicle is in transit, resides in or moves through the area that could be occupied by the horizontal member of the rear impact guard, as defined by the guard width, height and rear surface requirements of §571.224 (paragraphs S5.1.1 through S5.1.3), in effect on the date of manufacture, or a subsequent edition.

(2) A motor vehicle, not described by paragraph (1) of this definition, having work-performing equipment that,

while the motor vehicle is in transit, resides in or moves through the area that could be occupied by the horizontal member of the rear impact guard, as defined by the guard width, height and rear surface requirements of §393.86(b)(1).

Split service brake system. A brake system consisting of two or more subsystems actuated by a single control designed so that a leakage-type failure of a pressure component in a single subsystem (except structural failure of a housing that is common to two or more subsystems) shall not impair the operation of any other subsystem.

Steering wheel lash. The condition in which the steering wheel may be turned through some part of a revolution without associated movement of the front wheels.

Stop lamps. Lamps shown to the rear of a motor vehicle to indicate that the service brake system is engaged.

Surge brake. A self-contained, permanently closed hydraulic brake system for trailers that relies on inertial forces, developed in response to the braking action of the towing vehicle, applied to a hydraulic device mounted on or connected to the tongue of the trailer, to slow down or stop the towed vehicle.

Tail lamps. Lamps used to designate the rear of a motor vehicle.

Tiedown. A combination of securing devices which forms an assembly that attaches articles of cargo to, or restrains articles of cargo on, a vehicle or trailer, and is attached to anchor point(s).

Tow bar. A strut or column-like device temporarily attached between the rear of a towing vehicle and the front of the vehicle being towed.

Tractor-pole trailer. A combination vehicle that carries logs lengthwise so that they form the body of the vehicle. The logs are supported by a bunk located on the rear of the tractor, and another bunk on the skeletal trailer. The tractor bunk may rotate about a vertical axis, and the trailer may have a fixed, scoping, or cabled reach, or other mechanical freedom, to allow it to turn.

Trailer kingpin. A pin (with a flange on its lower end) which extends vertically from the front of the underside of a semitrailer and which locks into a fifth wheel.

Turn signals. Lamps used to indicate a change in direction by emitting a flashing light on the side of a motor vehicle towards which a turn will be made.

Upper coupler assembly. A structure consisting of an upper coupler plate, king pin and supporting frame-work which interfaces with and couples to a fifth wheel.

Upper coupler plate. A plate structure through which the king pin neck and collar extend. The bottom surface of the plate contacts the fifth wheel when coupled.

Vacuum brake system. A system that uses a vacuum and atmospheric pressure for transmitting a force from the driver control to the service brake, not including a system that uses vacuum only to assist the driver in applying muscular force to hydraulic or mechanical components.

Void filler. Material used to fill a space between articles of cargo and the structure of the vehicle that has sufficient strength to prevent movement of the articles of cargo.

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Well. The depression formed between two cylindrical articles of cargo when they are laid with their eyes horizontal and parallel against each other.

Wheels back vehicle. (1) A trailer or semitrailer manufactured on or after January 26, 1998, whose rearmost axle is permanently fixed and is located such that the rearmost surface of the tires (of the size recommended by the vehicle manufacturer for the rear axle) is not more than 305 mm (12 inches) forward of the transverse vertical plane tangent to the rear extremity of the vehicle.

(2) A motor vehicle, not described by paragraph (1) of this definition, whose rearmost axle is permanently fixed and is located such that the rearmost surface of the tires (of the size recommended by the vehicle manufacturer for the rear axle) is not more than 610 mm (24 inches) forward of the transverse vertical plane tangent to the rear extremity of the vehicle.

Width of a manufactured home. The largest exterior width in the traveling mode, including any projections which contain interior space. Width does not include bay windows, roof projections, overhangs, or eaves under which there is no interior space.

Windshield. The principal forward facing glazed surface provided for forward vision in operating a motor vehicle.

Working load limit (WLL). The maximum load that may be applied to a component of a cargo securement system during normal service, usually assigned by the manufacturer of the component.

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§393.7 Matter incorporated by reference.

(a) **Incorporation by reference.** Part 393 includes references to certain matter or materials, as listed in paragraph (b) of this section. The text of the materials is not included in the regulations contained in part 393. The materials are hereby made a part of the regulations in part 393. The Director of the Federal Register has approved the materials incorporated by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. For materials subject to change, only the specific version approved by the Director of the Federal Register and specified in the regulation are incorporated. Material is incorporated as it exists on the date of the approval and a notice of any change in these materials will be published in the *Federal Register*.

(b) **Matter or materials referenced in part 393.** The matter or materials listed in this paragraph are incorporated by reference in the corresponding sections noted.

(1) Auxiliary Upper Beam Lamps, Society of Automotive Engineers (SAE) J581, July 2004, incorporation by reference approved for §393.24(b).

(2) Front Fog Lamp, SAE J583, August 2004, incorporation by reference approved for §393.24(b).

(3) Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width, SAE J586, March 2000, incorporation by reference approved for §393.25(c).

(4) Stop Lamps and Front- and Rear-Turn Signal Lamps for Use on Motor Vehicles 2032 mm or more in Overall Width, SAE J2261, January 2002, incorporated by reference approved for §393.25(c).

(5) Tail Lamps (Rear Position Lamps) for Use on Motor Vehicles Less Than 2032 mm in Overall Width, SAE J585, March 2000, incorporation by reference approved for §393.25(c).

(6) Tail Lamps (Rear Position Lamps) for Use on Vehicles 2032 mm or More in Overall Width, SAE J2040, March 2002, incorporation by reference approved for §393.25(c).

(7) Turn Signal Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width, SAE J588, March 2000, incorporation by reference approved for §393.25(c).

(8) Sidemarkers Lamps for Use on Road Vehicles Less Than 2032 mm in Overall Width, SAE J592, August 2000, incorporation by reference approved for §393.25(c).

(9) Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles, SAE J595, January 2005, incorporation by reference approved for §393.25(e).

(10) Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles, SAE J845, May 1997, incorporation by reference approved for §393.25(e).

(11) Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance, and Service Vehicles, SAE J1318, May 1998, incorporation by reference approved for §393.25(e).

(12) Reflex Reflectors, SAE J594, December 2003, incorporation by reference approved for §393.26(c).

(13) Standard Specification for Retroreflective Sheet- ing for Traffic Control, American Society of Testing and

Materials, ASTM D 4956-04, 2004, incorporation by reference approved for §393.26(c).

(14) Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring, SAE J1292, October 1981, incorporated by reference approved for §393.28.

(15) [Reserved]

(16) American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways-Safety Standard, SAE Z26.1-1996, August 1997, incorporation by reference approved for §393.62(d).

(17) Specification for Sound Level Meters, American National Standards Institute, S1.4-1983, incorporation by reference approved for §393.94(c).

(18) Standard Specification for Strapping, Flat Steel and Seals, American Society for Testing and Materials (ASTM), D3953-97, February 1998, incorporation by reference approved for §393.104(e).

(19) Welded Steel Chain Specifications, National Association of Chain Manufacturers, September 28, 2005, incorporation by reference approved for §393.104(e).

(20) Recommended Standard Specification for Synthetic Web Tiedowns, Web Sling and Tiedown Association, WSTDA-T1, 1998, incorporation by reference approved for §393.104(e).

(21) Wire Rope Users Manual, 2nd Edition, Wire Rope Technical Board November 1985, incorporation by reference approved for §393.104(e).

(22) Cordage Institute rope standards approved for incorporation into §393.104(e):

(i) PETRS-2, Polyester Fiber Rope, 3-Strand and 8-Strand Constructions, January 1993;

(ii) PPRS-2, Polypropylene Fiber Rope, 3-Strand and 8-Strand Constructions, August 1992;

(iii) CRS-1, Polyester/Polypropylene Composite Rope Specifications, Three-Strand and Eight-Strand Standard Construction, May 1979;

(iv) NRS-1, Nylon Rope Specifications, Three-Strand and Eight-Strand Standard Construction, May 1979; and

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(v) C-1, Double Braided Nylon Rope Specifications DBN, January 1984.

(c) **Availability.** The materials incorporated by reference are available as follows:

(1) Standards of the Underwriters Laboratories, Inc. Information and copies may be obtained by writing to: Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, Illinois 60062.

(2) Specifications of the American Society for Testing and Materials. Information and copies may be obtained by writing to: American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959.

(3) Specifications of the National Association of Chain Manufacturers. Information and copies may be obtained by writing to: National Association of Chain Manufacturers, P.O. Box 22681, Lehigh Valley, Pennsylvania 18002-2681.

(4) Specifications of the Web Sling and Tiedown Association. Information and copies may be obtained by writing to: Web Sling and Tiedown Association, Inc., 5024-R Campbell Boulevard, Baltimore, Maryland 21236-5974.

(5) Manuals of the Wire Rope Technical Board. Information and copies may be obtained by writing to: Wire Rope Technical Committee, P.O. Box 849, Stevensville, Maryland 21666.

(6) Standards of the Cordage Institute. Information and copies may be obtained by writing to: Cordage Institute, 350 Lincoln Street, 115, Hingham, Massachusetts 02043.

(7) Standards of the Society of Automotive Engineers (SAE). Information and copies may be obtained by writing to: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

(8) Standards of the American National Standards Institute (ANSI). Information and copies may be obtained by writing to: American National Standards Institute, 25 West 43rd Street, New York, New York 10036.

(9) [Reserved].

(10) All of the materials incorporated by reference are available for inspection at:

(i) The Federal Motor Carrier Safety Administration, Office of Bus and Truck Standards and Operations (MC-PS), 1200 New Jersey Ave., SE., Washington, DC 20590-0001; and

(ii) The Office of the Federal Register, 800 North Capitol Street, NW, Suite 700, Washington, DC.

Subpart B—Lamps, reflective devices and electrical wiring

§393.9 Lamps operable, prohibition of obstructions of lamps and reflectors.

(a) All lamps required by this subpart shall be capable of being operated at all times. This paragraph shall not

be construed to require that any auxiliary or additional lamp be capable of operating at all times.

(b) Lamps and reflective devices/material required by this subpart must not be obscured by the tailboard, or by any part of the load, or its covering by dirt, or other added vehicle or work equipment, or otherwise. Exception: The conspicuity treatments on the front end protection devices may be obscured by part of the load being transported.

§393.11 Lamps and reflective devices.

(a)(1) **Lamps and reflex reflectors.** Table 1 specifies the requirements for lamps, reflective devices and associated equipment by the type of commercial motor vehicle. The diagrams in this section illustrate the position of the lamps, reflective devices and associated equipment specified in Table 1. All commercial motor vehicles manufactured on or after December 25, 1968, must, at a minimum, meet the applicable requirements of 49 CFR 571.108 (FMVSS No. 108) in effect at the time of manufacture of the vehicle. Commercial motor vehicles manufactured before December 25, 1968, must, at a minimum, meet the requirements of subpart B of part 393 in effect at the time of manufacture.

(2) **Exceptions:** Pole trailers and trailer converter dollies must meet the part 393 requirements for lamps, reflective devices and electrical equipment in effect at the time of manufacture. Trailers which are equipped with conspicuity material which meets the requirements of §393.11(b) are not required to be equipped with the reflex reflectors listed in Table 1 if—

(i) The conspicuity material is placed at the locations where reflex reflectors are required by Table 1; and

(ii) The conspicuity material when installed on the motor vehicle meets the visibility requirements for the reflex reflectors.

(b) **Conspicuity Systems.** Each trailer of 2,032 mm (80 inches) or more overall width, and with a GVWR over 4,536 kg (10,000 pounds), manufactured on or after December 1, 1993, except pole trailers and trailers designed exclusively for living or office use, shall be equipped with either retroreflective sheeting that meets the requirements of FMVSS No. 108 (S5.7.1), reflex reflectors that meet the requirements FMVSS No. 108 (S5.7.2), or a combination of retroreflective sheeting and reflex reflectors that meet the requirements of FMVSS No. 108 (S5.7.3). The conspicuity system shall be installed and located as specified in FMVSS No. 108 [S5.7.1.4 (for retroreflective sheeting), S5.7.2.2 (for reflex reflectors), S5.7.3 (for a combination of sheeting and reflectors)] and have certification and markings as required by S5.7.1.5 (for retroreflective tape) and S5.7.2.3 (for reflex reflectors).

(c) **Prohibition on the use of amber stop lamps and tail lamps.** No commercial motor vehicle may be equipped with an amber stop lamp, a tail lamp, or other lamp which is optically combined with an amber stop lamp or tail lamp.

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TABLE 1 OF §393.11—REQUIRED LAMPS AND REFLECTORS ON COMMERCIAL MOTOR VEHICLES

Item on the vehicle	Quantity	Color	Location	Position	Height above the road surface in millimeters (mm) (with English units in parenthesis) measured from the center of the lamp at curb weight	Vehicles for which the devices are required
Headlamps	2	White	Front	On the front at the same height, with an equal number at each side of the vertical center line as far apart as practicable.	Not less than 559 mm (22 inches) nor more than 1,372 mm (54 inches).	A, B, C
Turn signal (front). See footnotes #2 and 12.	2	Amber	At or near the front.	One on each side of the vertical centerline at the same height and as far apart as practicable.	Not less than 381 mm (15 inches) nor more than 2,108 mm (83 inches).	A, B, C
Identification lamps (front). See footnote #1.	3	Amber	Front	As close as practicable to the top of the vehicle, at the same height, and as close as practicable to the vertical centerline of the vehicle (or the vertical centerline of the cab where different from the centerline of the vehicle) with lamp centers spaced not less than 152 mm (6 inches) or more than 305 mm (12 inches) apart. Alternatively, the front lamps may be located as close as practicable to the top of the cab.	All three on the same level as close as practicable to the top of the motor vehicle.	B, C
Tail lamps. See footnotes #5 and 11.	2	Red	Rear	One lamp on each side of the vertical centerline at the same height and as far apart as practicable.	Both on the same level between 381 mm (15 inches) and 1,829 mm (72 inches).	A, B, C, D, E, F, G, H
Stop lamps. See footnotes #5 and 13.	2	Red	Rear	One lamp on each side of the vertical centerline at the same height and as far apart as practicable.	Both on the same level between 381 mm (15 inches) and 1,829 mm (72 inches).	A, B, C, D, E, F, G
Clearance lamps. See footnotes #8, 9, 10, 15 & 17.	2	Amber	One on each side of the front of the vehicle.	One on each side of the vertical centerline to indicate overall width.	Both on the same level as high as practicable.	B, C, D, G, H
Clearance lamps. See footnotes #8, 9, 10, 15 & 17.	2	Red	One on each side of the rear of the vehicle.	One on each side of the vertical centerline to indicate overall width.	Both on the same level as high as practicable.	B, D, G, H
Reflex reflector, intermediate (side).	2	Amber	One on each side.	At or near the midpoint between the front and rear side marker lamps, if the length of the vehicle is more than 9,144 mm (30 feet).	Between 381 mm (15 inches) and 1,524 (60 inches).	A, B, D, F, G
Reflex reflector (rear). See footnotes #5, 6, and 8.	2	Red	Rear	One on each side of the vertical centerline, as far apart as practicable and at the same height.	Both on the same level, between 381 mm (15 inches) and 1,524 mm (60 inches).	A, B, C, D, E, F, G
Reflex reflector (rear side).	2	Red	One on each side (rear).	As far to the rear as practicable.	Both on the same level, between 381 mm (15 inches) and 1,524 mm (60 inches).	A, B, D, F, G
Reflex reflector (front side). See footnote #16.	2	Amber	One on each side (front).	As far to the front as practicable.	Between 381 mm (15 inches) and 1,524 mm (60 inches).	A, B, C, D, F, G
License plate lamp (rear). See footnote #11.	1	White	At rear license plate to illuminate the plate from the top or sides.		No requirements	A, B, C, D, F, G
Side marker lamp (front). See footnote #16.	2	Amber	One on each side.	As far to the front as practicable.	Not less than 381 mm (15 inches).	A, B, C, D, F
Side marker lamp intermediate.	2	Amber	One on each side.	At or near the midpoint between the front and rear side marker lamps, if the length of the vehicle is more than 9,144 mm (30 feet).	Not less than 381 mm (15 inches).	A, B, D, F, G

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TABLE 1 OF §393.11—REQUIRED LAMPS AND REFLECTORS ON COMMERCIAL MOTOR VEHICLES, Continued

Item on the vehicle	Quantity	Color	Location	Position	Height above the road surface in millimeters (mm) (with English units in parenthesis) measured from the center of the lamp at curb weight	Vehicles for which the devices are required
Side marker lamp (rear). See footnotes #4 and 8.	2	Red	One on each side.	As far to the rear as practicable.	Not less than 381 mm (15 inches), and on the rear of trailers not more than 1,524 mm (60 inches).	A, B, D, F, G
Turn signal (rear). See footnotes #5 and 12.	2	Amber or red	Rear	One lamp on each side of the vertical centerline as far apart as practicable.	Both on the same level, between 381 mm (15 inches) and 2,108 mm (83 inches).	A, B, C, D, E, F, G
Identification lamp (rear). See footnotes #3, 7, and 15.	3	Red	Rear	One as close as practicable to the vertical centerline. One on each side with lamp centers spaced not less than 152 mm (6 inches) or more than 305 mm (12 inches) apart.	All three on the same level as close as practicable to the top of the vehicle.	B, D, G
Vehicular hazard warning signal flasher lamps. See footnotes #5 and 12.	2	Amber	Front	One lamp on each side of the vertical centerline, as far apart as practicable.	Both on the same level, between 381 mm (15 inches) and 2,108 mm (83 inches).	A, B, C
Vehicular hazard warning signal flasher lamps. See footnotes #5 and 12.	2	Amber or red	Rear	One lamp on each side of the vertical centerline, as far apart as practicable.	Both on the same level, between 381 mm (15 inches) and 2,108 mm (83 inches).	A, B, C, D, E, F, G
Backup lamp. See footnote #14.	1 or 2	White	Rear	Rear	No requirement	A, B, C
Parking lamp	2	Amber or white	Front	One lamp on each side of the vertical centerline, as far apart as practicable.	Both on the same level, between 381 mm (15 inches) and 2,108 mm (83 inches).	A

Legend: Types of commercial motor vehicles shown in the last column of Table 1.

A. Buses and trucks less than 2,032 mm (80 inches) in overall width.

B. Buses and trucks 2,032 mm (80 inches) or more in overall width.

C. Truck tractors.

D. Semitrailers and full trailers 2,032 mm (80 inches) or more in overall width except converter dollies.

E. Converter dolly.

F. Semitrailers and full trailers less than 2,032 mm (80 inches) in overall width.

G. Pole trailers.

H. Projecting loads.

Note: Lamps and reflectors may be combined as permitted by §393.22 and S5.4 of 49 CFR 571.108, Equipment combinations.

Footnote—1 Identification lamps may be mounted on the vertical centerline of the cab where different from the centerline of the vehicle, except where the cab is not more than 42 inches wide at the front roofline, then a single lamp at the center of the cab shall be deemed to comply with the requirements for identification lamps. No part of the identification lamps or their mountings may extend below the top of the vehicle windshield.

Footnote—2 Unless the turn signals on the front are so constructed (double-faced) and located as to be visible to passing drivers, two turn signals are required on

the rear of the truck tractor, one at each side as far apart as practicable.

Footnote—3 The identification lamps need not be visible or lighted if obscured by a vehicle in the same combination.

Footnote—4 Any semitrailer or full trailer manufactured on or after March 1, 1979, shall be equipped with rear side—marker lamps at a height of not less than 381 mm (15 inches), and on the rear of trailers not more than 1,524 mm (60 inches) above the road surface, as measured from the center of the lamp on the vehicle at curb weight.

Footnote—5 Each converter dolly, when towed singly by another vehicle and not as part of a full trailer, shall be equipped with one stop lamp, one tail lamp, and two reflectors (one on each side of the vertical centerline, as far apart as practicable) on the rear. Each converter dolly shall be equipped with rear turn signals and vehicular hazard warning signal flasher lamps when towed singly by another vehicle and not as part of a full trailer, if the converter dolly obscures the turn signals at the rear of the towing vehicle.

Footnote—6 Pole trailers shall be equipped with two reflex reflectors on the rear, one on each side of the vertical centerline as far apart as practicable, to indicate the extreme width of the trailer.

Footnote—7 Pole trailers, when towed by motor vehicles with rear identification lamps meeting the requirements of §393.11 and mounted at a height greater

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than the load being transported on the pole trailer, are not required to have rear identification lamps.

Footnote—8 Pole trailers shall have on the rearmost support for the load: (1) two front clearance lamps, one on each side of the vehicle, both on the same level and as high as practicable to indicate the overall width of the pole trailer; (2) two rear clearance lamps, one on each side of the vehicle, both on the same level and as high as practicable to indicate the overall width of the pole trailer; (3) two rear side marker lamps, one on each side of the vehicle, both on the same level, not less than 375 mm (15 inches) above the road surface; (4) two rear reflex reflectors, one on each side, both on the same level, not less than 375 mm (15 inches) above the road surface to indicate maximum width of the pole trailer; and (5) one red reflector on each side of the rearmost support for the load. Lamps and reflectors may be combined as allowed in §393.22.

Footnote—9 Any motor vehicle transporting a load which extends more than 102 mm (4 inches) beyond the overall width of the motor vehicle shall be equipped with the following lamps in addition to other required lamps when operated during the hours when headlamps are required to be used.

(1) The foremost edge of that portion of the load which projects beyond the side of the vehicle shall be marked (at its outermost extremity) with an amber lamp visible from the front and side.

(2) The rearmost edge of that portion of the load which projects beyond the side of the vehicle shall be marked (at its outermost extremity) with a red lamp visible from the rear and side.

(3) If the projecting load does not measure more than 914 mm (3 feet) from front to rear, it shall be marked with an amber lamp visible from the front, both sides, and rear, except that if the projection is located at or near the rear it shall be marked by a red lamp visible from front, side, and rear.

Footnote—10 Projections beyond rear of motor vehicles. Motor vehicles transporting loads which extend more than 1,219 mm (4 feet) beyond the rear of the motor vehicle, or which have tailboards or tailgates extending more than 1,219 mm (4 feet) beyond the body, shall have these projections marked as follows when the vehicle is operated during the hours when headlamps are required to be used:

(1) On each side of the projecting load, one red side marker lamp, visible from the side, located so as to indicate maximum overhang.

(2) On the rear of the projecting load, two red lamps, visible from the rear, one at each side; and two red reflectors visible from the rear, one at each side, located so as to indicate maximum width.

Footnote—11 To be illuminated when tractor headlamps are illuminated.

Footnote—12 Every bus, truck, and truck tractor shall be equipped with a signaling system that, in addition to signaling turning movements, shall have a switch or combination of switches that will cause the two front turn signals and the two rear signals to flash simultaneously as a vehicular traffic signal warning, required by

§392.22(a). The system shall be capable of flashing simultaneously with the ignition of the vehicle on or off.

Footnote—13 To be actuated upon application of service brakes.

Footnote—14 Backup lamp required to operate when bus, truck, or truck tractor is in reverse.

Footnote—15

(1) For the purposes of §393.11, the term “overall width” refers to the nominal design dimension of the widest part of the vehicle, exclusive of the signal lamps, marker lamps, outside rearview mirrors, flexible fender extensions, and mud flaps.

(2) Clearance lamps may be mounted at a location other than on the front and rear if necessary to indicate the overall width of a vehicle, or for protection from damage during normal operation of the vehicle.

(3) On a trailer, the front clearance lamps may be mounted at a height below the extreme height if mounting at the extreme height results in the lamps failing to mark the overall width of the trailer.

(4) On a truck tractor, clearance lamps mounted on the cab may be located to indicate the width of the cab, rather than the width of the vehicle.

(5) When the rear identification lamps are mounted at the extreme height of a vehicle, rear clearance lamps are not required to be located as close as practicable to the top of the vehicle.

Footnote—16 A trailer subject to this part that is less than 1829 mm (6 feet) in overall length, including the trailer tongue, need not be equipped with front side marker lamps and front side reflex reflectors.

Footnote—17 A boat trailer subject to this part whose overall width is 2032 mm (80 inches) or more need not be equipped with both front and rear clearance lamps provided an amber (front) and red (rear) clearance lamp is located at or near the midpoint on each side so as to indicate its extreme width.

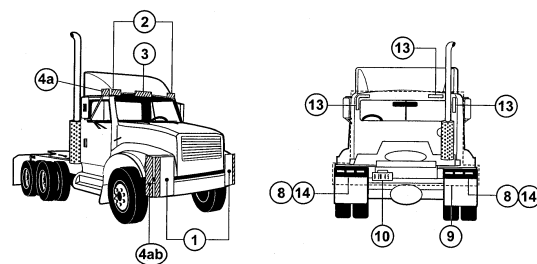


Figure 1 Truck Illustration for § 393.11

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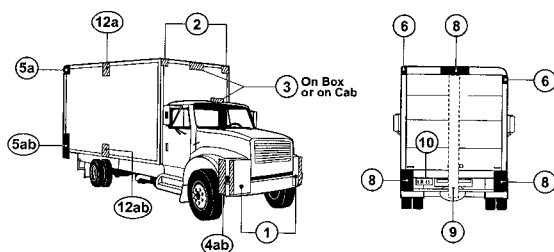


Figure 2 Straight Truck Illustration for § 393.11

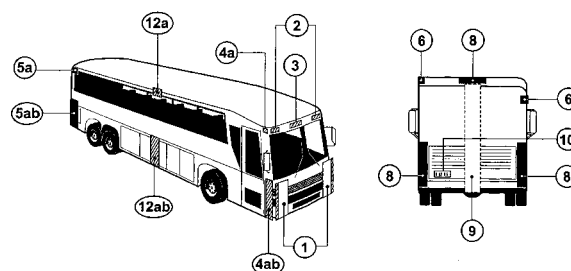


Figure 7 Bus Illustration for § 393.11

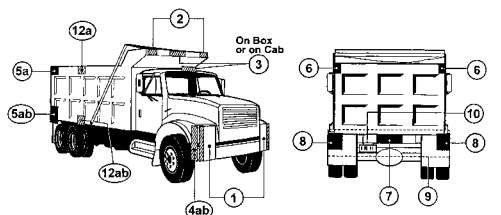


Figure 3 Straight Truck illustration for § 393.11

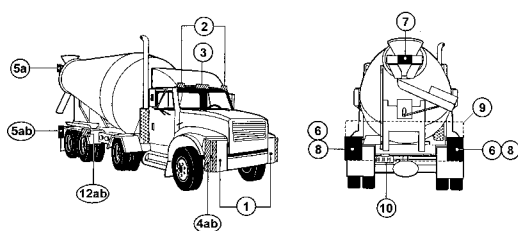


Figure 4 Straight Truck Illustration for § 393.11

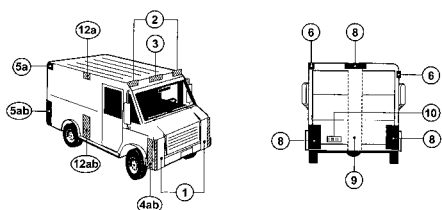


Figure 5 Straight Truck Illustration for § 393.11

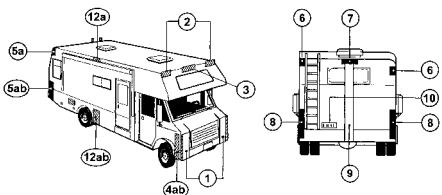


Figure 6 Straight Truck Illustration for § 393.11

LEGEND FOR FIGURES 1 THROUGH 7 - 49 CFR 393.11 TRUCK & BUS VEHICLE ILLUSTRATIONS (DOES NOT APPLY TO FIGURES 8 THROUGH 18 FOR TRAILERS)

Area	Equipment
1	Headlamps - Lower Beam
	Headlamps - Upper Beam
	Parking Lamps - Attention: Required only on vehicles less than 2032mm wide
	Front Turn Signal/Hazard Warning Lamps
2	Front Clearance Lamps - Attention: Required for vehicles 2032mm wide or wider
3	Front Identification Lamps (ID)
4	Front Side Marker Lamps
4a	Front Side Reflex Reflectors
5a	Rear Side Marker Lamps - Not required on Truck Tractors
5b	Rear Side Reflex Reflectors - Not required on Truck Tractors
6	Rear Clearance Lamps
6a	Attention: Required for vehicles 2032mm wide or wider, but not required on Truck Tractors
7	Rear Identification Lamps (ID)
7a	Attention: Required for vehicles 2032mm wide or wider, but not required on Truck Tractors
8	Tail Lamps
9	Stop Lamps
10	Rear Turn Signal/Hazard Warning Lamps
11	Rear Reflex Reflectors
12	Backup Lamp
13	License Plate Lamp
14	Center High Mounted Stop Lamp
15	Attention: Required for vehicles less than 2032mm wide and 4536kg

ADDITIONAL EQUIPMENT FOR SPECIFIC TRUCKS AND BUS VEHICLES

Area	Equipment
12a	Intermediate Side Marker Lamps
12b	Intermediate Side Reflex Reflectors

TRUCK TRACTORS

Area	DESCRIPTION
16	Rear Upper Body Marking
17	Rear Marking

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LEGEND FOR FIGURES 1 THROUGH 7 - 49 CFR 393.11
TRUCK & BUS VEHICLE ILLUSTRATIONS
(DOES NOT APPLY TO FIGURES 8 THROUGH 18 FOR TRAILERS)

Area	Equipment
1	Headlamps - Lower Beam
	Headlamps - Upper Beam
	Parking Lamps - Attention: Required only on vehicles less than 2032mm wide
	Front Turn Signal/Hazard Warning Lamps
2	Front Clearance Lamps - Attention: Required for vehicles 2032mm wide or wider
3	Front Identification Lamps (ID)
4a	Front Side Marker Lamps
4b	Front Side Reflex Reflectors
5a	Rear Side Marker Lamps - Not required on Truck Tractors
5b	Rear Side Reflex Reflectors - Not required on Truck Tractors
6	Rear Clearance Lamps Attention: Required for vehicles 2032mm wide or wider, but not required on Truck Tractors
7	Rear Identification Lamps (ID) Attention: Required for vehicles 2032mm wide or wider, but not required on Truck Tractors
8	Tail Lamps
	Stop Lamps
	Rear Turn Signal/Hazard Warning Lamps
9	Rear Reflex Reflectors
10	Backup Lamp
11	License Plate Lamp
12	Center High Mounted Stop Lamp Attention: Required for vehicles less than 2032mm wide and 4536kg

ADDITIONAL EQUIPMENT FOR SPECIFIC TRUCKS AND BUS VEHICLES

Area	Equipment
12a	Intermediate Side Marker Lamps
12b	Intermediate Side Reflex Reflectors

TRUCK TRACTORS

Area	DESCRIPTION
13	Rear Upper Body Marking
14	Rear Marking

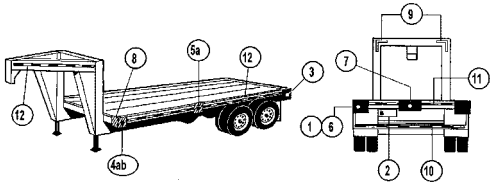


Figure 10 Semi Trailer Illustration for § 393.11

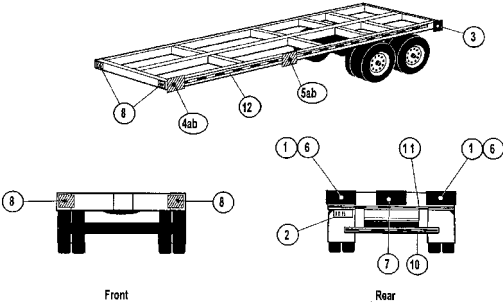


Figure 11 Container Chassis Illustration for § 393.11

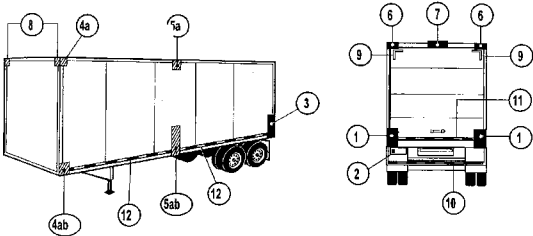


Figure 8 Semi Trailer Illustration for § 393.11

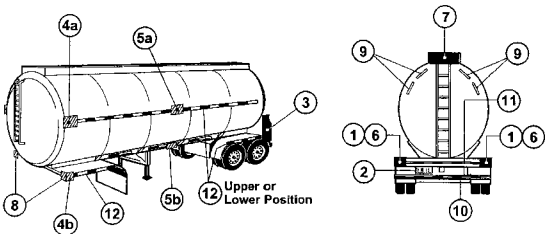


Figure 9 Semi Trailer Illustration for § 393.11

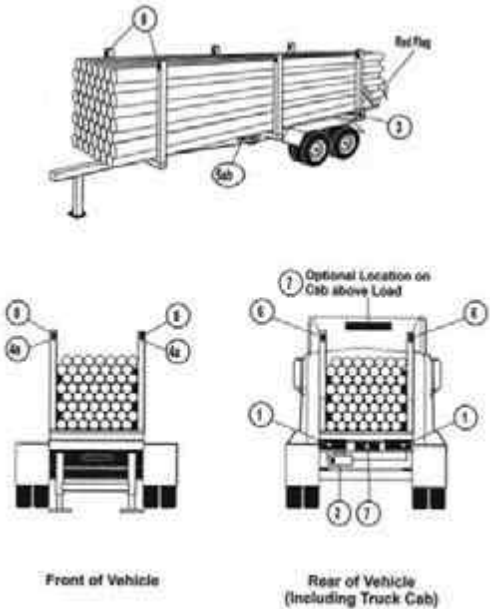


Figure 12 Pole Trailer Illustration for § 393.11

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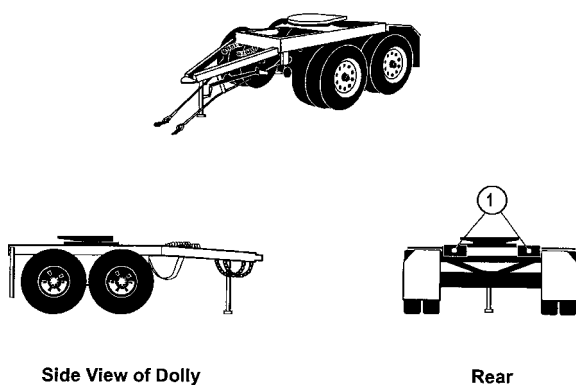


Figure 13 Converter Dolly Illustration for § 393.11

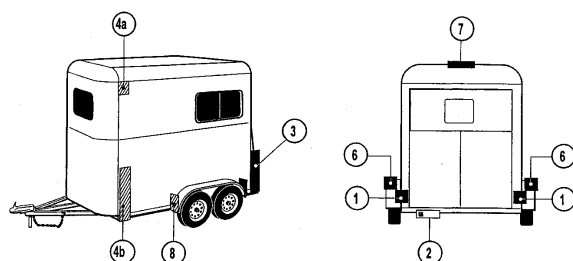


Figure 14 Semi Trailer Illustration for § 393.11

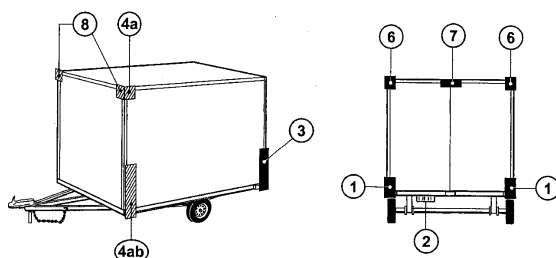


Figure 15 Semi Trailer Illustration for § 393.11

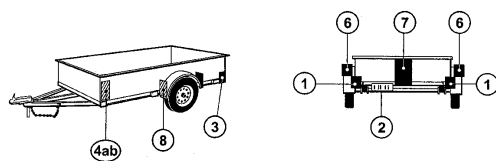


Figure 16 Semi Trailer Illustration for § 393.11

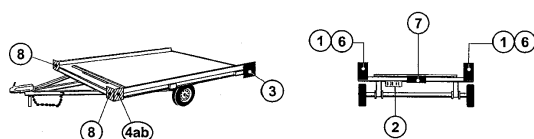


Figure 17 Semi Trailer Illustration for § 393.11

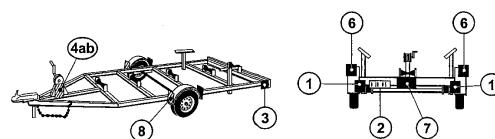


Figure 18 Semi Trailer Illustration for § 393.11

LEGEND FOR FIGURES 8 THROUGH 18 - 49 CFR 393.11 TRAILER ILLUSTRATIONS (DOES NOT APPLY TO FIGURES 1 THROUGH 7 FOR TRUCKS & BUSES)

Area	Equipment
	Tail Lamps
	Stop Lamps
1	Rear Turn Signal Lamps
	Rear Reflex Reflectors
2	License Plate Lamp (s)
3	Rear Side Marker Lamps
	Rear Side Reflex Reflectors
4a	Front Side Marker Lamps
4b	Front Side Reflex Reflectors

ADDITIONAL EQUIPMENT FOR TRAILERS EXCEEDING THE FOLLOWING PARAMETERS

LENGTH 9.1 m (30 ft.) OR LONGER

Area	Equipment
5a	Intermediate Side Marker Lamps
5b	Intermediate Side Reflex Reflectors

WIDTH 2.032 m (80 in.) OR WIDER

Area	Equipment
6	Rear Clearance Lamps
7	Rear Identification Lamps
8	Front Clearance Lamps

WIDTH 2.032 m (80 in.) OR WIDER AND GVWR 4,536 kg (10,000 lb.) OR MORE

Area	DESCRIPTION
	Conspicuity Treatment
9	Rear Upper Body Marking
10	Bumper Bar Marking
11	Rear Lower Body Marking
12	Side Marking

LEGEND FOR FIGURES 8 THROUGH 18 - 49 CFR 393.11 TRAILER ILLUSTRATIONS (DOES NOT APPLY TO FIGURES 1 THROUGH 7 FOR TRUCKS & BUSES)

Area	Equipment
	Tail Lamps
	Stop Lamps
1	Rear Turn Signal Lamps
	Rear Reflex Reflectors
2	License Plate Lamp (s)
3	Rear Side Marker Lamps
	Rear Side Reflex Reflectors
4a	Front Side Marker Lamps
4b	Front Side Reflex Reflectors

ADDITIONAL EQUIPMENT FOR TRAILERS EXCEEDING THE FOLLOWING PARAMETERS

LENGTH 9.1 m (30 ft.) OR LONGER

Area	Equipment
5a	Intermediate Side Marker Lamps
5b	Intermediate Side Reflex Reflectors

WIDTH 2.032 m (80 in.) OR WIDER

Area	Equipment
6	Rear Clearance Lamps
7	Rear Identification Lamps
8	Front Clearance Lamps

WIDTH 2.032 m (80 in.) OR WIDER AND GVWR 4,536 kg (10,000 lb.) OR MORE

Area	DESCRIPTION
	Conspicuity Treatment
9	Rear Upper Body Marking
10	Bumper Bar Marking
11	Rear Lower Body Marking
12	Side Marking

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§393.13 Retroreflective sheeting and reflex reflectors, requirements for semitrailers and trailers manufactured before December 1, 1993.

(a) **Applicability.** All trailers and semitrailers manufactured prior to December 1, 1993, which have an overall width of 2,032 mm (80 inches) or more and a gross vehicle weight rating of 4,536 kg (10,001 pounds) or more, except trailers that are manufactured exclusively for use as offices or dwellings, pole trailers (as defined in §390.5 of this subchapter), and trailers transported in a driveaway-towaway operation, must be equipped with retroreflective sheeting or an array of reflex reflectors that meet the requirements of this section. Motor carriers operating trailers, other than container chassis (as defined in §393.5), have until June 1, 2001, to comply with the requirements of this section. Motor carriers operating container chassis have until December 1, 2001, to comply with the requirements of this section.

(b) **Retroreflective sheeting and reflex reflectors.** Motor carriers are encouraged to retrofit their trailers with a conspicuity system that meets all of the requirements applicable to trailers manufactured on or after December 1, 1993, including the use of retroreflective sheeting or reflex reflectors in a red and white pattern (see Federal Motor Vehicle Safety Standard No. 108 (49 CFR 571.108), S5.7, Conspicuity systems). Motor carriers which do not retrofit their trailers to meet the requirements of FMVSS No. 108, for example by using an alternative color pattern, must comply with the remainder of this paragraph and with paragraph (c) or (d) of this section. Retroreflective sheeting or reflex reflectors in colors or color combinations other than red and white may be used on the sides or lower rear area of the semitrailer or trailer until June 1, 2009. The alternate color or color combination must be uniform along the sides and lower rear area of the trailer. The retroreflective sheeting or reflex reflectors on the upper rear area of the trailer must be white and conform to the requirements of FMVSS No. 108 (S5.7). Red retroreflective sheeting or reflex reflectors shall not be used along the sides of the trailer unless it is used as part of a red and white pattern. Retroreflective sheeting shall have a width of at least 50 mm (2 inches).

(c) **Locations for retroreflective sheeting.**

(1) **Sides.** Retroreflective sheeting shall be applied to each side of the trailer or semitrailer. Each strip of retroreflective sheeting shall be positioned as horizontally as practicable, beginning and ending as close to the front and rear as practicable. The strip need not be continuous but the sum of the length of all of the segments shall be at least half of the length of the trailer and the spaces between the segments of the strip shall be distributed as evenly as practicable. The centerline for each strip of retroreflective sheeting shall be between 375 mm (15 inches) and 1,525 mm (60 inches) above the road surface when measured with the trailer empty or unladen, or as close as practicable to this area. If necessary to clear rivet heads or other similar obstructions, 50 mm (2 inches) wide retroreflective sheeting may be separated into two 25 mm (1 inch) wide strips of the

same length and color, separated by a space of not more than 25 mm (1 inch).

(2) **Lower rear area.** The rear of each trailer and semitrailer must be equipped with retroreflective sheeting. Each strip of retroreflective sheeting shall be positioned as horizontally as practicable, extending across the full width of the trailer, beginning and ending as close to the extreme edges as practicable. The centerline for each of the strips of retroreflective sheeting shall be between 375 mm (15 inches) and 1,525 mm (60 inches) above the road surface when measured with the trailer empty or unladen, or as close as practicable to this area.

(3) **Upper rear area.** Two pairs of white strips of retroreflective sheeting, each pair consisting of strips 300 mm (12 inches) long, must be positioned horizontally and vertically on the right and left upper corners of the rear of the body of each trailer and semitrailer, as close as practicable to the top of the trailer and as far apart as practicable. If the perimeter of the body, as viewed from the rear, is not square or rectangular, the strips may be applied along the perimeter, as close as practicable to the uppermost and outermost areas of the rear of the body on the left and right sides.

(d) **Locations for reflex reflectors.**

(1) **Sides.** Reflex reflectors shall be applied to each side of the trailer or semitrailer. Each array of reflex reflectors shall be positioned as horizontally as practicable, beginning and ending as close to the front and rear as practicable. The array need not be continuous but the sum of the length of all of the array segments shall be at least half of the length of the trailer and the spaces between the segments of the strip shall be distributed as evenly as practicable. The centerline for each array of reflex reflectors shall be between 375 mm (15 inches) and 1,525 mm (60 inches) above the road surface when measured with the trailer empty or unladen, or as close as practicable to this area. The center of each reflector shall not be more than 100 mm (4 inches) from the center of each adjacent reflector in the segment of the array. If reflex reflectors are arranged in an alternating color pattern, the length of reflectors of the first color shall be as close as practicable to the length of the reflectors of the second color.

(2) **Lower rear area.** The rear of each trailer and semitrailer must be equipped with reflex reflectors. Each array of reflex reflectors shall be positioned as horizontally as practicable, extending across the full width of the trailer, beginning and ending as close to the extreme edges as practicable. The centerline for each array of reflex reflectors shall be between 375 mm (15 inches) and 1,525 mm (60 inches) above the road surface when measured with the trailer empty or unladen, or as close as practicable to this area. The center of each reflector shall not be more than 100 mm (4 inches) from the center of each adjacent reflector in the segment of the array.

(3) **Upper rear area.** Two pairs of white reflex reflector arrays, each pair at least 300 mm (12 inches) long, must be positioned horizontally and vertically on the right and left upper corners of the rear of the body of each trailer and semitrailer, as close as practicable to

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the top of the trailer and as far apart as practicable. If the perimeter of the body, as viewed from the rear, is not square or rectangular, the arrays may be applied along the perimeter, as close as practicable to the uppermost and outermost areas of the rear of the body on the left and right sides. The center of each reflector shall not be more than 100 mm (4 inches) from the center of each adjacent reflector in the segment of the array.

§393.17 Lamps and reflectors-combinations in driveaway-towaway operation.

A combination of motor vehicles engaged in driveaway-tow-away operation must be equipped with operative lamps and reflectors conforming to the rules in this section.

(a) The towing vehicle must be equipped as follows:

(1) On the front, there must be at least two headlamps, an equal number at each side, two turn signals, one at each side, and two clearance lamps, one at each side.

(2) On each side, there must be at least one side-marker lamp, located near the front of the vehicle.

(3) On the rear, there must be at least two tail lamps, one at each side, and two stop lamps, one at each side.

(b) Except as provided in paragraph (c) of this section, the rearmost towed vehicle of the combination (including the towed vehicles of a tow-bar combination, the towed vehicle of a single saddle-mount combination, and the rearmost towed vehicle of a double or triple saddle-mount combination) or, in the case of a vehicle full-mounted on a saddle-mount vehicle, either the full-mounted vehicle or the rearmost saddle-mounted vehicle must be equipped as follows:

(1) On each side, there must be at least one side-marker lamp, located near the rear of the vehicle.

(2) On the rear, there must be at least two tail lamps, two stop lamps, two turn signals, two clearance lamps, and two reflectors, one of each type at each side. In addition, if any vehicle in the combination is 80 inches or more in overall width, there must be three identification lamps on the rear.

(c) If the towed vehicle in a combination is a mobile structure trailer, it must be equipped in accordance with the following lighting devices. For the purposes of this part, "mobile structure trailer" means a trailer that has a roof and walls, is at least 10 feet wide, and can be used off road for dwelling or commercial purposes.

(1) When the vehicle is operated in accordance with the terms of a special permit prohibiting operation during the times when lighted lamps are required under §392.30, it must have on the rear—

(i) Two stop lamps, one on each side of the vertical centerline, at the same height, and as far apart as practicable;

(ii) Two tail lamps, one on each side of the vertical centerline, at the same height, and as far apart as practicable;

(iii) Two red reflex reflectors, one on each side of the vertical centerline, at the same height, and as far apart as practicable; and

(iv) Two turn signal lamps, one on each side of the vertical centerline, at the same height, and as far apart as practicable.

(2) At all other times, the vehicle must be equipped as specified in paragraph (b) of this section.

(d) An intermediate towed vehicle in a combination consisting of more than two vehicles (including the first saddle-mounted vehicle of a double saddle-mount combination and the first and second saddle-mount vehicles of a triple saddle-mount combination) must have one side-marker lamp on each side, located near the rear of the vehicle.

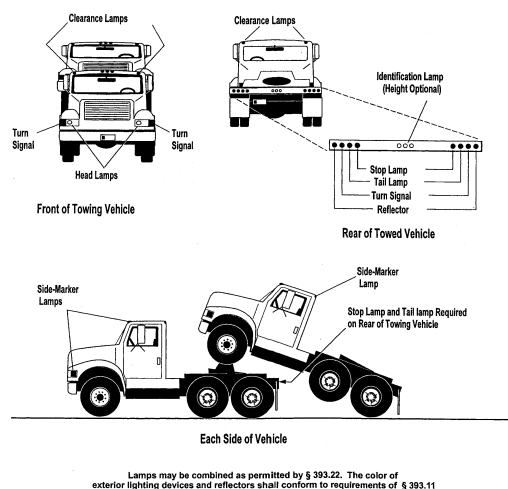


Figure 19 Single-Saddle-Mount Diagram to Illustrate § 393.17

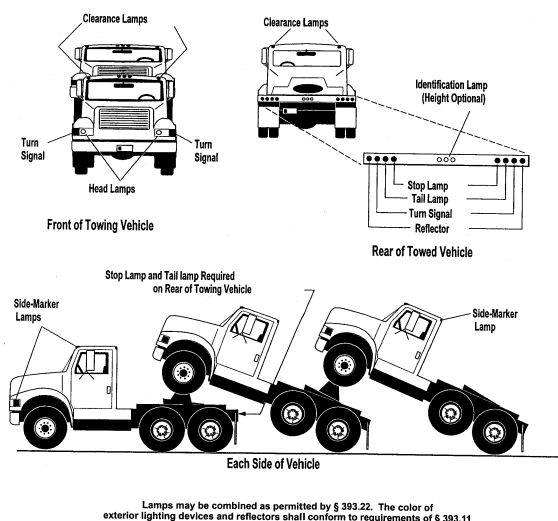


Figure 20 Double-Saddle-Mount Diagram to Illustrate § 393.17

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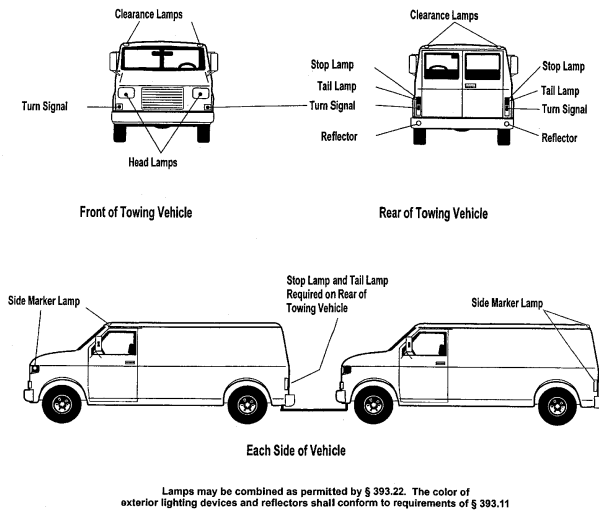


Figure 21 Tow-bar Diagram to Illustrate § 393.17

§393.19 Hazard warning signals.

The hazard warning signal operating unit on each commercial motor vehicle shall operate independently of the ignition or equivalent switch, and when activated, cause all turn signals required by §393.11 to flash simultaneously.

§393.20 [Reserved]

§393.22 Combination of lighting devices and reflectors.

(a) **Permitted combinations.** Except as provided in paragraph (b) of this section, two or more lighting devices and reflectors (whether or not required by the rules in this part) may be combined optically if—

(1) Each required lighting device and reflector conforms to the applicable rules in this Part; and

(2) Neither the mounting nor the use of a nonrequired lighting device or reflector impairs the effectiveness of a required lighting device or reflector or causes that device or reflector to be inconsistent with the applicable rules in this Part.

(b) **Prohibited combinations.** (1) A turn signal lamp must not be combined optically with either a head lamp or other lighting device or combination of lighting devices that produces a greater intensity of light than the turn signal lamp;

(2) A turn signal lamp must not be combined optically with a stop lamp unless the stop lamp function is always deactivated when the turn signal function is activated;

(3) A clearance lamp must not be combined optically with a tail lamp or identification lamp.

§393.23 Power supply for lamps.

All required lamps must be powered by the electrical system of the motor vehicle with the exception of battery powered lamps used on projecting loads.

§393.24 Requirement for head lamps, auxiliary driving lamps and front fog lamps.

(a) **Headlamps.** Every bus, truck and truck tractor shall be equipped with headlamps as required by §393.11(a). The head-lamps shall provide an upper and lower beam distribution of light, selectable at the driver's will and be steady-burning. The headlamps shall be marked in accordance with FMVSS No. 108. Auxiliary driving lamps and/or front fog lamps may not be used to satisfy the requirements of this paragraph.

(b) **Auxiliary driving lamps and front fog lamps.** Commercial motor vehicles may be equipped with auxiliary driving lamps and/or front fog lamps for use in conjunction with, but not in lieu of the required headlamps. Auxiliary driving lamps shall meet SAE Standard J581 Auxiliary Upper Beam Lamps, July 2004, and front fog lamps shall meet SAE Standard J583 Front Fog Lamp, August 2004. (See §393.7 for information on the incorporation by reference and availability of these documents.)

(c) **Mounting.** Headlamps shall be mounted and aimable in accordance with FMVSS No. 108. Auxiliary driving lamps and front fog lamps shall be mounted so that the beams are aimable and the mounting shall prevent the aim of the lighting device from being disturbed while the vehicle is operating on public roads.

(d) **Aiming.** Headlamps, auxiliary driving lamps and front fog lamps shall be aimed to meet the aiming specifications in FMVSS No. 108 (49 CFR 571.108), SAE J581, and SAE J583, respectively.

§393.25 Requirements for lamps other than head lamps.

(a) **Mounting.** All lamps shall be securely mounted on a rigid part of the vehicle. Temporary lamps must be securely mounted to the load and are not required to be mounted to a permanent part of the vehicle.

(b) **Visibility.** Each lamp shall be located so that it meets the visibility requirements specified by FMVSS No. 108 in effect at the time of manufacture of the vehicle. Vehicles which were not subject to FMVSS No. 108 at the time of manufacture shall have each lamp located so that it meets the visibility requirements specified in the SAE standards listed in paragraph (c) of this section. If motor vehicle equipment (e.g., mirrors, snow plows, wrecker booms, backhoes, and winches) prevents compliance with this paragraph by any required lamp, an auxiliary lamp or device meeting the requirements of this paragraph shall be provided. This shall not be construed to apply to lamps on one unit which are obscured by another unit of a combination of vehicles.

(c) **Specifications.** All required lamps (except marker lamps on projecting loads, lamps which are temporarily attached to vehicles transported in driveaway-towaway operations, and lamps on converter dollies and pole trailers) on vehicles manufactured on or after December 25, 1968, shall, at a minimum, meet the applicable requirements of FMVSS No. 108 in effect on the date of manufacture of the vehicle. Marker lamps on projecting loads, all lamps which are temporarily attached to vehicles transported in driveaway-towaway operations, and all lamps on converter dollies and pole

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trailers must meet the following applicable SAE standards: J586-Stop Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width, March 2000; J2261 Stop Lamps and Front- and Rear-Turn Signal Lamps for Use on Motor Vehicles 2032 mm or More in Overall Width, January 2002; J585-Tail Lamps (Rear Position Lamps) for Use on Motor Vehicles Less Than 2032 mm in Overall Width, March 2000; J588-Turn Signal Lamps for Use on Motor Vehicles Less Than 2032 mm in Overall Width, March 2000; J2040-Tail Lamps (Rear Position Lamps) for Use on Vehicles 2032 mm or More in Overall Width, March 2002; J592-Sidemarkers Lamps for Use on Road Vehicles Less Than 2032 mm in Overall Width, August 2000. (See §393.7 for information on the incorporation by reference and availability of these documents.)

(d) (Reserved)

(e) Lamps to be steady-burning. All exterior lamps (both required lamps and any additional lamps) shall be steady-burning with the exception of turn signal lamps; hazard warning signal lamps; school bus warning lamps; amber warning lamps or flashing warning lamps on tow trucks and commercial motor vehicles transporting oversized loads; and warning lamps on emergency and service vehicles authorized by State or local authorities. Lamps combined into the same shell or housing with a turn signal are not required to be steady burning while the turn signal is in use. Amber warning lamps must meet SAE J845-Optical Warning Devices for Authorized Emergency, Maintenance and Service Vehicles, May 1997. Amber flashing warning lamps must meet SAE J595-Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance and Service Vehicles, January 2005. Amber gaseous discharge warning lamps must meet SAE J1318 Gaseous Discharge Warning Lamp for Authorized Emergency, Maintenance, and Service Vehicles, May 1998. (See §393.7(b) for information on the incorporation by reference and availability of these documents.)

(f) Stop lamp operation. The stop lamps on each vehicle shall be activated upon application of the service brakes. The stop lamps are not required to be activated when the emergency feature of the trailer brakes is used or when the stop lamp is optically combined with the turn signal and the turn signal is in use.

§393.26 Requirements for reflex reflectors.

(a) Mounting. Reflex reflectors shall be mounted at the locations required by §393.11. In the case of motor vehicles so constructed that requirement for a 381 mm (15-inch) minimum height above the road surface is not practical, the reflectors shall be mounted as close as practicable to the required mounting height range. All permanent reflex reflectors shall be securely mounted on a rigid part of the vehicle. Temporary reflectors on projecting loads must be securely mounted to the load and are not required to be permanently mounted to a part of the vehicle. Temporary reflex reflectors on vehicles transported in drive-away-towaway operations must be firmly attached.

(b) Specifications. All required reflex reflectors (except reflex reflectors on projecting loads, vehicles transported in a driveaway-towaway operation, con-

verter dollies and pole trailers) on vehicles manufactured on or after December 25, 1968, shall meet the applicable requirements of FMVSS No. 108 in effect on the date of manufacture of the vehicle. Reflex reflectors on projecting loads, vehicles transported in a driveaway-tow-away operation, and all reflex reflectors on converter dollies and pole trailers must conform to SAE J594-Reflex Reflectors, December 2003.

(c) Substitute material for side reflex reflectors. Reflective material conforming to ASTM D 4956-04, Standard Specification for Retroreflective Sheeting for Traffic Control, may be used in lieu of reflex reflectors if the material as used on the vehicle, meets the performance standards in either Table I of SAE J594 or Table IA of SAE J594-Reflex Reflectors, December 2003. (See §393.7(b) for information on the incorporation by reference and availability of these documents.)

(d) Use of additional retroreflective surfaces. Additional retroreflective surfaces may be used in conjunction with, but not in lieu of the reflex reflectors required in subpart B of part 393, and the substitute material for side reflex reflectors allowed by paragraph (c) of this section, provided:

(1) Designs do not resemble traffic control signs, lights, or devices, except that straight edge striping resembling a barricade pattern may be used.

(2) Designs do not tend to distort the length and/or width of the motor vehicle.

(3) Such surfaces shall be at least 3 inches from any required lamp or reflector unless of the same color as such lamp or reflector.

(4) No red color shall be used on the front of any motor vehicle, except for display of markings or placards required by §177.823 of this title.

(5) Retroreflective license plates required by State or local authorities may be used.

§393.27 [Reserved]

§393.28 Wiring systems.

Electrical wiring shall be installed and maintained to conform to SAE J1292-Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring, October 1981, except the jumper cable plug and receptacle need not conform to SAE J560. The reference to SAE J1292 shall not be construed to require circuit protection on trailers. (See §393.7(b) for information on the incorporation by reference and availability of this document.)

§393.29 [Reserved]

§393.30 Battery installation.

Every storage battery on every vehicle, unless located in the engine compartment, shall be covered by a fixed part of the motor vehicle or protected by a removable cover or enclosure. Removable covers, or enclosures shall be substantial and shall be securely latched or fastened. The storage battery compartment and adjacent metal parts which might corrode by reason of battery leakage shall be painted or coated with an acid-resisting paint or coating and shall have openings to provide ample battery ventilation and drainage. Whenever the cable to the starting motor passes through a

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metal compartment, the cable shall be protected against grounding by an acid and waterproof insulating bushing. Wherever a battery and a fuel tank are both placed under the driver's seat, they shall be partitioned from each other, and each compartment shall be provided with an independent cover, ventilation, and drainage.

§§393.31–393.33 [Reserved]

Subpart C—Brakes

§393.40 Required brake systems.

(a) Each commercial motor vehicle must have brakes adequate to stop and hold the vehicle or combination of motor vehicles. Each commercial motor vehicle must meet the applicable service, parking, and emergency brake system requirements provided in this section.

(b) **Service brakes.** (1) **Hydraulic brake systems.** Motor vehicles equipped with hydraulic brake systems and manufactured on or after September 2, 1983, must, at a minimum, have a service brake system that meets the requirements of FMVSS No. 105 in effect on the date of manufacture. Motor vehicles which were not subject to FMVSS No. 105 on the date of manufacture must have a service brake system that meets the applicable requirements of §§393.42, 393.48, 393.49, 393.51, and 393.52 of this subpart.

(2) **Air brake systems.** Buses, trucks and truck tractors equipped with air brake systems and manufactured on or after March 1, 1975, and trailers manufactured on or after January 1, 1975, must, at a minimum, have a service brake system that meets the requirements of FMVSS No. 121 in effect on the date of manufacture. Motor vehicles which were not subject to FMVSS No. 121 on the date of manufacture must have a service brake system that meets the applicable requirements of §§393.42, 393.48, 393.49, 393.51, and 393.52 of this subpart.

(3) **Vacuum brake systems.** Motor vehicles equipped with vacuum brake systems must have a service brake system that meets the applicable requirements of §§393.42, 393.48, 393.49, 393.51, and 393.52 of this subpart.

(4) **Electric brake systems.** Motor vehicles equipped with electric brake systems must have a service brake system that meets the applicable requirements of §§393.42, 393.48, 393.49, 393.51, and 393.52 of this subpart.

(5) **Surge brake systems.** Motor vehicles equipped with surge brake systems must have a service brake system that meets the applicable requirements of §§393.42, 393.48, 393.49, and 393.52 of this subpart.

(c) **Parking brakes.** Each commercial motor vehicle must be equipped with a parking brake system that meets the applicable requirements of §393.41.

(d) **Emergency brakes—partial failure of service brakes.**

(1) **Hydraulic brake systems.** Motor vehicles manufactured on or after September 2, 1983, and equipped with a split service brake system must, at a minimum, meet the partial failure requirements of FMVSS No. 105 in effect on the date of manufacture.

(2) **Air brake systems.** Buses, trucks and truck tractors manufactured on or after March 1, 1975, and trailers manufactured on or after January 1, 1975, must be equipped with an emergency brake system which, at a minimum, meets the requirements of FMVSS No. 121 in effect on the date of manufacture.

(3) **Vehicles not subject to FMVSS Nos. 105 and 121 on the date of manufacture.** Buses, trucks and truck tractors not subject to FMVSS Nos. 105 or 121 on the date of manufacture must meet the requirements of §393.40(e). Trailers not subject to FMVSS No. 121 at the time of manufacture must meet the requirements of §393.43.

(e) **Emergency brakes, vehicles manufactured on or after July 1, 1973.** (1) A bus, truck, truck tractor, or a combination of motor vehicles manufactured on or after July 1, 1973, and not covered under paragraphs (d)(1) or (d)(2) of this section, must have an emergency brake system which consists of emergency features of the service brake system or an emergency system separate from the service brake system. The emergency brake system must meet the applicable requirements of §§393.43 and 393.52.

(2) A control by which the driver applies the emergency brake system must be located so that the driver can operate it from the normal seating position while restrained by any seat belts with which the vehicle is equipped. The emergency brake control may be combined with either the service brake control or the parking brake control. However, all three controls may not be combined.

(f) **Interconnected systems.** (1) If the brake systems required by §393.40(a) are interconnected in any way, they must be designed, constructed, and maintained so that in the event of a failure of any part of the operating mechanism of one or more of the systems (except the service brake actuation pedal or valve), the motor vehicle will have operative brakes and, for vehicles manufactured on or after July 1, 1973, be capable of meeting the requirements of §393.52(b).

(2) A motor vehicle to which the requirements of FMVSS No. 105 (S5.1.2), dealing with partial failure of the service brake, applied at the time of manufacture meets the requirements of §393.40(f)(1) if the motor vehicle is maintained in conformity with FMVSS No. 105 and the motor vehicle is capable of meeting the requirements of §393.52(b), except in the case of a structural failure of the brake master cylinder body.

(3) A bus is considered to meet the requirements of §393.40(f)(1) if it meets the requirements of §393.44 and §393.52(b).

§393.41 Parking brake system.

(a) **Hydraulic-braked vehicles manufactured on or after September 2, 1983.** Each truck and bus (other than a school bus) with a GVWR of 4,536 kg (10,000 pounds) or less which is subject to this part and school buses with a GVWR greater than 4,536 kg (10,000 pounds) shall be equipped with a parking brake system as required by FMVSS No. 571.105 (S5.2) in effect at the time of manufacture. The parking brake shall be capable of holding the vehicle or combination of vehicles

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stationary under any condition of loading in which it is found on a public road (free of ice and snow). Hydraulic-braked vehicles which were not subject to the parking brake requirements of FMVSS No. 571.105 (S5.2) must be equipped with a parking brake system that meets the requirements of paragraph (c) of this section.

(b) **Air-braked power units manufactured on or after March 1, 1975, and air-braked trailers manufactured on or after January 1, 1975.** Each air-braked bus, truck and truck tractor manufactured on and after March 1, 1975, and each air-braked trailer except an agricultural commodity trailer, converter dolly, heavy hauler trailer or pulpwood trailer, shall be equipped with a parking brake system as required by FMVSS No. 121 (S5.6) in effect at the time of manufacture. The parking brake shall be capable of holding the vehicle or combination of vehicles stationary under any condition of loading in which it is found on a public road (free of ice and snow). An agricultural commodity trailer, heavy hauler or pulpwood trailer shall carry sufficient chocking blocks to prevent movement when parked.

(c) **Vehicles not subject to FMVSS Nos. 105 and 121 on the date of manufacture.** (1) Each singly driven motor vehicle not subject to parking brake requirements of FMVSS Nos. 105 or 121 at the time of manufacture, and every combination of motor vehicles must be equipped with a parking brake system adequate to hold the vehicle or combination on any grade on which it is operated, under any condition of loading in which it is found on a public road (free of ice and snow).

(2) The parking brake system shall, at all times, be capable of being applied by either the driver's muscular effort or by spring action. If other energy is used to apply the parking brake, there must be an accumulation of that energy isolated from any common source and used exclusively for the operation of the parking brake.

Exception: This paragraph shall not be applicable to air-applied, mechanically-held parking brake systems which meet the parking brake requirements of FMVSS No. 121 (S5.6).

(3) The parking brake system shall be held in the applied position by energy other than fluid pressure, air pressure, or electric energy. The parking brake system shall not be capable of being released unless adequate energy is available to immediately reapply the parking brake with the required effectiveness.

§393.42 Brakes required on all wheels.

(a) Every commercial motor vehicle shall be equipped with brakes acting on all wheels. This requirement also applies to certain motor vehicles being towed in a driveaway-towaway operation, as follows:

(1) Any motor vehicle towed by means of a tow-bar when another motor vehicle is full-mounted on the towed vehicle; and

(2) Any saddle-mount configuration with a fullmount.

(b) **Exception.**

(1) Trucks or truck tractors having three or more axles and manufactured before July 25, 1980, are not required to have brakes on the front wheels. However, these vehicles must meet the requirements of §393.52.

(2) Motor vehicles being towed in a driveaway-towaway operation (including the last truck of triple saddle-mount combinations (see §393.71(a)(3)) are not required to have operative brakes provided the combination of vehicles meets the requirements of §393.52.

(3) Any semitrailer or pole trailer (laden or unladen) with a gross weight of 1,361 kg (3,000 pounds) or less which is subject to this part is not required to be equipped with brakes if the axle weight of the towed vehicle does not exceed 40 percent of the sum of the axle weights of the towing vehicle.

(4) Any full trailer or four-wheel pole trailer (laden or unladen) with a gross weight of 1,361 kg (3,000 pounds) or less which is subject to this part is not required to be equipped with brakes if the sum of the axle weights of the towed vehicle does not exceed 40 percent of the sum of the axle weights of the towing vehicle.

(5) Brakes are not required on the steering axle of a three-axle dolly which is steered by a co-driver.

(6) Loaded housemoving dollies, specialized trailers and dollies used to transport industrial furnaces, reactors, and similar motor vehicles are not required to be equipped with brakes, provided the speed at which the combination of vehicles will be operated does not exceed 32 km/hour (20 mph) and brakes on the combination of vehicles are capable of stopping the combination within 12.2 meters (40 feet) from the speed at which the vehicle is being operated or 32 km/hour (20 mph), whichever is less.

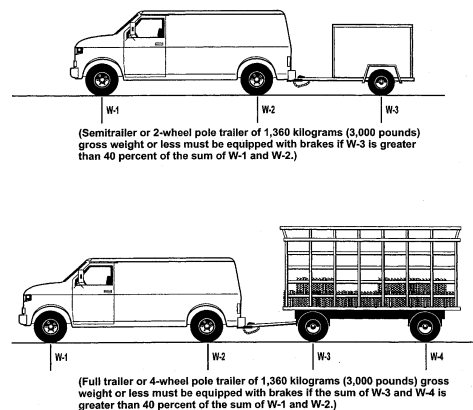


Figure 22-Illustrations of Brake Requirements for Light-Duty Trailers in §393.42

§393.43 Breakaway and emergency braking.

(a) **Towing vehicle protection system.** Every motor vehicle, if used to tow a trailer equipped with brakes, shall be equipped with a means for providing that in the case of a breakaway of the trailer, the service brakes on the towing vehicle will be capable of stopping the towing vehicle. For air braked towing units, the tractor protection valve or similar device shall operate automatically when the air pressure on the towing vehicle is between 138 kPa and 310 kPa (20 psi and 45 psi).

(b) **Emergency brake requirements, air brakes.** Every truck or truck tractor equipped with air brakes,

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when used for towing other vehicles equipped with air brakes, shall be equipped with two means of activating the emergency features of the trailer brakes. One of these means shall operate automatically in the event of reduction of the towing vehicle air supply to a fixed pressure which shall not be lower than 20 pounds per square inch nor higher than 45 pounds per square inch. The other means shall be a manually controlled device readily operable by a person seated in the driving seat. Its emergency position or method of operation shall be clearly indicated. In no instance may the manual means be so arranged as to permit its use to prevent operation of the automatic means. The automatic and manual means required by this section may be, but are not required to be, separate.

(c) **Emergency brake requirements, vacuum brakes.** Every truck tractor and truck when used for towing other vehicles equipped with vacuum brakes, shall have, in addition to the single control required by §393.49 to operate all brakes of the combination, a second manual control device which can be used to operate the brakes on the towed vehicles in emergencies. Such second control shall be independent of brake air, hydraulic, and other pressure, and independent of other controls, unless the braking system be so arranged that failure of the pressure on which the second control depends will cause the towed vehicle brakes to be applied automatically. The second control is not required by this rule to provide modulated or graduated braking.

(d) **Breakaway braking requirements for trailers.** Every trailer required to be equipped with brakes shall have brakes which apply automatically and immediately upon breakaway from the towing vehicle. With the exception of trailers having three or more axles, all brakes with which the trailer is required to be equipped must be applied upon breakaway from the towing vehicle. The brakes must remain in the applied position for at least 15 minutes.

(e) **Emergency valves.** Air brake systems installed on towed vehicles shall be so designed, by the use of “no-bleed-back” relay emergency valves or equivalent devices, that the supply reservoir used to provide air for brakes shall be safeguarded against backflow of air to the towing vehicle upon reduction of the towing vehicle air pressure.

(f) **Exception.** The requirements of paragraphs (b), (c) and (d) of this section shall not be applicable to commercial motor vehicles being transported in driveaway-towaway operations.

§393.44 Front brake lines, protection.

On every bus, if equipped with air brakes, the braking system shall be so constructed that in the event any brake line to any of the front wheels is broken, the driver can apply the brakes on the rear wheels despite such breakage. The means used to apply the brakes may be located forward of the driver’s seat as long as it can be operated manually by the driver when the driver is properly restrained by any seat belt assembly provided for use. Every bus shall meet this requirement or comply with the regulations in effect at the time of its manufacture.

§393.45 Brake tubing and hoses; hose assemblies and end fittings.

(a) **General construction requirements for tubing and hoses, assemblies, and end fittings.** All brake tubing and hoses, brake hose assemblies, and brake hose end fittings must meet the applicable requirements of FMVSS No. 106 (49 CFR 571.106).

(b) **Brake tubing and hose installation.** Brake tubing and hose must—

(1) Be long and flexible enough to accommodate without damage all normal motions of the parts to which it is attached;

(2) Be secured against chaffing, kinking, or other mechanical damage; and

(3) Be installed in a manner that prevents it from contacting the vehicle’s exhaust system or any other source of high temperatures.

(c) **Nonmetallic brake tubing.** Coiled nonmetallic brake tubing may be used for connections between towed and towing motor vehicles or between the frame of a towed vehicle and the unsprung subframe of an adjustable axle of the motor vehicle if—

(1) The coiled tubing has a straight segment (pigtail) at each end that is at least 51 mm (2 inches) in length and is encased in a spring guard or similar device which prevents the tubing from kinking at the fitting at which it is attached to the vehicle; and

(2) The spring guard or similar device has at least 51 mm (2 inches) of closed coils or similar surface at its interface with the fitting and extends at least 38 mm (1 ½ inches) into the coiled segment of the tubing from its straight segment.

(d) **Brake tubing and hose connections.** All connections for air, vacuum, or hydraulic braking systems shall be installed so as to ensure an attachment free of leaks, constrictions or other conditions which would adversely affect the performance of the brake system.

§393.46 [Reserved]

§393.47 Brake actuators, slack adjusters, linings/pads, and drums/rotors.

(a) **General requirements.** Brake components must be constructed, installed and maintained to prevent excessive fading and grabbing. The means of attachment and physical characteristics must provide for safe and reliable stopping of the commercial motor vehicle.

(b) **Brake chambers.** The service brake chambers and spring brake chambers on each end of an axle must be the same size.

(c) **Slack adjusters.** The effective length of the slack adjuster on each end of an axle must be the same.

(d) **Linings and pads.** The thickness of the brake linings or pads shall meet the applicable requirements

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of this paragraph—

(1) **Steering axle brakes.** The brake lining/pad thickness on the steering axle of a truck, truck-tractor or bus shall not be less than 4.8 mm ($\frac{3}{16}$ inch) at the shoe center for a shoe with a continuous strip of lining; less than 6.4 mm ($\frac{1}{4}$ inch) at the shoe center for a shoe with two pads; or worn to the wear indicator if the lining is so marked, for air drum brakes. The steering axle brake lining/pad thickness shall not be less than 3.2 mm ($\frac{1}{8}$ inch) for air disc brakes, or 1.6 mm ($\frac{1}{16}$ inch) or less for hydraulic disc, drum and electric brakes.

(2) **Non-steering axle brakes.** An air braked commercial motor vehicle shall not be operated with brake lining/pad thickness less than 6.4 mm ($\frac{1}{4}$ inch) or to the wear indicator if the lining is so marked (measured at the shoe center for drum brakes); or less than 3.2 mm ($\frac{1}{8}$ inch) for disc brakes. Hydraulic or electric braked commercial motor vehicles shall not be operated with a lining/pad thickness less than 1.6 mm ($\frac{1}{16}$ inch) (measured at the shoe center) for disc or drum brakes.

(e) **Clamp, Bendix DD-3, bolt-type, and rotochamber brake actuator readjustment limits.**

(1) The pushrod stroke must not be greater than the values specified in the following tables:

CLAMP-TYPE BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit: standard stroke chamber	Brake readjustment limit: long stroke chamber
6.....	4 $\frac{1}{2}$ in. (114 mm)	1 $\frac{1}{4}$ in. (31.8 mm).	
9	5 $\frac{1}{4}$ in. (133 mm)	1 $\frac{3}{8}$ in. (34.9 mm).	
12	5 $\frac{1}{16}$ in. (145 mm)	1 $\frac{3}{8}$ in. (34.9 mm).	1 $\frac{3}{4}$ in. (44.5 mm).
16.....	6 $\frac{3}{8}$ in. (162 mm)	1 $\frac{3}{4}$ in. (44.5 mm).	2 in. (50.8 mm).
20	6 $\frac{25}{32}$ in. (172 mm)	1 $\frac{3}{4}$ in. (44.5 mm).	2 in. (50.8 mm). 2 $\frac{1}{2}$ in. (63.5 mm). ¹
24.....	7 $\frac{7}{32}$ in. (184 mm)	1 $\frac{3}{4}$ in. (44.5 mm).	2 in. (50.8 mm). 2 $\frac{1}{2}$ in. (63.5 mm). ²
30.....	8 $\frac{3}{32}$ in. (206 mm)	2 in. (50.8 mm)....	2 $\frac{1}{2}$ in. (63.5 mm).
36.....	9 in. (229 mm).....	2 $\frac{1}{4}$ in. (57.2 mm).	

¹ For type 20 chambers with a 3-inch (76 mm) rated stroke.

² For type 24 chambers with a 3-inch (76 mm) rated stroke.

BENDIX DD-3 BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit
30	8 $\frac{1}{8}$ in. (206 mm)	2 $\frac{1}{4}$ in. (57.2 mm).

BOLT-TYPE BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit
A.....	6 $\frac{15}{16}$ in. (176 mm)	1 $\frac{3}{8}$ in. (34.9 mm).
B	9 $\frac{3}{16}$ in. (234 mm)	1 $\frac{3}{4}$ in. (44.5 mm).
C	8 $\frac{1}{16}$ in. (205 mm)	1 $\frac{3}{4}$ in. (44.5 mm)
D	5 $\frac{1}{4}$ in. (133 mm)	1 $\frac{1}{4}$ in. (31.8 mm).
E.....	6 $\frac{3}{16}$ in. (157 mm)	1 $\frac{3}{8}$ in. (34.9 mm).
F.....	11 in. (279 mm)	2 $\frac{1}{4}$ in. (57.2 mm).
G	9 $\frac{7}{8}$ in. (251 mm)	2 in. (50.8 mm).

ROTOCHAMBER-TYPE BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit
9	4 $\frac{9}{32}$ in. (109 mm)	1 $\frac{1}{2}$ in. (38.1 mm).
12	4 $\frac{13}{16}$ in. (122 mm)	1 $\frac{1}{2}$ in. (38.1 mm).
16.....	5 $\frac{13}{32}$ in. (138 mm)	2 in. (50.8 mm).
20	5 $\frac{15}{16}$ in. (151 mm)	2 in. (50.8 mm).
24.....	6 $\frac{13}{32}$ in. (163 mm)	2 in. (50.8 mm).
30.....	7 $\frac{1}{16}$ in. (180 mm)	2 $\frac{1}{4}$ in. (57.2 mm).
36.....	7 $\frac{5}{8}$ in. (194 mm)	2 $\frac{3}{4}$ in. (69.9 mm).
50.....	8 $\frac{7}{8}$ in. (226 mm)	3 in. (76.2 mm).

(2) For actuator types not listed in these tables, the pushrod stroke must not be greater than 80 percent of the rated stroke marked on the actuator by the actuator manufacturer, or greater than the readjustment limit marked on the actuator by the actuator manufacturer.

(f) **Wedge Brake Adjustment.** The movement of the scribe mark on the lining shall not exceed 1.6 mm ($\frac{1}{16}$ inch).

(g) **Drums and rotors.** The thickness of the drums or rotors shall not be less than the limits established by the brake drum or rotor manufacturer.

§393.48 Brakes to be operative.

(a) **General rule.** Except as provided in paragraphs (b), (c), and (d) of this section, all brakes with which a motor vehicle is equipped must at all times be capable of operating.

(b) **Devices to reduce or remove front-wheel braking effort.** A commercial motor vehicle may be equipped with a device to reduce the front wheel braking effort (or in the case of a three-axle truck or truck tractor manufactured before March 1, 1975, a device to remove the front-wheel braking effort) if that device meets the applicable requirements of paragraphs (b)(1) and (2) of this section.

(1) **Manually operated devices.** Manually operated devices to reduce or remove front-wheel braking effort may only be used on buses, trucks, and truck tractors manufactured before March 1, 1975. Such devices must not be used unless the vehicle is being operated under adverse conditions such as wet, snowy, or icy roads.

(2) **Automatic devices.** Automatic devices must not reduce the front-wheel braking force by more than 50 percent of the braking force available when the automatic device is disconnected (regardless of whether or not an antilock system failure has occurred on any axle). The device must not be operable by the driver except upon application of the control that activates the braking system. The device must not be operable when the brake control application pressure exceeds 85 psig (for vehicles equipped with air brakes) or 85 percent of the maximum system pressure (for vehicles which are not equipped with air brakes).

(c) **Exception.** Paragraph (a) of this section does not apply to—

(1) A towed vehicle with disabling damage as defined in §390.5;

(2) A vehicle which is towed in a driveway-towaway operation and is included in the exemption to the requirement for brakes on all wheels, §393.42(b);

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(3) Unladen converter dollies with a gross weight of 1,361 kg (3,000 lbs) or less, and manufactured prior to March 1, 1998;

(4) The steering axle of a three-axle dolly which is steered by a co-driver;

(5) Loaded house moving dollies, specialized trailers and dollies used to transport industrial furnaces, reactors, and similar motor vehicles provided the speed at which the combination of vehicles will be operated does not exceed 32 km/hour (20 mph) and brakes on the combination of vehicles are capable of stopping the combination within 12.2 meters (40 feet) from the speed at which the vehicle is being operated or 32 km/hour (20 mph), whichever is less.

(6) **Raised lift axles.** Brakes on lift axles need not be capable of being operated while the lift axle is raised. However, brakes on lift axles must be capable of being applied whenever the lift axle is lowered and the tires contact the roadway.

(d) **Surge brakes.** (1) Surge brakes are allowed on:

(i) Any trailer with a gross vehicle weight rating (GVWR) of 12,000 pounds or less, when its GVWR does not exceed 1.75 times the GVWR of the towing vehicle; and

(ii) Any trailer with a GVWR greater than 12,000 pounds, but less than 20,001 pounds, when its GVWR does not exceed 1.25 times the GVWR of the towing vehicle.

(2) The gross vehicle weight (GVW) of a trailer equipped with surge brakes may be used instead of its GVWR to calculate compliance with the weight ratios specified in paragraph (d)(1) of this section when the trailer manufacturer's GVWR label is missing.

(3) The GVW of a trailer equipped with surge brakes must be used to calculate compliance with the weight ratios specified in paragraph (d)(1) of this section when the trailer's GVW exceeds its GVWR.

(4) The surge brakes must meet the requirements of §393.40.

§393.49 Control valves for brakes.

(a) **General rule.** Except as provided in paragraphs (b) and (c) of this section, every motor vehicle manufactured after June 30, 1953, which is equipped with power brakes, must have the braking system so arranged that one application valve must when activated cause all of the service brakes on the motor vehicle or combination motor vehicle to operate. This requirement must not be construed to prohibit motor vehicles from being equipped with an additional valve to be used to operate the brakes on a trailer or trailers or as required for buses in §393.44.

(b) **Driveaway-towaway exception.** This section is not applicable to driveaway-towaway operations unless the brakes on such operations are designed to be operated by a single valve.

(c) **Surge brake exception.** This requirement is not applicable to trailers equipped with surge brakes that satisfy the conditions specified in §393.48(d).

§393.50 Reservoirs required.

(a) **Reservoir capacity for air-braked power units manufactured on or after March 1, 1975, and air-braked trailers manufactured on or after January 1, 1975.** Buses, trucks, and truck-tractors manufactured on or after March 1, 1975, and air-braked trailers manufactured on or after January 1, 1975, must meet the reservoir requirements of FMVSS No. 121, S5.1.2, in effect on the date of manufacture.

(b) **Reservoir capacity for air-braked vehicles not subject to FMVSS No. 121 on the date of manufacture and all vacuum braked vehicles.** Each motor vehicle using air or vacuum braking must have either reserve capacity, or a reservoir, that would enable the driver to make a full service brake application with the engine stopped without depleting the air pressure or vacuum below 70 percent of that indicated by the air or vacuum gauge immediately before the brake application is made. For the purposes of this paragraph, a full service brake application means depressing the brake pedal or treadle valve to the limit of its travel.

(c) **Safeguarding of air and vacuum.** Each service reservoir system on a motor vehicle shall be protected against a loss of air pressure or vacuum due to a failure or leakage in the system between the service reservoir and the source of air pressure or vacuum, by check valves or equivalent devices whose proper functioning can be checked without disconnecting any air or vacuum line, or fitting.

(d) **Drain valves for air braked vehicles.** Each reservoir must have a condensate drain valve that can be manually operated. Automatic condensate drain valves may be used provided (1) they may be operated manually, or (2) a manual means of draining the reservoirs is retained.

§393.51 Warning signals, air pressure and vacuum gauges.

(a) **General rule.** Every bus, truck and truck tractor, except as provided in paragraph (f), must be equipped with a signal that provides a warning to the driver when a failure occurs in the vehicle's service brake system. The warning signal must meet the applicable requirements of paragraphs (b), (c), (d) or (e) of this section.

(b) **Hydraulic brakes.** Vehicles manufactured on or after September 1, 1975, must meet the brake system indicator lamp requirements of FMVSS No. 571.105 (S5.3) applicable to the vehicle on the date of manufacture. Vehicles manufactured on or after July 1, 1973 but before September 1, 1975, or to which FMVSS No. 571.105 was not applicable on the date of manufacture, must have a warning signal which operates before or upon application of the brakes in the event of a hydraulic-type complete failure of a partial system. The signal must be either visible within the driver's forward field of view or audible. The signal must be continuous. (Note: FMVSS No. 105 was applicable to trucks and buses from September 1, 1975 to October 12, 1976, and from September 1, 1983, to the present. FMVSS No. 105 was not applicable to trucks and buses manufactured between October 12, 1976, and September 1, 1983. Motor carriers have the

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option of equipping those vehicles to meet either the indicator lamp requirements of FMVSS No. 105, or the indicator lamp requirements specified in this paragraph for vehicles which were not subject to FMVSS No. 105 on the date of manufacture.)

(c) **Air brakes.** A commercial motor vehicle (regardless of the date of manufacture) equipped with service brakes activated by compressed air (air brakes) or a commercial motor vehicle towing a vehicle with service brakes activated by compressed air (air brakes) must be equipped with a pressure gauge and a warning signal. Trucks, truck tractors, and buses manufactured on or after March 1, 1975, must, at a minimum, have a pressure gauge and a warning signal which meets the requirements of FMVSS No. 121 (S5.1.4 for the pressure gauge and S5.1.5 for the warning signal) applicable to the vehicle on the date of manufacture of the vehicle. Power units to which FMVSS No. 571.121 was not applicable on the date of manufacture of the vehicle must be equipped with—

(1) A pressure gauge, visible to a person seated in the normal driving position, which indicates the air pressure (in kilopascals (kPa) or pounds per square inch (psi)) available for braking; and

(2) A warning signal that is audible or visible to a person in the normal driving position and provides a continuous warning to the driver whenever the air pressure in the service reservoir system is at 379 kPa (55 psi) and below, or one-half of the compressor governor cutout pressure, whichever is less.

(d) **Vacuum brakes.** A commercial motor vehicle (regardless of the date it was manufactured) having service brakes activated by vacuum or a vehicle towing a vehicle having service brakes activated by vacuum must be equipped with—

(1) A vacuum gauge, visible to a person seated in the normal driving position, which indicates the vacuum (in millimeters or inches of mercury) available for braking; and

(2) A warning signal that is audible or visible to a person in the normal driving position and provides a continuous warning to the driver whenever the vacuum in the vehicle's supply reservoir is less than 203 mm (8 inches) of mercury.

(e) **Hydraulic brakes applied or assisted by air or vacuum.** Each vehicle equipped with hydraulically activated service brakes which are applied or assisted by compressed air or vacuum, and to which FMVSS No. 105 was not applicable on the date of manufacture, must be equipped with a warning signal that conforms to paragraph (b) of this section for the hydraulic portion of the system; paragraph (c) of this section for the air assist/air applied portion; or paragraph (d) of this section for the vacuum assist/vacuum applied portion. This paragraph shall not be construed as requiring air pressure gauges or vacuum gauges, only warning signals.

(f) **Exceptions.** The rules in paragraphs (c), (d) and (e) of this section do not apply to property carrying commercial motor vehicles which have less than three axles and (1) were manufactured before July 1, 1973, and (2) have a manufacturer's gross vehicle weight rating less than 4,536 kg (10,001 pounds).

§393.52 Brake performance.

(a) Upon application of its service brakes, a motor vehicle or combination of motor vehicles must under any condition of loading in which it is found on a public highway, be capable of—

(1) Developing a braking force at least equal to the percentage of its gross weight specified in the table in paragraph (d) of this section;

(2) Decelerating to a stop from 20 miles per hour at not less than the rate specified in the table in paragraph (d) of this section; and

(3) Stopping from 20 miles per hour in a distance, measured from the point at which movement of the service brake pedal or control begins, that is not greater than the distance specified in the table in paragraph (d) of this section; or, for motor vehicles or motor vehicle combinations that have a GVWR or GVW greater than 4,536 kg (10,000 pounds),

(4) Developing only the braking force specified in paragraph (a)(1) of this section and the stopping distance specified in paragraph (a)(3) of this section, if braking force is measured by a performance-based brake tester which meets the requirements of functional specifications for performance-based brake testers for commercial motor vehicles, where braking force is the sum of the braking force at each wheel of the vehicle or vehicle combination as a percentage of gross vehicle or combination weight.

(b) Upon application of its emergency brake system and with no other brake system applied, a motor vehicle or combination of motor vehicles must, under any condition of loading in which it is found on a public highway, be capable of stopping from 20 miles per hour in a distance, measured from the point at which movement of the emergency brake control begins, that is not greater than the distance specified in the table in paragraph (d) of this section.

(c) Conformity to the stopping-distance requirements of paragraphs (a) and (b) of this section shall be determined under the following conditions:

(1) Any test must be made with the vehicle on a hard surface that is substantially level, dry, smooth, and free of loose material.

(2) The vehicle must be in the center of a 12-foot-wide lane when the test begins and must not deviate from that lane during the test.

(d) Vehicle brake performance table:

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Type of motor vehicle	Service brake systems			Emergency brake systems
	Braking force as a percentage of gross vehicle or combination weight	Deceleration in feet per second per second	Application and braking distance in feet from initial speed of 20 m.p.h.	Application and braking distance in feet from initial speed of 20 m.p.h.
A. Passenger-carrying vehicles.				
(1) Vehicles with a seating capacity of 10 persons or less, including driver, and built on a passenger car chassis	65.2	21	20	54
(2) Vehicles with a seating capacity of more than 10 persons, including driver, and built on a passenger car chassis; vehicles built on a truck or bus chassis and having a manufacturer's GVWR of 10,000 pounds or less	52.8	17	25	66
(3) All other passenger-carrying vehicles	43.5	14	35	85
B. Property-carrying vehicles.				
(1) Single unit vehicles having a manufacturer's GVWR of 10,000 pounds or less	52.8	17	25	66
(2) Single unit vehicles having a manufacturer's GVWR of more than 10,000 pounds, except truck tractors. Combinations of a 2-axle towing vehicle and trailer having a GVWR of 3,000 pounds or less. All combinations of 2 or less vehicles in drive-away or tow-away operation	43.5	14	35	85
(3) All other property-carrying vehicles and combinations of property-carrying vehicles	43.5	14	40	90

Notes: (a) There is a definite mathematical relationship between the figures in columns 2 and 3. If the decelerations set forth in column 3 are divided by 32.2 feet per-second per-second, the figures in column 2 will be obtained. (For example, 21 divided by 32.2 equals 65.2 percent.) Column 2 is included in the tabulation because certain brake testing devices utilize this factor.

(b) The decelerations specified in column 3 are an indication of the effectiveness of the basic brakes, and as measured in practical brake testing are the maximum decelerations attained at some time during the stop. These decelerations as measured in brake tests cannot be used to compute the values in column 4 because the deceleration is not sustained at the same rate over the entire period of the stop. The deceleration increases from zero to a maximum during a period of brake system application and brake-force buildup. Also, other factors may cause the deceleration to decrease after reaching a maximum. The added distance that results because maximum deceleration is not sustained is included in the figures in column 4 but is not indicated by the usual brake-testing devices for checking deceleration.

(c) The distances in column 4 and the decelerations in column 3 are not directly related. "Brake-system application and braking distance in feet" (column 4) is a definite measure of the overall effectiveness of the braking system, being the distance traveled between the point at which the driver starts to move the braking controls and the point at which the vehicle comes to rest. It includes distance traveled while the brakes are being applied and distance traveled while the brakes are retarding the vehicle.

(d) The distance traveled during the period of brake-system application and brake-force buildup varies with vehicle type, being negligible for many passenger cars and greatest for combinations of commercial vehicles. This fact accounts for the variation from 20 to 40 feet in the values in column 4 for the various classes of vehicles.

(e) The terms "GVWR" and "GVW" refer to the manufacturer's gross vehicle rating and the actual gross vehicle weight, respectively.

§393.53 Automatic brake adjusters and brake adjustment indicators.

(a) **Automatic brake adjusters (hydraulic brake systems).** Each commercial motor vehicle manufactured on or after October 20, 1993, and equipped with a hydraulic brake system, shall meet the automatic brake adjustment system requirements of Federal Motor Vehicle Safety Standard No. 105 (49 CFR 571.105, S5.1) applicable to the vehicle at the time it was manufactured.

(b) **Automatic brake adjusters (air brake systems).** Each commercial motor vehicle manufactured on or after October 20, 1994, and equipped with an air brake system must meet the automatic brake adjustment system requirements of Federal Motor Vehicle Safety Standard No. 121 (49 CFR 571.121, S5.1.8 or S5.2.2) applicable to the vehicle at the time it was manufactured.

(c) **Brake adjustment indicator (air brake systems).** On each commercial motor vehicle manufactured on or after October 20, 1994, and equipped with an air brake system which contains an external automatic adjustment mechanism and an exposed pushrod, the condition of service brake under-adjustment must be

displayed by a brake adjustment indicator conforming to the requirements of Federal Motor Vehicle Safety Standard No. 121 (49 CFR 571.121, S5.1.8 or S5.2.2) applicable to the vehicle at the time it was manufactured.

§393.55 Antilock brake systems.

(a) **Hydraulic brake systems.** Each truck and bus manufactured on or after March 1, 1999 (except trucks and buses engaged in driveaway-towaway operations), and equipped with a hydraulic brake system, shall be equipped with an antilock brake system that meets the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 105 (49 CFR 571.105, S5.5).

(b) **ABS malfunction indicators for hydraulic braked vehicles.** Each hydraulic braked vehicle subject to the requirements of paragraph (a) of this section shall be equipped with an ABS malfunction indicator system that meets the requirements of FMVSS No. 105 (49 CFR 571.105, S5.3).

(c) **Air brake systems.** (1) Each truck tractor manufactured on or after March 1, 1997 (except truck tractors engaged in drive-away-towaway operations), shall be

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equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(b)).

(2) Each air braked commercial motor vehicle other than a truck tractor, manufactured on or after March 1, 1998 (except commercial motor vehicles engaged in driveaway-towaway operations), shall be equipped with an antilock brake system that meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.1(a) for trucks and buses, S5.2.3 for semitrailers, converter dollies and full trailers).

(d) ABS malfunction circuits and signals for air braked vehicles.

(1) Each truck tractor manufactured on or after March 1, 1997, and each single-unit air braked vehicle manufactured on or after March 1, 1998, subject to the requirements of paragraph (c) of this section, shall be

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equipped with an electrical circuit that is capable of signaling a malfunction that affects the generation or transmission of response or control signals to the vehicle's antilock brake system (49 CFR 571.121, S5.1.6.2(a)).

(2) Each truck tractor manufactured on or after March 1, 2001, and each single-unit vehicle that is equipped to tow another air-braked vehicle, subject to the requirements of paragraph (c) of this section, shall be equipped with an electrical circuit that is capable of transmitting a malfunction signal from the antilock brake system(s) on the towed vehicle(s) to the trailer ABS malfunction lamp in the cab of the towing vehicle, and shall have the means for connection of the electrical circuit to the towed vehicle. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.1.6.2(b)).

(3) Each semitrailer, trailer converter dolly, and full trailer manufactured on or after March 1, 2001, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this ABS malfunction circuit to the towing vehicle. In addition, each trailer manufactured on or after March 1, 2001, subject to the requirements of paragraph (c)(2) of this section, that is designed to tow another air-brake equipped trailer shall be capable of transmitting a malfunction signal from the antilock brake system(s) of the trailer(s) it tows to the vehicle in front of the trailer. The ABS malfunction circuit and signal shall meet the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.2).

(e) **Exterior ABS malfunction indicator lamps for trailers.** Each trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, and subject to the requirements of paragraph (c)(2) of this section, shall be equipped with an ABS malfunction indicator lamp which meets the requirements of FMVSS No. 121 (49 CFR 571.121, S5.2.3.3).

Subpart D—Glazing and window construction

§393.60 Glazing in specified openings.

(a) **Glazing material.** Glazing material used in windshields, windows, and doors on a motor vehicle manufactured on or after December 25, 1968, shall at a minimum meet the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 205 in effect on the date of manufacture of the motor vehicle. The glazing material shall be marked in accordance with FMVSS No. 205 (49 CFR 571.205, S6).

(b) **Windshields required.** Each bus, truck and truck-tractor shall be equipped with a windshield. Each windshield or portion of a multi-piece windshield shall be mounted using the full periphery of the glazing material.

(c) **Windshield condition.** With the exception of the conditions listed in paragraphs (c)(1), (c)(2), and (c)(3) of this section, each windshield shall be free of discoloration or damage in the area extending upward from the height of the top of the steering wheel (excluding a 51

mm (2 inch) border at the top of the windshield) and extending from a 25 mm (1 inch) border at each side of the windshield or windshield panel.

Exceptions:

(1) Coloring or tinting which meets the requirements of paragraph (d) of this section;

(2) Any crack that is not intersected by any other cracks;

(3) Any damaged area which can be covered by a disc 19 mm ($\frac{3}{4}$ inch) in diameter if not closer than 76 mm (3 inches) to any other similarly damaged area.

(d) **Coloring or tinting of windshields and windows.** Coloring or tinting of windshields and the windows to the immediate right and left of the driver is allowed, provided the parallel luminous transmittance through the colored or tinted glazing is not less than 70 percent of the light at normal incidence in those portions of the windshield or windows which are marked as having a parallel luminous transmittance of not less than 70 percent. The transmittance restriction does not apply to other windows on the commercial motor vehicle.

(e) **Prohibition on obstructions to the driver's field of view—(1) Devices mounted at the top of the windshield.** Antennas, transponders, and similar devices must not be mounted more than 152 mm (6 inches) below the upper edge of the windshield. These devices must be located outside the area swept by the windshield wipers, and outside the driver's sight lines to the road and highway signs and signals.

(2) **Decals and stickers mounted on the windshield.** Commercial Vehicle Safety Alliance (CVSA) inspection decals, and stickers and/or decals required under Federal or State laws may be placed at the bottom or sides of the windshield provided such decals or stickers do not extend more than 115 mm ($4\frac{1}{2}$ inches) from the bottom of the windshield and are located outside the area swept by the windshield wipers, and outside the driver's sight lines to the road and highway signs or signals.

§393.61 Truck and truck tractor window construction.

Each truck and truck tractor (except trucks engaged in armored car service) shall have at least one window on each side of the driver's compartment. Each window must have a minimum area of 1,290 cm² (200 in²) formed by a rectangle 33 cm by 45 cm (13 inches by 17 $\frac{3}{4}$ inches). The maximum radius of the corner arcs shall not exceed 152 mm (6 inches). The long axis of the rectangle shall not make an angle of more than 45 degrees with the surface on which the unladen vehicle stands. If the cab is designed with a folding door or doors or with clear openings where doors or windows are customarily located, no windows shall be required in those locations.

§393.62 Emergency exits for buses.

(a) **Buses manufactured on or after September 1, 1994.** Each bus with a GVWR of 4,536 kg (10,000 pounds) or less must meet the emergency exit requirements of FMVSS No. 217 (S5.2.2.3) in effect on the date of manufacture. Each bus with a GVWR of more than 4,536 kg (10,000 pounds) must have emergency exits which meet the applicable emergency exit requirements of FMVSS

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No. 217 (S5.2.2 or S5.2.3) in effect on the date of manufacture.

(b) **Buses manufactured on or after September 1, 1973, but before September 1, 1994.** (1) Each bus (including a school bus used in interstate commerce for non-school bus operations) with a GVWR of more than 4,536 kg (10,000 lbs) must meet the requirements of FMVSS No. 217, S5.2.2 in effect on the date of manufacture.

(2) Each bus (including a school bus used in interstate commerce for non-school bus operations) with a GVWR of 4,536 kg (10,000 lbs) or less must meet the requirements of FMVSS No. 217, S5.2.2.3 in effect on the date of manufacture.

(c) **Buses manufactured before September 1, 1973.** For each seated passenger space provided, inclusive of the driver there shall be at least 432 cm² (67 square inches) of glazing if such glazing is not contained in a push-out window; or, at least 432 cm² (67 square inches) of free opening resulting from opening of a push-out type window. No area shall be included in this minimum prescribed area unless it will provide an unobstructed opening of at least 1,290 cm² (200 in²) formed by a rectangle 33 cm by 45 cm (13 inches by 17¾ inches). The maximum radius of the corner arcs shall not exceed 152 mm (6 inches). The long axis of the rectangle shall not make an angle of more than 45 degrees with the surface on which the unladen vehicle stands. The area shall be measured either by removal of the glazing if not of the push-out type, or of the movable sash if of the push-out type. The exit must comply with paragraph (d) of this section. Each side of the bus must have at least 40 percent of emergency exit space required by this paragraph.

(d) **Laminated safety glass/push-out window requirements for buses manufactured before September 1, 1973.** Emergency exit space used to satisfy the requirements of paragraph (c) of this section must have laminated safety glass or push-out windows designed and maintained to yield outward to provide a free opening.

(1) **Safety glass.** Laminated safety glass must meet Test No. 25, Egress, of American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways-Safety Standards ANSI/SAE Z26. 1/96, August 1997. (See §393.7(b) for information on incorporation by reference and availability of this document.)

(2) **Push-out windows.** Each push-out window shall be releasable by operating no more than two mechanisms and allow manual release of the exit by a single occupant. For mechanisms which require rotary or straight (parallel to the undisturbed exit surface) motions to operate the exit, no more than 89 Newtons (20 pounds) of force shall be required to release the exit. For exits which require a straight motion perpendicular to the undisturbed exit surface, no more than 267 Newtons (60 pounds) shall be required to release the exit.

(e) **Emergency exit identification.** Each bus and each school bus used in interstate commerce for non-school bus operations, manufactured on or after September 1, 1973, shall meet the applicable emergency exit identification or marking requirements of FMVSS

No. 217, S5.5, in effect on the date of manufacture. The emergency exits and doors on all buses (including school buses used in interstate commerce for non-school bus operations) must be marked "Emergency Exit" or "Emergency Door" followed by concise operating instructions describing each motion necessary to unlatch or open the exit located within 152 mm (6 inches) of the release mechanism.

(f) **Exception for the transportation of prisoners.** The requirements of this section do not apply to buses used exclusively for the transportation of prisoners.

§393.63 [Reserved]

Subpart E—Fuel systems

§393.65 All fuel systems.

(a) **Application of the rules in this section.** The rules in this section apply to systems for containing and supplying fuel for the operation of motor vehicles or for the operation of auxiliary equipment installed on, or used in connection with, motor vehicles.

(b) **Location.** Each fuel system must be located on the motor vehicle so that—

(1) No part of the system extends beyond the widest part of the vehicle;

(2) No part of a fuel tank is forward of the front axle of a power unit;

(3) Fuel spilled vertically from a fuel tank while it is being filled will not contact any part of the exhaust or electrical systems of the vehicle, except the fuel level indicator assembly;

(4) Fill pipe openings are located outside the vehicle's passenger compartment and its cargo compartment;

(5) A fuel line does not extend between a towed vehicle and the vehicle that is towing it while the combination of vehicles is in motion; and

(6) No part of the fuel system of a bus manufactured on or after January 1, 1973, is located within or above the passenger compartment.

(c) **Fuel tank installation.** Each fuel tank must be securely attached to the motor vehicle in a workmanlike manner.

(d) **Gravity or syphon feed prohibited.** A fuel system must not supply fuel by gravity or syphon feed directly to the carburetor or injector.

(e) **Selection control valve location.** If a fuel system includes a selection control valve which is operable by the driver to regulate the flow of fuel from two or more fuel tanks, the valve must be installed so that either—

(1) The driver may operate it while watching the roadway and without leaving his driving position; or

(2) The driver must stop the vehicle and leave his seat in order to operate the valve.

(f) **Fuel lines.** A fuel line which is not completely enclosed in a protective housing must not extend more

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than 2 inches below the fuel tank or its sump. Diesel fuel crossover, return, and withdrawal lines which extend below the bottom of the tank or sump must be protected against damage from impact. Every fuel line must be—

(1) Long enough and flexible enough to accommodate normal movements of the parts to which it is attached without incurring damage; and

(2) Secured against chafing, kinking, or other causes of mechanical damage.

(g) **Excess flow valve.** When pressure devices are used to force fuel from a fuel tank, a device which prevents the flow of fuel from the fuel tank if the fuel feed line is broken must be installed in the fuel system.

§393.67 Liquid fuel tanks.

(a) **Application of the rules in this section.** The rules in this section apply to tanks containing or supplying fuel for the operation of commercial motor vehicles or for the operation of auxiliary equipment installed on, or used in connection with commercial motor vehicles.

(1) A liquid fuel tank manufactured on or after January 1, 1973, and a side-mounted gasoline tank must conform to all the rules in this section.

(2) A diesel fuel tank manufactured before January 1, 1973, and mounted on a bus must conform to the rules in paragraphs (c)(7)(ii) and (d)(2) of this section.

(3) A diesel fuel tank manufactured before January 1, 1973, and mounted on a vehicle other than bus must conform to the rules in paragraph (c)(7)(ii) of this section.

(4) A gasoline tank, other than a side-mounted gasoline tank, manufactured before January 1, 1973, and mounted on a bus must conform to the rules in paragraphs (c)(1) through (10) and (d)(2) of this section.

(5) A gasoline tank, other than a side-mounted gasoline tank, manufactured before January 1, 1973, and mounted on a vehicle other than a bus must conform to the rules in paragraphs (c)(1) through (10), inclusive, of this section.

(6) **Private motor carrier of passengers.** Motor carriers engaged in the private transportation of passengers may continue to operate a commercial motor vehicle which was not subject to this section or 49 CFR 571.301 at the time of its manufacture, provided the fuel tank of such vehicle is maintained to the original manufacturer's standards.

(7) Motor vehicles that meet the fuel system integrity requirements of 49 CFR 571.301 are exempt from the requirements of this subpart, as they apply to the vehicle's fueling system.

(b) **Definitions.** As used in this section—

(1) The term "liquid fuel tank" means a fuel tank designed to contain a fuel that is liquid at normal atmospheric pressures and temperatures.

(2) A "side-mounted" fuel tank is a liquid fuel tank which—

(i) If mounted on a truck tractor, extends outboard of the vehicle frame and outside of the plan view outline of the cab; or

(ii) If mounted on a truck, extends outboard of a line parallel to the longitudinal centerline of the truck and tangent to the outboard side of a front tire in a straight ahead position. In determining whether a fuel tank on a truck or truck tractor is side-mounted, the fill pipe is not considered a part of the tank.

(c) **Construction of liquid fuel tanks—**

(1) **Joints.** Joints of a fuel tank body must be closed by arc-, gas-, seam-, or spot-welding, by brazing, by silver soldering, or by techniques which provide heat resistance and mechanical securement at least equal to those specifically named. Joints must not be closed solely by crimping or by soldering with a lead-based or other soft solder.

(2) **Fittings.** The fuel tank body must have flanges or spuds suitable for the installation of all fittings.

(3) **Threads.** The threads of all fittings must be Dryseal American Standard Taper Pipe Thread or Dryseal SAE Short Taper Pipe Thread, specified in Society of Automotive Engineers Standard J476, as contained in the 1971 edition of the "SAE Handbook", except that straight (non-tapered) threads may be used on fittings having integral flanges and using gaskets for sealing. At least four full threads must be in engagement in each fitting.

(4) **Drains and bottom fittings.**

(i) Drains or other bottom fittings must not extend more than $\frac{3}{4}$ of an inch below the lowest part of the fuel tank or sump.

(ii) Drains or other bottom fittings must be protected against damage from impact.

(iii) If a fuel tank has drains the drain fittings must permit substantially complete drainage of the tank.

(iv) Drains or other bottom fittings must be installed in a flange or spud designed to accommodate it.

(5) **Fuel withdrawal fittings.** Except for diesel fuel tanks, the fittings through which fuel is withdrawn from a fuel tank must be located above the normal level of fuel in the tank when the tank is full.

(6) [Reserved]

(7) **Fill pipe.** (i) Each fill pipe must be designed and constructed to minimize the risk of fuel spillage during fueling operations and when the vehicle is involved in a crash.

(ii) For diesel-fueled vehicles, the fill pipe and vents of a fuel tank having a capacity of more than 94.75 L (25 gallons) of fuel must permit filling the tank with fuel at a rate of at least 75.8 L/m (20 gallons per minute) without fuel spillage.

(iii) For gasoline- and methanol-fueled vehicles with a GVWR of 3,744 kg (8,500 pounds) or less, the vehicle must permit filling the tank with fuel dispensed at the applicable fill rate required by the regulations of the Environmental Protection Agency under 40 CFR 80.22.

(iv) For gasoline- and methanol-fueled vehicles with a GVWR of 14,000 pounds (6,400 kg) or less, the vehicle must comply with the applicable fuel-spitback prevention and onboard refueling vapor recovery regulations of the Environmental Protection Agency under 40 CFR part 86.

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(v) Each fill pipe must be fitted with a cap that can be fastened securely over the opening in the fill pipe. Screw threads or a bayonet-type point are methods of conforming to the requirements of paragraph (c) of this section.

(8) **Safety venting system.** A liquid fuel tank with a capacity of more than 25 gallons of fuel must have a venting system which, in the event the tank is subjected to fire, will prevent internal tank pressure from rupturing the tank's body, seams, or bottom opening (if any).

(9) **Pressure resistance.** The body and fittings of a liquid fuel tank with a capacity of more than 25 gallons of fuel must be capable of withstanding an internal hydrostatic pressure equal to 150 percent of the maximum internal pressure reached in the tank during the safety venting system test specified in paragraph (d)(1) of this section.

(10) **Air vent.** Each fuel tank must be equipped with a non-spill air vent (such as a ball check). The air vent may be combined with the fill-pipe cap or safety vent, or it may be a separate unit installed on the fuel tank.

(11) **Markings.** If the body of the fuel tank is readily visible when the tank is installed on the vehicle, the tank must be plainly marked with its liquid capacity. The tank must also be plainly marked with a warning against filling it to more than 95 percent of its liquid capacity.

(12) **Overfill restriction.** A liquid fuel tank manufactured on or after January 1, 1973, must be designed and constructed so that—

(i) The tank cannot be filled, in a normal filling operation, with a quantity of fuel that exceeds 95 percent of the tank's liquid capacity; and

(ii) When the tank is filled, normal expansion of the fuel will not cause fuel spillage.

(d) **Liquid fuel tank tests.** Each liquid fuel tank must be capable of passing the tests specified in paragraphs (d)(1) and (2) of this section. The specified tests are a measure of performance only. Alternative procedures which assure that equipment meets the required performance standards may be used.

(1) **Safety venting system test—**

(i) **Procedure.** Fill the tank three-fourths full with fuel, seal the fuel feed outlet, and invert the tank. When the fuel temperature is between 50°F. and 80°F., apply an enveloping flame to the tank so that the temperature of the fuel rises at a rate of not less than 6°F. and not more than 8°F. per minute.

(ii) **Required performance.** The safety venting system required by paragraph (c)(8) of this section must activate before the internal pressure in the tank exceeds 50 pounds per square inch, gauge, and the internal pressure must not thereafter exceed the pressure at which the system activated by more than five pounds per square inch despite any further increase in the temperature of the fuel.

(2) **Leakage test—**

(i) **Procedure.** Fill the tank to capacity with fuel having a temperature between 50 °F. and 80 °F. With the fill-pipe cap installed, turn the tank through an angle of

150° in any direction about any axis from its normal position.

(ii) **Required performance.** Neither the tank nor any fitting may leak more than a total of one ounce by weight of fuel per minute in any position the tank assumes during the test.

(e) **Side-mounted liquid fuel tank tests.** Each side-mounted liquid fuel tank must be capable of passing the tests specified in paragraphs (e)(1) and (2) of this section and the test specified in paragraphs (d)(1) and (2) of this section. The specified tests are a measure of performance only. Alternative procedures which assure that equipment meets the required performance criteria may be used.

(1) **Drop test—**

(i) **Procedure.** Fill the tank with a quantity of water having a weight equal to the weight of the maximum fuel load of the tank and drop the tank 30 feet onto an unyielding surface so that it lands squarely on one corner.

(ii) **Required performance.** Neither the tank nor any fitting may leak more than a total of 1 ounce by weight of water per minute.

(2) **Fill-pipe test—**

(i) **Procedure.** Fill the tank with a quantity of water having a weight equal to the weight of the maximum fuel load of the tank and drop the tank 10 feet onto an unyielding surface so that it lands squarely on its fill-pipe.

(ii) **Required performance.** Neither the tank nor any fitting may leak more than a total of 1 ounce by weight of water per minute.

(f) **Certification and markings.** Each liquid fuel tank shall be legibly and permanently marked by the manufacturer with the following minimum information:

(1) The month and year of manufacture.

(2) The manufacturer's name on tanks manufactured on and after July 1, 1989, and means of identifying the facility at which the tank was manufactured, and

(3) A certificate that it conforms to the rules in this section applicable to the tank. The certificate must be in the form set forth in either of the following:

(i) If a tank conforms to all rules in this section pertaining to side-mounted fuel tanks: "Meets all FMCSA sidemounted tank requirements."

(ii) If a tank conforms to all rules in this section pertaining to tanks which are not side-mounted fuel tanks: "Meets all FMCSA requirements for non-side-mounted fuel tanks."

(iii) The form of certificate specified in paragraph (f)(3) (i) or (ii) of this section may be used on a liquid fuel tank manufactured before July 11, 1973, but it is not mandatory for liquid fuel tanks manufactured before March 7, 1989. The form of certification manufactured on or before March 7, 1989, must meet the requirements in effect at the time of manufacture.

(4) **Exception.** The following previously exempted vehicles are not required to carry the certification and marking specified in paragraphs (f)(1) through (3) of this section:

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(i) Ford vehicles with GVWR over 10,000 pounds identified as follows: The vehicle identification numbers (VINs) contain A, K, L, M, N, W, or X in the fourth position.

(ii) GM G-Vans (Chevrolet Express and GMC Savanna) and full-sized C/K trucks (Chevrolet Silverado and GMC Sierra) with GVWR over 10,000 pounds identified as follows: The VINs contain either a “J” or a “K” in the fourth position. In addition, the seventh position of the VINs on the G-Van will contain a “1.”

§393.68 Compressed natural gas fuel containers.

(a) **Applicability.** The rules in this section apply to compressed natural gas (CNG) fuel containers used for supplying fuel for the operation of commercial motor vehicles or for the operation of auxiliary equipment installed on, or used in connection with commercial motor vehicles.

(b) **CNG containers manufactured on or after March 26, 1995.** Any motor vehicle manufactured on or after March 26, 1995, and equipped with a CNG fuel tank must meet the CNG container requirements of FMVSS No. 304 (49 CFR 571.304) in effect at the time of manufacture of the vehicle.

(c) **Labeling.** Each CNG fuel container shall be permanently labeled in accordance with the requirements of FMVSS No. 304, S7.4.

§393.69 Liquefied petroleum gas systems.

(a) A fuel system that uses liquefied petroleum gas as a fuel for the operation of a motor vehicle or for the operation of auxiliary equipment installed on, or used in connection with, a motor vehicle must conform to the “Standards for the Storage and Handling of Liquefied Petroleum Gases” of the National Fire Protection Association, Battery March Park, Quincy, MA 02269, as follows:

(1) A fuel system installed before December 31, 1962, must conform to the 1951 edition of the Standards.

(2) A fuel system installed on or after December 31, 1962, and before January 1, 1973, must conform to Division IV of the June 1959 edition of the Standards.

(3) A fuel system installed on or after January 1, 1973, and providing fuel for propulsion of the motor vehicle must conform to Division IV of the 1969 edition of the Standards.

(4) A fuel system installed on or after January 1, 1973, and providing fuel for the operation of auxiliary equipment must conform to Division VII of the 1969 edition of the Standards.

(b) When the rules in this section require a fuel system to conform to a specific edition of the Standards, the fuel system may conform to the applicable provisions in a later edition of the Standards specified in this section.

(c) The tank of a fuel system must be marked to indicate that the system conforms to the Standards.

Subpart F—Coupling devices and towing methods

§393.70 Coupling devices and towing methods, except for driveaway-towaway operations.

(a) **Tracking.** When two or more vehicles are operated in combination, the coupling devices connecting the vehicles shall be designed, constructed, and installed, and the vehicles shall be designed and constructed, so that when the combination is operated in a straight line on a level, smooth, paved surface, the path of the towed vehicle will not deviate more than 3 inches to either side of the path of the vehicle that tows it.

(b) **Fifth wheel assemblies—(1) Mounting—(i) Lower half.** The lower half of a fifth wheel mounted on a truck tractor or converter dolly must be secured to the frame of that vehicle with properly designed brackets, mounting plates or angles and properly tightened bolts of adequate size and grade, or devices that provide equivalent security. The installation shall not cause cracking, warping, or deformation of the frame. The installation must include a device for positively preventing the lower half of the fifth wheel from shifting on the frame to which it is attached.

(ii) **Upper half.** The upper half of a fifth wheel must be fastened to the motor vehicle with at least the same security required for the installation of the lower half on a truck tractor or converter dolly.

(2) **Locking.** Every fifth wheel assembly must have a locking mechanism. The locking mechanism, and any adapter used in conjunction with it, must prevent separation of the upper and lower halves of the fifth wheel assembly unless a positive manual release is activated. The release may be located so that the driver can operate it from the cab. If a motor vehicle has a fifth wheel designed and constructed to be readily separable, the fifth wheel locking devices shall apply automatically on coupling.

(3) **Location.** The lower half of a fifth wheel shall be located so that, regardless of the condition of loading, the relationship between the kingpin and the rear axle or axles of the towing motor vehicle will properly distribute the gross weight of both the towed and towing vehicles on the axles of those vehicles, will not unduly interfere with the steering, braking, and other maneuvering of the towing vehicle, and will not otherwise contribute to unsafe operation of the vehicles comprising the combination. The upper half of a fifth wheel shall be located so that the weight of the vehicles is properly distributed on their axles and the combination of vehicles will operate safely during normal operation.

(c) **Towing of full trailers.** A full trailer must be equipped with a tow-bar and a means of attaching the tow-bar to the towing and towed vehicles. The tow-bar and the means of attaching it must—

(1) Be structurally adequate for the weight being drawn;

(2) Be properly and securely mounted;

(3) Provide for adequate articulation at the connection without excessive slack at that location; and

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(4) Be provided with a locking device that prevents accidental separation of the towed and towing vehicles. The mounting of the trailer hitch (pintle hook or equivalent mechanism) on the towing vehicle must include reinforcement or bracing of the frame sufficient to produce strength and rigidity of the frame to prevent its undue distortion.

(d) **Safety devices in case of tow-bar failure or disconnection.** Every full trailer and every converter dolly used to convert a semitrailer to a full trailer must be coupled to the frame, or an extension of the frame, of the motor vehicle which tows it with one or more safety devices to prevent the towed vehicle from breaking loose in the event the tow-bar fails or becomes disconnected. The safety device must meet the following requirements:

(1) The safety device must not be attached to the pintle hook or any other device on the towing vehicle to which the tow-bar is attached. However, if the pintle hook or other device was manufactured prior to July 1, 1973, the safety device may be attached to the towing vehicle at a place on a pintle hook forging or casting if that place is independent of the pintle hook.

(2) The safety device must have no more slack than is necessary to permit the vehicles to be turned properly.

(3) The safety device, and the means of attaching it to the vehicles, must have an ultimate strength of not less than the gross weight of the vehicle or vehicles being towed.

(4) The safety device must be connected to the towed and towing vehicles and to the tow-bar in a manner which prevents the tow-bar from dropping to the ground in the event it fails or becomes disconnected.

(5) Except as provided in paragraph (d) (6) of this section, if the safety device consists of safety chains or cables, the towed vehicle must be equipped with either two safety chains or cables or with a bridle arrangement of a single chain or cable attached to its frame or axle at two points as far apart as the configuration of the frame or axle permits. The safety chains or cables shall be either two separate pieces, each equipped with a hook or other means for attachment to the towing vehicle, or a single piece leading along each side of the tow-bar from the two points of attachment on the towed vehicle and arranged into a bridle with a single means of attachment to be connected to the towing vehicle. When a single length of cable is used, a thimble and twin-base cable clamps shall be used to form the forward bridle eye. The hook or other means of attachment to the towing vehicle shall be secured to the chains or cables in a fixed position.

(6) If the towed vehicle is a converter dolly with a solid tongue and without a hinged tow-bar or other swivel between the fifth wheel mounting and the attachment point of the tongue eye or other hitch device—

(i) Safety chains or cables, when used as the safety device for that vehicle, may consist of either two chains or cables or a single chain or cable used alone;

(ii) A single safety device, including a single chain or cable used alone as the safety device, must be in line with the centerline of the trailer tongue; and

(iii) The device may be attached to the converter dolly at any point to the rear of the attachment point of the tongue eye or other hitch device.

(7) Safety devices other than safety chains or cables must provide strength, security of attachment, and directional stability equal to, or greater than, safety chains or cables installed in accordance with paragraphs (d)(5) and (6) of this section.

(8)(i) When two safety devices, including two safety chains or cables, are used and are attached to the towing vehicle at separate points, the points of attachment on the towing vehicle shall be located equally distant from, and on opposite sides of, the longitudinal centerline of the towing vehicle.

(ii) Where two chains or cables are attached to the same point on the towing vehicle, and where a bridle or a single chain or cable is used, the point of attachment must be on the longitudinal centerline or within 152 mm (6 inches) to the right of the longitudinal centerline of the towing vehicle.

(iii) A single safety device, other than a chain or cable, must also be attached to the towing vehicle at a point on the longitudinal centerline or within 152 mm (6 inches) to the right of the longitudinal centerline of the towing vehicle.

§393.71 Coupling devices and towing methods, driveaway-towaway operations.

(a) **Number in combination.** (1) No more than three saddle-mounts may be used in any combination.

(2) No more than one tow-bar or ball-and-socket type coupling device may be used in any combination.

(3) When motor vehicles are towed by means of triple saddle-mounts, all but the final towed vehicle must have brakes acting on all wheels in contact with the roadway.

(b) **Carrying vehicles on towing vehicle.** (1) When adequately and securely attached by means equivalent in security to that provided in paragraph (j)(2) of this section, a motor vehicle or motor vehicles may be full-mounted on the structure of a towing vehicle engaged in any driveaway-towaway operation.

(2) No motor vehicle or motor vehicles may be full-mounted on a towing vehicle unless the relationship of such full-mounted vehicles to the rear axle or axles results in proper distribution of the total gross weight of the vehicles and does not unduly interfere with the steering, braking, or maneuvering of the towing vehicle, or otherwise contribute to the unsafe operation of the vehicles comprising the combination.

(3) Saddle-mounted vehicles must be arranged such that the gross weight of the vehicles is properly distributed to prevent undue interference with the steering, braking, or maneuvering of the combination of vehicles.

(c) **Carrying vehicles on towed vehicles.** (1) When adequately and securely attached by means equivalent in security to that provided in paragraph (j)(2) of this section, a motor vehicle or motor vehicles may be full-mounted on the structure of towed vehicles engaged in any driveaway-towaway operation.

(2) No motor vehicle shall be full-mounted on a motor vehicle towed by means of a tow-bar unless the towed

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vehicle is equipped with brakes and is provided with means for effective application of brakes acting on all wheels and is towed on its own wheels.

(3) No motor vehicle or motor vehicles shall be full-mounted on a motor vehicle towed by means of a saddle-mount unless the centerline of the kingpin or equivalent means of attachment of such towed vehicle shall be so located on the towing vehicle that the relationship to the rear axle or axles results in proper distribution of the total gross weight of the vehicles and does not unduly interfere with the steering, braking, or maneuvering of the towing vehicle or otherwise contribute to the unsafe operation of vehicles comprising the combination; and unless a perpendicular to the ground from the center of gravity of the full-mounted vehicles lies forward of the centerline of the rear axle of the saddle-mounted vehicle.

(4) If a motor vehicle towed by means of a saddle-mount has any vehicle full-mounted on it, the saddle-mounted vehicle must at all times while so loaded have effective brakes acting on all wheels in contact with the roadway.

(d) **Bumper tow-bars on heavy vehicles prohibited.** Tow-bars of the type which depend upon the bumpers as a means of transmitting forces between the vehicles shall not be used to tow a motor vehicle weighing more than 5,000 pounds.

(e) **Front wheels of saddle-mounted vehicles restrained.** A motor vehicle towed by means of a saddle-mount shall have the motion of the front wheels restrained if under any condition of turning of such wheels they will project beyond the widest part of either the towed or towing vehicle.

(f) **Vehicles to be towed in forward position.** Unless the steering mechanism is adequately locked in a straight forward position, all motor vehicles towed by means of a saddle-mount shall be towed with the front end mounted on the towing vehicle.

(g) **Means required for towing.** Means required for towing. No motor vehicles or combination of motor vehicles shall be towed in driveaway-towaway operations by means other than a tow-bar, ball-and-socket type coupling device, saddle-mount connections which meet the requirements of this section, or in the case of a semi-trailer equipped with an upper coupler assembly, a fifth-wheel meeting the requirements of §393.70.

(h) **Requirements for tow-bars.** Tow-bars shall comply with the following requirements:

(1) **Tow-bars, structural adequacy and mounting.** Every tow-bar shall be structurally adequate and properly installed and maintained. To insure that it is structurally adequate, it must, at least, meet the requirements of the following table:

Gross weight of towed vehicle (pounds) ¹	Longitudinal strength in tension and compression ²		Strength as a beam (in any direction concentrated load at center) ^{2,3}
	All towbars	New towbars acquired and used by a motor carrier after Sept. 30, 1948	
	Pounds	Pounds	Pounds

Gross weight of towed vehicle (pounds) ¹	Longitudinal strength in tension and compression ²		Strength as a beam (in any direction concentrated load at center) ^{2,3}
	All towbars	New towbars acquired and used by a motor carrier after Sept. 30, 1948	
Less than 5,000	3,000	6,500	3,000
5,000 and over			
Less than 10,000	6,000	(¹)	(¹)
10,000 and over			
Less than 15,000	9,000	(¹)	(¹)

¹The required strength of tow-bars for towed vehicles of 15,000 pounds and over gross weight and of new tow-bars acquired and used after Sept. 30, 1948, for towed vehicles of 5,000 pounds and over gross weight shall be computed by means of the following formulae: Longitudinal strength = gross weight of towed vehicle x 1.3. Strength as a beam = gross weight of towed vehicle x 0.6.

²In testing, the whole unit shall be tested with all clamps, joints, and pins so mounted and fastened as to approximate conditions of actual operation.

³This test shall be applicable only to tow-bars which are, in normal operation, subjected to a bending movement such as tow-bars for house trailers.

(2) **Tow-bars, jointed.** The tow-bar shall be so constructed as to freely permit motion in both horizontal and vertical planes between the towed and towing vehicles. The means used to provide the motion shall be such as to prohibit the transmission of stresses under normal operation between the towed and towing vehicles, except along the longitudinal axis of the tongue or tongues.

(3) **Tow-bar fastenings.** The means used to transmit the stresses to the chassis or frames of the towed and towing vehicles may be either temporary structures or bumpers or other integral parts of the vehicles: Provided, however, that the means used shall be so constructed, installed, and maintained that, when tested as an assembly, failure in such members shall not occur when the weakest new tow-bar which is permissible under paragraph (h)(1) of this section is subjected to the tests given therein.

(4) **Means of adjusting length.** On tow-bars, adjustable as to length, the means used to make such adjustment shall fit tightly and not result in any slackness or permit the tow-bar to bend. With the tow-bar supported rigidly at both ends and with a load of 50 pounds at the center, the sag, measured at the center, in any direction shall not exceed 0.25 inch under any condition of adjustment as to length.

(5) **Method of clamping.** Adequate means shall be provided for securely fastening the tow-bar to the towed and towing vehicles.

(6) **Tow-bar connection to steering mechanism.** The tow-bar shall be provided with suitable means of attachment to and actuation of the steering mechanism, if any, of the towed vehicle. The attachment shall provide for sufficient angularity of movement of the front wheels of the towed vehicle so that it may follow substantially in the path of the towing vehicle without cramping the tow-bar. The tow-bar shall be provided with suitable joints to permit such movement.

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(7) **Tracking.** The tow-bar shall be so designed, constructed, maintained, and mounted as to cause the towed vehicle to follow substantially in the path of the towing vehicle. Tow-bars of such design or in such condition as to permit the towed vehicle to deviate more than 3 inches to either side of the path of a towing vehicle moving in a straight line as measured from the center of the towing vehicle are prohibited.

(8) **Passenger car-trailer type couplings.** Trailer couplings used for driveaway-towaway operations of passenger car trailers shall conform to Society of Automotive Engineers Standard No. J684c, "Trailer Couplings and Hitches—Automotive Type," July 1970.¹

(9) **Marking tow-bars.** Every tow-bar acquired and used in driveaway-towaway operations by a motor carrier shall be plainly marked with the following certification of the manufacturer thereof (or words of equivalent meaning):

This tow-bar complies with the requirements of the Federal Motor Carrier Safety Administration for (maximum gross weight for which tow-bar is manufactured) vehicles.

Allowable Maximum Gross Weight _____
 Manufactured _____
 (Month and year)
 by _____
 (Name of manufacturer)

Tow-bar certification manufactured before March 7, 1989 must meet requirements in effect at the time of manufacture.

(10) **Safety devices in case of tow-bar failure or disconnection.** (i) The towed vehicle shall be connected to the towing vehicle by a safety device to prevent the towed vehicle from breaking loose in the event the tow-bar fails or becomes disconnected. When safety chains or cables are used as the safety device for that vehicle, at least two safety chains or cables meeting the requirements of paragraph (h)(10)(ii) of this section shall be used. The tensile strength of the safety device and the means of attachment to the vehicles shall be at least equivalent to the corresponding longitudinal strength for tow-bars required in the table of paragraph (h)(1) of this section. If safety chains or cables are used as the safety device, the required strength shall be the combined strength of the combination of chains and cables.

(ii) If chains or cables are used as the safety device, they shall be crossed and attached to the vehicles near the points of bumper attachments to the chassis of the vehicles. The length of chain used shall be no more than necessary to permit free turning of the vehicles. The chains shall be attached to the tow-bar at the point of crossing or as close to that point as is practicable.

(iii) A safety device other than safety chains or cables must provide strength, security of attachment, and directional stability equal to, or greater than, that provided by safety chains or cables installed in accordance with paragraph (h)(10)(ii) of this section. A safety device other than safety chains or cables must be designed, constructed, and installed so that, if the tow-bar fails or

becomes disconnected, the tow-bar will not drop to the ground.

(i) [Reserved]

(j) **Requirements for upper-half of saddle-mounts.** The upper-half of any saddle-mount shall comply with the following requirements:

(1) **Upper-half connection to towed vehicle.** The upper-half shall be securely attached to the frame or axle of the towed vehicle by means of U-bolts or other means providing at least equivalent security.

(2) **U-bolts or other attachments.** U-bolts used to attach the upper-half to the towed vehicles shall be made of steel rod, free of defects, so shaped as to avoid at any point a radius of less than 1 inch; Provided, however, that a lesser radius may be utilized if the U-bolt is so fabricated as not to cause more than 5 percent reduction in cross-sectional area at points of curvature, in which latter event the minimum radius shall be one-sixteenth inch. U-bolts shall have a diameter not less than required by the following table:

DIAMETER OF U-BOLTS IN INCHES

Weights in pounds of heaviest towed vehicle	Double or triple saddle-mount			
	Front mount	Middle or front mount	Rear mount	Single saddle-mount ¹
Up to 5,000 .	0.625	0.5625	0.0500	0.500
5,000 and over.....	0.6875	0.625	0.5625	0.5625

¹The total weight of all the vehicles being towed shall govern. If other devices are used to accomplish the same purposes as U-bolts they shall have at least equivalent strength of U-bolts made of mild steel. Cast iron shall not be used for clamps or any other holding devices.

(3) **U-bolts and points of support, location.** The distance between the most widely separated U-bolts shall not be less than 9 inches. The distance between the widely separated points where the upper-half supports the towed vehicle shall not be less than 9 inches, except that saddle-mounts employing ball and socket joints shall employ a device which clamps the axle of the towed vehicle throughout a length of not less than 5 inches.

(4) **Cradle-type upper-halves, specifications.** Upper-halves of the cradle-type using vertical members to restrain the towed vehicle from relative movement in the direction of motion of the vehicles shall be substantially constructed and adequate for the purpose. Such cradle-mounts shall be equipped with at least one bolt or equivalent means to provide against relative vertical movement between the upper-half and the towed vehicle. Bolts, if used, shall be at least one-half inch in diameter. Devices using equivalent means shall have at least equivalent strength. The means used to provide against relative vertical motion between the upper-half and the towed vehicle shall be such as not to permit a relative motion of over one-half inch. The distance between the most widely separated points of support between the upper-half and the towed vehicle shall be at least 9 inches.

¹See footnote 1 to §393.24(c).

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(5) **Lateral movement of towed vehicle.** (i) Towed vehicles having a straight axle or an axle having a drop of less than 3 inches, unless the saddle-mount is constructed in accordance with paragraph (m)(2) of this section, shall be securely fastened by means of chains or cables to the upper-half so as to insure against relative lateral motion between the towed vehicle and the upper-half. The chains or cables shall be at least $\frac{3}{16}$ -inch diameter and secured by bolts of at least equal diameter.

(ii) Towed vehicles with an axle with a drop of 3 inches or more, or connected by a saddle-mount constructed in accordance with paragraph (m)(2) of this section, need not be restrained by chains or cables provided that the upper-half is so designed as to provide against such relative motion.

(iii) Chains or cables shall not be required if the upper-half is so designed as positively to provide against lateral movement of the axle.

(k) **Requirements for lower half of saddle-mounts.** The lower half of any saddle-mount shall comply with the following requirements:

(1) **U-bolts or other attachments.** U-bolts used to attach the lower half to the towing vehicle shall be made of steel rod, free of defects, so shaped as to avoid at any point a radius of less than 1 inch: Provided, however, That a lesser radius may be utilized if the U-bolt is so fabricated as not to cause more than 5 percent reduction in cross-sectional area at points of curvature, in which latter event the minimum radius shall be one-sixteenth inch. U-bolts shall have a total cross-sectional area not less than as required by the following table:

TOTAL CROSS-SECTIONAL AREA OF U-BOLTS IN SQUARE INCHES

Weight in pounds of heaviest towed vehicle	Double or triple saddle-mount			
	Front mount	Middle or front mount	Rear mount	Single saddle-mount ¹
Up to 5,000.....	1.2	1.0	0.8	0.8
5,000 and over	1.4	1.2	1.0	1.0

¹The total weight of all the vehicles being towed shall govern. If other devices are used to accomplish the same purposes as U-bolts they shall have at least equivalent strength of U-bolts made of mild steel. Cast iron shall not be used for clamps or any other holding devices.

(2) **Shifting.** Adequate provision shall be made by design and installation to provide against relative movement between the lower-half and the towing vehicle especially during periods of rapid acceleration and deceleration. To insure against shifting, designs of the tripod type shall be equipped with adequate and securely fastened hold-back chains or similar devices.

(3) **Swaying.** (i) Adequate provision shall be made by design and installation to provide against swaying or lateral movement of the towed vehicle relative to the towing vehicle. To insure against swaying, lower-halves designed with cross-members attached to but separable from vertical members shall have such cross-members fastened to the vertical members by at least two bolts on each side. Such bolts shall be of at least equivalent cross-sectional area as those required for U-bolts for the corresponding saddle-mount as given in the table in paragraph (k)(1) of this section. The minimum distance

between the most widely separated points of support of the cross-member by the vertical member shall be three inches as measured in a direction parallel to the longitudinal axis of the towing vehicle.

(ii) The lower-half shall have a bearing surface on the frame of the towing vehicle of such dimensions that the pressure exerted by the lower-half upon the frame of the towing vehicle shall not exceed 200 pounds per square inch under any conditions of static loading. Hardwood blocks or blocks of other suitable material, such as hard rubber, aluminum or brakelining, if used between the lower-half and the frame of the towing vehicle shall be at least $\frac{1}{2}$ inch thick, 3 inches wide, and a combined length of 6 inches.

(iii) Under no condition shall the highest point of support of the towed vehicle by the upper-half be more than 24 inches, measured vertically, above the top of the frame of the towing vehicle, measured at the point where the lower-half rests on the towing vehicle.

(4) **Wood blocks.** (i) Hardwood blocks of good quality may be used to build up the height of the front end of the towed vehicle, provided that the total height of such wood blocks shall not exceed 8 inches and not over two separate pieces are placed upon each other to obtain such height; however, hardwood blocks, not over 4 in number, to a total height not to exceed 14 inches, may be used if the total cross-sectional area of the U-bolts used to attach the lower-half of the towing vehicle is at least 50 percent greater than that required by the table contained in paragraph (k)(1) of this section, or, if other devices are used in lieu of U-bolts, they shall provide for as great a resistance to bending as is provided by the larger U-bolts above prescribed.

(ii) Hardwood blocks must be at least 4 inches in width and the surfaces between blocks or block and lower-half or block and upper-half shall be planed and so installed and maintained as to minimize any tendency of the towed vehicle to sway or rock.

(5) **Cross-member, general requirements.** The cross-member, which is that part of the lower-half used to distribute the weight of the towed vehicle equally to each member of the frame of the towing vehicle, if used, shall be structurally adequate and properly installed and maintained adequately to perform this function.

(6) **Cross-member, use of wood.** No materials, other than suitable metals, shall be used as the cross-member, and wood may not be used structurally in any manner that will result in its being subject to tensile stresses. Wood may be used in cross-members if supported throughout its length by suitable metal cross-members.

(7) **Lower-half strength.** The lower-half shall be capable of supporting the loads given in the following table. For the purpose of test, the saddle-mount shall be mounted as normally operated and the load applied through the upper-half:

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MINIMUM TEST LOAD IN POUNDS

Weight in pounds of heaviest towed vehicle	Double or triple saddle-mount			
	Front mount	Middle or front mount	Rear mount	Single saddle-mount ¹
Up to 5,000	15,000	10,000	5,000	5,000
5,000 and over	30,000	20,000	10,000	10,000

¹ The total weight of all the vehicles being towed shall govern.

(1) **Requirements for kingpins of saddle-mounts.** The kingpin of any saddle-mount shall comply with the following requirements:

(1) **Kingpin size.** (i) Kingpins shall be constructed of steel suitable for the purpose, free of defects, and having a diameter not less than required by the following table:

DIAMETER OF SOLID KINGPIN IN INCHES

Weight in pounds of heaviest towed vehicle	Double or triple saddle-mount							
	Front mount		Middle or front mount		Rear mount		Single saddle-mount ¹	
	Mild steel	H.T.S. ²	Mild steel	H.T.S. ²	Mild steel	H.T.S. ²	Mild steel	H.T.S.
Up to 5,000	1.125	1.000	1.000	0.875	0.875	0.750	0.875	0.750
5,000 & over	1.500	1.125	1.250	1.000	1.000	0.875	1.000	0.875

¹The total weight of all the vehicles being towed shall govern.

²High tensile steel is steel having a minimum ultimate strength of 65,000 pounds per square inch.

(ii) If a ball and socket joint is used in place of a kingpin, the diameter of the neck of the ball shall be at least equal to the diameter of the corresponding solid kingpin given in the above table. If hollow kingpins are used, the metallic cross-sectional area shall be at least equal to the cross-sectional area of the corresponding solid kingpin.

(2) **Kingpin fit.** If a kingpin bushing is not used, the kingpin shall fit snugly into the upper and lower-halves but shall not bind. Those portions of the upper or lower-halves in moving contact with the kingpin shall be smoothly machined with no rough or sharp edges. The bearing surface thus provided shall not be less in depth than the radius of the kingpin.

(3) **Kingpin bushing on saddle-mounts.** The kingpin of all new saddle-mounts acquired and used shall be snugly enclosed in a bushing at least along such length of the kingpin as may be in moving contact with either the upper or lower-halves. The bearing surface thus provided shall not be less in depth than the radius of the kingpin.

(4) **Kingpin to restrain vertical motion.** The kingpin shall be so designed and installed as to restrain the upper-half from moving in a vertical direction relative to the lower-half.

(m) **Additional requirements for saddle-mounts.** Saddle-mounts shall comply with the following requirements:

(1) **Bearing surface between upper and lower-halves.** The upper and lower-halves shall be so constructed and connected that the bearing surface between the two halves shall not be less than 16 square

inches under any conditions of angularity between the towing and towed vehicles: Provided, however, That saddle-mounts using a ball and socket joint shall have a ball of such dimension that the static bearing load shall not exceed 800 pounds per square inch, based on the projected cross-sectional area of the ball: And further provided, That saddle-mounts having the upper-half supported by ball, taper, or roller-bearings shall not have such bearings loaded beyond the limits prescribed for such bearings by the manufacturer thereof. The upper-half shall rest evenly and smoothly upon the lower-half and the contact surfaces shall be lubricated and maintained so that there shall be a minimum of frictional resistance between the parts.

(2) **Saddle-mounts, angularity.** All saddle-mounts acquired and used shall provide for angularity between the towing and towed vehicles due to vertical curvatures of the highway. Such means shall not depend upon either the looseness or deformation of the parts of either the saddle-mount or the vehicles to provide for such angularity.

(3) **Tracking.** The saddle-mount shall be so designed, constructed, maintained, and installed that the towed vehicle or vehicles will follow substantially in the path of the towing vehicle without swerving. Towed vehicles shall not deviate more than 3 inches to either side of the path of the towing vehicle when moving in a straight line.

(4) **Prevention of frame bending.** Where necessary, provision shall be made to prevent the bending of the frame of the towing vehicle by insertion of suitable blocks inside the frame channel to prevent kinking. The saddle-mount shall not be so located as to cause deformation of the frame by reason of cantilever action.

(5) **Extension of frame.** No saddle-mount shall be located at a point to the rear of the frame of a towing vehicle.

(6) **Nuts, secured.** All nuts used on bolts, U-bolts, kingpins, or in any other part of the saddle-mount shall be secured against accidental disconnection by means of cotter-keys, lock-washers, double nuts, safety nuts, or equivalent means. Parts shall be so designed and installed that nuts shall be fully engaged.

(7) **Inspection of all parts.** The saddle-mount shall be so designed that it may be disassembled and each separate part inspected for worn, bent, cracked, broken, or missing parts.

(8) **Saddle-mounts, marking.** Every new saddle-mount acquired and used in driveaway-towaway operations by a motor carrier shall have the upper-half and the lower-half separately marked with the following certification of the manufacturer thereof (or words of equivalent meaning).

This saddle-mount complies with the requirements of the Federal Motor Carrier Safety Administration for vehicles up to 5,000 pounds (or over 5,000 pounds):

Manufactured _____

(Month and year)

by _____

(Name of manufacturer)

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(n) Requirements for devices used to connect motor vehicles or parts of motor vehicles together to form one vehicle—

(1) **Front axle attachment.** The front axle of one motor vehicle intended to be coupled with another vehicle as defined in paragraph (g)(2)(ii) of this section shall be attached with U-bolts meeting the requirements of paragraph (j)(2) of this section.

(2) **Rear axle attachment.** The rear axle of one vehicle shall be coupled to the frame of the other vehicle by means of a connecting device which when in place forms a rectangle. The device shall be composed of two pieces, top and bottom. The device shall be made of 4-inch by ½-inch steel bar bent to shape and shall have the corners reinforced with a plate at least 3 inches by ½ inch by 8 inches long. The device shall be bolted together with ¾-inch bolts and at least three shall be used on each side. Wood may be used as spacers to keep the frames apart and it shall be at least 4 inches square.

Subpart G—Miscellaneous parts and accessories

§393.75 Tires.

(a) No motor vehicle shall be operated on any tire that (1) has body ply or belt material exposed through the tread or sidewall, (2) has any tread or sidewall separation, (3) is flat or has an audible leak, or (4) has a cut to the extent that the ply or belt material is exposed.

(b) Any tire on the front wheels of a bus, truck, or truck tractor shall have a tread groove pattern depth of at least ¼ of an inch when measured at any point on a major tread groove. The measurements shall not be made where tie bars, humps, or fillets are located.

(c) Except as provided in paragraph (b) of this section, tires shall have a tread groove pattern depth of at least ⅜ of an inch when measured in a major tread groove. The measurement shall not be made where tie bars, humps or fillets are located.

(d) No bus shall be operated with regrooved, recapped or retreaded tires on the front wheels.

(e) A regrooved tire with a load-carrying capacity equal to or greater than 2,232 kg (4,920 pounds) shall not be used on the front wheels of any truck or truck tractor.

(f) **Tire loading restrictions (except on manufactured homes).** No motor vehicle (except manufactured homes, which are governed by paragraph (g) of this section) shall be operated with tires that carry a weight greater than that marked on the side-wall of the tire or, in the absence of such a marking, a weight greater than that specified for the tires in any of the publications of any of the organizations listed in Federal Motor Vehicle Safety Standard No. 119 (49 CFR 571.119, S5.1(b)) unless:

(1) The vehicle is being operated under the terms of a special permit issued by the State; and

(2) The vehicle is being operated at a reduced speed to compensate for the tire loading in excess of the manufacturer's rated capacity for the tire. In no case shall the speed exceed 80 km/hr (50 mph).

(g)(1) **Tire loading restrictions for manufactured**

homes built before January 1, 2002. Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) before January 1, 2002, must not be transported on tires that are loaded more than 18 percent over the load rating marked on the sidewall of the tire or, in the absence of such a marking, more than 18 percent over the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)). Manufactured homes labeled before January 1, 2002, transported on tires overloaded by 9 percent or more must not be operated at speeds exceeding 80 km/hr (50 mph).

(2) **Tire loading restrictions for manufactured homes built on or after January 1, 2002.** Manufactured homes that are labeled pursuant to 24 CFR 3282.362(c)(2)(i) on or after January 1, 2002, must not be transported on tires loaded beyond the load rating marked on the sidewall of the tire or, in the absence of such a marking, the load rating specified in any of the publications of any of the organizations listed in FMVSS No. 119 (49 CFR 571.119, S5.1(b)).

(h) **Tire inflation pressure.** (1) No motor vehicle shall be operated on a tire which has a cold inflation pressure less than that specified for the load being carried.

(2) If the inflation pressure of the tire has been increased by heat because of the recent operation of the vehicle, the cold inflation pressure shall be estimated by subtracting the inflation buildup factor shown in Table 1 from the measured inflation pressure.

TABLE 1—INFLATION PRESSURE MEASUREMENT
CORRECTION FOR HEAT

Average speed of vehicle in the previous hour	Minimum inflation pressure buildup	
	Tires with 1,814 kg (4,000 lbs.) maximum load rating or less	Tires with over 1,814 kg (4,000 lbs.) load rating
66–88.5 km/hr (41–55 mph)	34.5 kPa (5 psi)	103.4 kPa (15 psi).

§393.76 Sleeper berths.

(a) **Dimensions—(1) Size.** A sleeper berth must be at least the following size:

Date of installation on motor vehicle	Length measured on centerline of longitudinal axis (inches)	Width measured on centerline of transverse axis (inches)	Height measured from highest point of top of mattress (inches) ¹
Before January 1, 1953	72	18	18
After December 31, 1952	75	21	21
and before October 1, 1975			
After September 30, 1975	75	24	24

¹In the case of a sleeper berth which utilizes an adjustable mechanical suspension system, the required clearance can be measured when the suspension system is adjusted to the height to which it would settle when occupied by a driver.

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(2) **Shape.** A sleeper berth installed on a motor vehicle on or after January 1, 1953 must be of generally rectangular shape, except that the horizontal corners and the roof corners may be rounded to radii not exceeding 10-½ inches.

(3) **Access.** A sleeper berth must be constructed so that an occupant's ready entrance to, and exit from, the sleeper berth is not unduly hindered.

(b) **Location.** (1) A sleeper berth must not be installed in or on a semitrailer or a full trailer other than a house trailer.

(2) A sleeper berth located within the cargo space of a motor vehicle must be securely compartmentalized from the remainder of the cargo space. A sleeper berth installed on or after January 1, 1953 must be located in the cab or immediately adjacent to the cab and must be securely fixed with relation to the cab.

(c) **Exit from the berth.** (1) Except as provided in paragraph (c)(2) of this section, there must be a direct and ready means of exit from a sleeper berth into the driver's seat or compartment. If the sleeper berth was installed on or after January 1, 1963, the exit must be a doorway or opening at least 18 inches high and 36 inches wide. If the sleeper berth was installed before January 1, 1963, the exit must have sufficient area to contain an ellipse having a major axis of 24 inches and a minor axis of 16 inches.

(2) A sleeper berth installed before January 1, 1953 must either:

(i) Conform to the requirements of paragraph (c)(1) of this section; or

(ii) Have at least two exits, each of which is at least 18 inches high and 21 inches wide, located at opposite ends of the vehicle and useable by the occupant without the assistance of any other person.

(d) **Communication with the driver.** A sleeper berth which is not located within the driver's compartment and has no direct entrance into the driver's compartment must be equipped with a means of communication between the occupant and the driver. The means of communication may consist of a telephone, speaker tube, buzzer, pull cord, or other mechanical or electrical device.

(e) **Equipment.** A sleeper berth must be properly equipped for sleeping. Its equipment must include:

(1) Adequate bedclothing and blankets; and

(2) Either:

(i) Springs and a mattress; or

(ii) An innerspring mattress; or

(iii) A cellular rubber or flexible foam mattress at least four inches thick; or

(iv) A mattress filled with a fluid and of sufficient thickness when filled to prevent "bottoming-out" when occupied while the vehicle is in motion.

(f) **Ventilation.** A sleeper berth must have louvers or other means of providing adequate ventilation. A sleeper berth must be reasonably tight against dust and rain.

(g) **Protection against exhaust and fuel leaks and**

exhaust heat. A sleeper berth must be located so that leaks in the vehicle's exhaust system or fuel system do not permit fuel, fuel system gases, or exhaust gases to enter the sleeper berth. A sleeper berth must be located so that it will not be overheated or damaged by reason of its proximity to the vehicle's exhaust system.

(h) **Occupant restraint.** A motor vehicle manufactured on or after July 1, 1971, and equipped with a sleeper berth must be equipped with a means of preventing ejection of the occupant of the sleeper berth during deceleration of the vehicle. The restraint system must be designed, installed, and maintained to withstand a minimum total force of 6,000 pounds applied toward the front of the vehicle and parallel to the longitudinal axis of the vehicle.

§393.77 Heaters.

On every motor vehicle, every heater shall comply with the following requirements:

(a) **Prohibited types of heaters.** The installation or use of the following types of heaters is prohibited:

(1) **Exhaust heaters.** Any type of exhaust heater in which the engine exhaust gases are conducted into or through any space occupied by persons or any heater which conducts engine compartment air into any such space.

(2) **Unenclosed flame heaters.** Any type of heater employing a flame which is not fully enclosed, except that such heaters are not prohibited when used for heating the cargo of tank motor vehicles.

(3) **Heaters permitting fuel leakage.** Any type of heater from the burner of which there could be spillage or leakage of fuel upon the tilting or overturning of the vehicle in which it is mounted.

(4) **Heaters permitting air contamination.** Any heater taking air, heated or to be heated, from the engine compartment or from direct contact with any portion of the exhaust system; or any heater taking air in ducts from the outside atmosphere to be conveyed through the engine compartment, unless said ducts are so constructed and installed as to prevent contamination of the air so conveyed by exhaust or engine compartment gases.

(5) **Solid fuel heaters except wood charcoal.** Any stove or other heater employing solid fuel except wood charcoal.

(6) **Portable heaters.** Portable heaters shall not be used in any space occupied by persons except the cargo space of motor vehicles which are being loaded or unloaded.

(b) **Heater specifications.** All heaters shall comply with the following specifications:

(1) **Heating elements, protection.** Every heater shall be so located or protected as to prevent contact therewith by occupants, unless the surface temperature of the protecting grilles or of any exposed portions of the heaters, inclusive of exhaust stacks, pipes, or conduits shall be lower than would cause contact burns. Adequate protection shall be afforded against igniting parts of the vehicle or burning occupants by direct radiation. Wood charcoal heaters shall be enclosed within a metal barrel,

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drum, or similar protective enclosure which enclosure shall be provided with a securely fastened cover.

(2) **Moving parts, guards.** Effective guards shall be provided for the protection of passengers or occupants against injury by fans, belts, or any other moving parts.

(3) **Heaters, secured.** Every heater and every heater enclosure shall be securely fastened to the vehicle in a substantial manner so as to provide against relative motion within the vehicle during normal usage or in the event the vehicle overturns. Every heater shall be so designed, constructed, and mounted as to minimize the likelihood of disassembly of any of its parts, including exhaust stacks, pipes, or conduits, upon overturn of the vehicle in or on which it is mounted. Wood charcoal heaters shall be secured against relative motion within the enclosure required by paragraph (c)(1) of this section, and the enclosure shall be securely fastened to the motor vehicle.

(4) **Relative motion between fuel tank and heater.** When either in normal operation or in the event of overturn, there is or is likely to be relative motion between the fuel tank for a heater and the heater, or between either of such units and the fuel lines between them, a suitable means shall be provided at the point of greatest relative motion so as to allow this motion without causing failure of the fuel lines.

(5) **Operating controls to be protected.** On every bus designed to transport more than 15 passengers, including the driver, means shall be provided to prevent unauthorized persons from tampering with the operating controls. Such means may include remote control by the driver; installation of controls at inaccessible places; control of adjustments by key or keys; enclosure of controls in a locked space, locking of controls, or other means of accomplishing this purpose.

(6) **Heater, hoses.** Hoses for all hot water and steam heater systems shall be specifically designed and constructed for that purpose.

(7) **Electrical apparatus.** Every heater employing any electrical apparatus shall be equipped with electrical conductors, switches, connectors, and other electrical parts of ample current-carrying capacity to provide against overheating; any electric motor employed in any heater shall be of adequate size and so located that it will not be overheated; electrical circuits shall be provided with fuses and/or circuit breakers to provide against electrical overloading; and all electrical conductors employed in or leading to any heater shall be secured against dangling, chafing, and rubbing and shall have suitable protection against any other condition likely to produce short or open circuits.

NOTE: Electrical parts certified as proper for use by Underwriters' Laboratories, Inc., shall be deemed to comply with the foregoing requirements.

(8) **Storage battery caps.** If a separate storage battery is located within the personnel or cargo space, such battery shall be securely mounted and equipped with nonspill filler caps.

(9) **Combustion heater exhaust construction.** Every heater employing the combustion of oil, gas, liquefied petroleum gas, or any other combustible material shall be provided with substantial means of conducting

the products of combustion to the outside of the vehicle: Provided, however, That this requirement shall not apply to heaters used solely to heat the cargo space of motor vehicles where such motor vehicles or heaters are equipped with means specifically designed and maintained so that the carbon monoxide concentration will never exceed 0.2 percent in the cargo space. The exhaust pipe, stack, or conduit if required shall be sufficiently substantial and so secured as to provide reasonable assurance against leakage or discharge of products of combustion within the vehicle and, if necessary, shall be so insulated as to make unlikely the burning or charring of parts of the vehicle by radiation or by direct contact. The place of discharge of the products of combustion to the atmosphere and the means of discharge of such products shall be such as to minimize the likelihood of their reentry into the vehicle under all operating conditions.

(10) **Combustion chamber construction.** The design and construction of any combustion-type heater except cargo space heaters permitted by the proviso of paragraph (c)(9) of this section and unenclosed flame heaters used for heating cargo of tank motor vehicles shall be such as to provide against the leakage of products of combustion into air to be heated and circulated. The material employed in combustion chambers shall be such as to provide against leakage because of corrosion, oxidation or other deterioration. Joints between combustion chambers and the air chambers with which they are in thermal and mechanical contact shall be so designed and constructed as to prevent leakage between the chambers and the materials employed in such joints shall have melting points substantially higher than the maximum temperatures likely to be attained at the points of jointure.

(11) **Heater fuel tank location.** Every bus designed to transport more than 15 passengers, including the driver, with heaters of the combustion type shall have fuel tanks therefor located outside of and lower than the passenger space. When necessary, suitable protection shall be afforded by shielding or other means against the puncturing of any such tank or its connections by flying stones or other objects.

(12) **Heater, automatic fuel control.** Gravity or siphon feed shall not be permitted for heaters using liquid fuels. Heaters using liquid fuels shall be equipped with automatic means for shutting off the fuel or for reducing such flow of fuel to the smallest practicable magnitude, in the event of overturn of the vehicle. Heaters using liquefied petroleum gas as fuel shall have the fuel line equipped with automatic means at the source of supply for shutting off the fuel in the event of separation, breakage, or disconnection of any of the fuel lines between the supply source and the heater.

(13) **"Tell-tale" indicators.** Heaters subject to paragraph (b)(14) of this section and not provided with automatic controls shall be provided with "tell-tale" means to indicate to the driver that the heater is properly functioning. The requirement shall not apply to heaters used solely for the cargo space in semitrailers or full trailers.

(14) **Shut-off control.** Automatic means, or manual means if the control is readily accessible to the driver

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without moving from the driver's seat, shall be provided to shut off the fuel and electrical supply in case of failure of the heater to function for any reason, or in case the heater should function improperly or overheat. This requirement shall not apply to wood charcoal heaters or to heaters used solely to heat the contents of cargo tank motor vehicles, but wood charcoal heaters must be provided with a controlled method of regulating the flow of combustion air.

(15) **Certification required.** Every combustion-type heater, except wood charcoal heaters, the date of manufacture of which is subsequent to December 31, 1952, and every wood charcoal heater, the date of manufacture of which is subsequent to September 1, 1953, shall be marked plainly to indicate the type of service for which such heater is designed and with a certification by the manufacturer that the heater meets the applicable requirements for such use. For example, "Meets I.C.C. Bus Heater Requirements," "Meets I.C.C. Flue-Vented Cargo Space Heater Requirements," and after December 31, 1967, such certification shall read "Meets FMCSA Bus Heater Requirements," "Meets FMCSA Flue-Vented Cargo Space Heater Requirements," etc.

(c) **Exception.** The certification for a catalytic heater which is used in transporting flammable liquid or gas shall be as prescribed under §177.834(l) of this title.

§393.78 Windshield wiping and washing systems.

(a) **Vehicles manufactured on or after December 25, 1968.** Each bus, truck, and truck-tractor manufactured on or after December 25, 1968, must have a windshield wiping system that meets the requirements of FMVSS No. 104 (S4.1) in effect on the date of manufacture. Each of these vehicles must have a windshield washing system that meets the requirements of FMVSS No. 104 (S4.2.2) in effect on the date of manufacture.

(b) **Vehicles manufactured between June 30, 1953, and December 24, 1968.** Each truck, truck-tractor, and bus manufactured between June 30, 1953, and December 24, 1968, shall be equipped with a power-driven windshield wiping system with at least two wiper blades, one on each side of the centerline of the windshield. Motor vehicles which depend upon vacuum to operate the windshield wipers, shall have the wiper system constructed and maintained such that the performance of the wipers will not be adversely affected by a change in the intake manifold pressure.

(c) **Driveaway-towaway operations.** Windshield wiping and washing systems need not be in working condition while a commercial motor vehicle is being towed in a driveaway-tow-away operation.

§393.79 Windshield defrosting and defogging systems.

(a) **Vehicles manufactured on or after December 25, 1968.** Each bus, truck, and truck-tractor manufactured on or after December 25, 1968, must have a windshield defrosting and defogging system that meets the requirements of FMVSS No. 103 in effect on the date of manufacture.

(b) **Vehicles manufactured before December 25, 1968.** Each bus, truck, and truck-tractor shall be equipped

with a means for preventing the accumulation of ice, snow, frost, or condensation that could obstruct the driver's view through the windshield while the vehicle is being driven.

§393.80 Rear-vision mirrors.

(a) Every bus, truck, and truck tractor shall be equipped with two rear-vision mirrors, one at each side, firmly attached to the outside of the motor vehicle, and so located as to reflect to the driver a view of the highway to the rear, along both sides of the vehicle. All such regulated rear-vision mirrors and their replacements shall meet, as a minimum, the requirements of FMVSS No. 111 (49 CFR 571.111) in force at the time the vehicle was manufactured.

(b) **Exceptions.** (1) Mirrors installed on a vehicle manufactured prior to January 1, 1981, may be continued in service, provided that if the mirrors are replaced they shall be replaced with mirrors meeting, as a minimum, the requirements of FMVSS No. 111 (49 CFR 571.111) in force at the time the vehicle was manufactured.

(2) Only one outside mirror shall be required, which shall be on the driver's side, on trucks which are so constructed that the driver has a view to the rear by means of an interior mirror.

(3) In driveaway-towaway operations, the driven vehicle shall have at least one mirror furnishing a clear view to the rear.

§393.81 Horn.

Every bus, truck, truck tractor, and every driven motor vehicle in driveaway-towaway operations shall be equipped with a horn and actuating elements which shall be in such condition as to give an adequate and reliable warning signal.

§393.82 Speedometer.

Each bus, truck, and truck-tractor must be equipped with a speedometer indicating vehicle speed in miles per hour and/or kilometers per hour. The speedometer must be accurate to within plus or minus 8 km/hr (5 mph) at a speed of 80 km/hr (50 mph).

§393.83 Exhaust systems.

(a) Every motor vehicle having a device (other than as part of its cargo) capable of expelling harmful combustion fumes shall have a system to direct the discharge of such fumes. No part shall be located where its location would likely result in burning, charring, or damaging the electrical wiring, the fuel supply, or any combustible part of the motor vehicle.

(b) No exhaust system shall discharge to the atmosphere at a location immediately below the fuel tank or the fuel tank filler pipe.

(c) The exhaust system of a bus powered by a gasoline engine shall discharge to the atmosphere at or within 6 inches forward of the rearmost part of the bus.

(d) The exhaust system of a bus using fuels other than gasoline shall discharge to the atmosphere either:

(1) At or within 15 inches forward of the rearmost part of the vehicle; or

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(2) To the rear of all doors or windows designed to be open, except windows designed to be opened solely as emergency exits.

(e) The exhaust system of every truck and truck tractor shall discharge to the atmosphere at a location to the rear of the cab or, if the exhaust projects above the cab, at a location near the rear of the cab.

(f) No part of the exhaust system shall be temporarily repaired with wrap or patches.

(g) No part of the exhaust system shall leak or discharge at a point forward of or directly below the driver/sleeper compartment. The exhaust outlet may discharge above the cab/sleeper roofline.

(h) The exhaust system must be securely fastened to the vehicle.

(i) Exhaust systems may use hangers which permit required movement due to expansion and contraction caused by heat of the exhaust and relative motion between engine and chassis of a vehicle.

§393.84 Floors.

The flooring in all motor vehicles shall be substantially constructed, free of unnecessary holes and openings, and shall be maintained so as to minimize the entrance of fumes, exhaust gases, or fire. Floors shall not be permeated with oil or other substances likely to cause injury to persons using the floor as a traction surface.

§393.85 [Reserved]

§393.86 Rear impact guards and rear end protection.

(a)(1) **General requirements for trailers and semitrailers manufactured on or after January 26, 1998.** Each trailer and semitrailer with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or more, and manufactured on or after January 26, 1998, must be equipped with a rear impact guard that meets the requirements of Federal Motor Vehicle Safety Standard No. 223 (49 CFR 571.223) in effect at the time the vehicle was manufactured. When the rear impact guard is installed on the trailer or semitrailer, the vehicle must, at a minimum, meet the requirements of FMVSS No. 224 (49 CFR 571.224) in effect at the time the vehicle was manufactured. The requirements of paragraph (a) of this section do not apply to pole trailers (as defined in §390.5 of this chapter); pulpwood trailers, low chassis vehicles, special purpose vehicles, wheels back vehicles (as defined in §393.5); and trailers towed in driveaway-towaway operations (as defined in §390.5).

(2) **Impact Guard Width.** The outermost surfaces of the horizontal member of the guard must extend to within 100 mm (4 inches) of the side extremities of the vehicle. The outermost surface of the horizontal member shall not extend beyond the side extremity of the vehicle.

(3) **Guard Height.** The vertical distance between the bottom edge of the horizontal member of the guard and the ground shall not exceed 560 mm (22 inches) at any point across the full width of the member. Guards with rounded corners may curve upward within 255 mm (10 inches) of the longitudinal vertical planes that are tangent to the side extremities of the vehicle.

(4) **Guard Rear Surface.** At any height 560 mm (22 inches) or more above the ground, the rearmost surface of the horizontal member of the guard must be within 305 mm (12 inches) of the rear extremity of the vehicle. This paragraph shall not be construed to prohibit the rear surface of the guard from extending beyond the rear extremity of the vehicle. Guards with rounded corners may curve forward within 255 mm (10 inches) of the side extremity.

(5) **Cross-Sectional Vertical Height.** The horizontal member of each guard must have a cross sectional vertical height of at least 100 mm (3.94 inches) at any point across the guard width.

(6) **Certification and labeling requirements for rear impact protection guards.** Each rear impact guard used to satisfy the requirements of paragraph (a)(1) of this section must be permanently marked or labeled as required by FMVSS No. 223 (49 CFR 571.223, S5.3). The label must be on the forward-facing surface of the horizontal member of the guard, 305 mm (12 inches) inboard of the right end of the guard. The certification label must contain the following information:

(i) The impact guard manufacturer's name and address;

(ii) The statement "Manufactured in _____" (inserting the month and a year that the guard was manufactured); and,

(iii) The letters "DOT", constituting a certification by the guard manufacturer that the guard conforms to all requirements of FMVSS No. 223.

(b)(1) **Requirements for motor vehicles manufactured after December 31, 1952 (except trailers or semitrailers manufactured on or after January 26, 1998).** Each motor vehicle manufactured after December 31, 1952, (except truck tractors, pole trailers, pulpwood trailers, or vehicles in driveaway-towaway operations) in which the vertical distance between the rear bottom edge of the body (or the chassis assembly if the chassis is the rearmost part of the vehicle) and the ground is greater than 76.2 cm (30 inches) when the motor vehicle is empty, shall be equipped with a rear impact guard(s). The rear impact guard(s) must be installed and maintained in such a manner that:

(i) The vertical distance between the bottom of the guard(s) and the ground does not exceed 76.2 cm (30 inches) when the motor vehicle is empty;

(ii) The maximum lateral distance between the closest points between guards, if more than one is used, does not exceed 61 cm (24 inches);

(iii) The outermost surfaces of the horizontal member of the guard are no more than 45.7 cm (18 inches) from each side extremity of the motor vehicle;

(iv) The impact guard(s) are no more than 61 cm (24 inches) forward of the rear extremity of the motor vehicle.

(2) **Construction and Attachment.** The rear impact guard(s) must be substantially constructed and attached by means of bolts, welding, or other comparable means.

(3) **Vehicle Components and Structures that may be used to satisfy the requirements of paragraph**

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(b) of this section. Low chassis vehicles, special purpose vehicles, or wheels back vehicles constructed and maintained so that the body, chassis, or other parts of the vehicle provide the rear end protection comparable to impact guard(s) conforming to the requirements of paragraph (b)(1) of this section shall be considered to be in compliance with those requirements.

§393.87 Warning flags on projecting loads.

(a) Any commercial motor vehicle transporting a load which extends beyond the sides by more than 102 mm (4 inches) or more than 1,219 mm (4 feet) beyond the rear must have the extremities of the load marked with red or orange fluorescent warning flags. Each warning flag must be at least 457 mm (18 inches) square.

(b) **Position of flags.** There must be a single flag at the extreme rear if the projecting load is two feet wide or less. Two warning flags are required if the projecting load is wider than two feet. Flags must be located to indicate maximum width of loads which extend beyond the sides and/or rear of the vehicle.

§393.88 Television receivers.

Any motor vehicle equipped with a television viewer, screen or other means of visually receiving a television broadcast shall have the viewer or screen located in the motor vehicle at a point to the rear of the back of the driver's seat if such viewer or screen is in the same compartment as the driver and the viewer or screen shall be so located as not to be visible to the driver, while he/she is driving the motor vehicle. The operating controls for the television receiver shall be so located that the driver cannot operate them without leaving the driver's seat.

§393.89 Buses, driveshaft protection.

Any driveshaft extending lengthways under the floor of the passenger compartment of a bus, shall be protected by means of at least one guard or bracket at that end of the shaft which is provided with a sliding connection (spline or other such device) to prevent the whipping of the shaft in the event of failure thereof or of any of its component parts. A shaft contained within a torque tube shall not require any such device.

§393.90 Buses, standee line or bar.

Except as provided below, every bus which is designed and constructed so as to allow standees, shall be plainly marked with a line of contrasting color at least 2 inches wide or equipped with some other means so as to indicate to any person that he/she is prohibited from occupying a space forward of a perpendicular plane drawn through the rear of the driver's seat and perpendicular to the longitudinal axis of the bus. Every bus shall have clearly posted at or near the front, a sign with letters at least one-half inch high stating that it is a violation of the Federal Motor Carrier Safety Administration's regulations for a bus to be operated with persons occupying the prohibited area. The requirements of this section shall not apply to any bus being transported in driveaway-towaway operation or to any level of the bus other than that level in which the driver is located nor shall they be construed to prohibit any seated person from occupying permanent seats located

in the prohibited area provided such seats are so located that persons sitting therein will not interfere with the driver's safe operation of the bus.

§393.91 Buses, aisle seats prohibited.

No bus shall be equipped with aisle seats unless such seats are so designed and installed as to automatically fold and leave a clear aisle when they are unoccupied. No bus shall be operated if any seat therein is not securely fastened to the vehicle.

§393.92 [Reserved]

§393.93 Seats, seat belt assemblies, and seat belt assembly anchorages.

(a) **Buses—(1) Buses manufactured on or after January 1, 1965, and before July 1, 1971.** After June 30, 1972, every bus manufactured on or after January 1, 1965, and before July 1, 1971, must be equipped with a Type 1 or Type 2 seat belt assembly that conforms to Federal Motor Vehicle Safety Standard No. 209¹ (§571.209) installed at the driver's seat and seat belt assembly anchorages that conform to the location and geometric requirements of Federal Motor Vehicle Safety Standard No. 210¹ (§571.210) for that seat belt assembly.

(2) **Buses manufactured on or after July 1, 1971.** Every bus manufactured on or after July 1, 1971, must conform to the requirements of Federal Motor Vehicle Safety Standard No. 208¹ (§571.208) (relating to installation of seat belt assemblies) and Federal Motor Vehicle Safety Standard No. 210¹ (§571.210) (relating to installation of seat belt assembly anchorages).

(3) **Buses manufactured on or after January 1, 1972.** Every bus manufactured on or after January 1, 1972, must conform to the requirements of Federal Motor Vehicle Safety Standard No. 207¹ (§571.207) (relating to seating systems).

(b) **Trucks and truck tractors. (1) Trucks and truck tractors manufactured on and after January 1, 1965, and before July 1, 1971.** Except as provided in paragraph (d) of this section, after June 30, 1972, every truck and truck tractor manufactured on or after January 1, 1965, and before July 1, 1971, must be equipped with a Type 1 or Type 2 seat belt assembly that conforms to Federal Motor Vehicle Safety Standard No. 209 (§571.209) installed at the driver's seat and at the right front outboard seat, if the vehicle has one, and seat belt assembly anchorages that conform to the location and geometric requirements of Federal Motor Vehicle Safety Standard No. 210 (§571.210) for each seat belt assembly that is required by this subparagraph.

(2) **Trucks and truck tractors manufactured on or after July 1, 1971.** Every truck and truck tractor manufactured on or after July 1, 1971, except a truck or truck tractor being transported in driveaway-towaway

¹Individual copies of Federal Motor Vehicle Safety Standards may be obtained from the National Highway Traffic Safety Administration, 1200 New Jersey Ave., SE., Washington, DC 20590-0001.

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operation and having an incomplete vehicle seating and cab configuration, must conform to the requirements of Federal Motor Vehicle Safety Standard No. 208¹ (§571.208) (relating to installation of seat belt assemblies) and Federal Motor Vehicle Safety Standard No. 210¹ (§571.210) (relating to installation of seat belt assembly anchorages).

(3) **Trucks and truck tractors manufactured on or after January 1, 1972.** Every truck and truck tractor manufactured on or after January 1, 1972, except a truck or truck tractor being transported in driveaway-towaway operation and having an incomplete vehicle seating and cab configuration, must conform to the requirements of Federal Motor Vehicle Safety Standard No. 207¹ (§571.207) (relating to seating systems).

(c) **Effective date of standards.** Whenever paragraph (a) or (b) of this section requires conformity to a Federal Motor Vehicle Safety Standard, the vehicle or equipment must conform to the version of the Standard that is in effect on the date the vehicle is manufactured or on the date the vehicle is modified to conform to the requirements of paragraph (a) or (b) of this section, whichever is later.

(d) Trucks and truck tractors manufactured on or after January 1, 1965, and before July 1, 1971, and operated in the State of Hawaii, must comply with the provisions of paragraph (b) of this section on and after January 1, 1976.

§393.94 Interior noise levels in power units.

(a) **Applicability of this section.** The interior noise level requirements apply to all trucks, truck-tractors, and buses.

(b) **General rule.** The interior sound level at the driver's seating position of a motor vehicle must not exceed 90 dB(A) when measured in accordance with paragraph (c) of this section.

(c) **Test procedure.** (1) Park the vehicle at a location so that no large reflecting surfaces, such as other vehicles, signboards, buildings, or hills, are within 50 feet of the driver's seating position.

(2) Close all vehicle doors, windows, and vents. Turn off all power-operated accessories.

(3) Place the driver in his/her normal seated position at the vehicle's controls. Evacuate all occupants except the driver and the person conducting the test.

(4) The sound level meters used to determine compliance with the requirements of this section must meet the American National Standards Institute "*Specification for Sound Level Meters*," ANSI S1.4-1983. (See §393.7(b) for information on the incorporation by reference and availability of this document.)

(5) Locate the microphone, oriented vertically upward, 6 inches to the right of, in the same plane as, and directly in line with, the driver's right ear.

(6) With the vehicle's transmission in neutral gear, accelerate its engine to either its maximum governed engine speed, if it is equipped with an engine governor, or its speed at its maximum rated horsepower, if it is not equipped with an engine governor. Stabilize the engine at that speed.

(7) Observe the A-weighted sound level reading on the meter for the stabilized engine speed condition. Record that reading, if the reading has not been influenced by extraneous noise sources such as motor vehicles operating on adjacent roadways.

(8) Return the vehicle's engine speed to idle and repeat the procedure specified in paragraphs (c)(6) and (7) of this section until two maximum sound levels within 2 dB of each other are recorded. Numerically average those two maximum sound level readings.

(9) The average obtained in accordance with paragraph (c)(8) of this section is the vehicle's interior sound level at the driver's seating position for the purpose of determining whether the vehicle conforms to the rule in paragraph (b) of this section. However, a 2dB tolerance over the sound level limitation specified in that paragraph is permitted to allow for variations in test conditions and variations in the capabilities of meters.

(10) If the motor vehicle's engine radiator fan drive is equipped with a clutch or similar device that automatically either reduces the rotational speed of the fan or completely disengages the fan from its power source in response to reduced engine cooling loads the vehicle may be parked before testing with its engine running at high idle or any other speed the operator may choose, for sufficient time but not more than 10 minutes, to permit the engine radiator fan to automatically disengage.

Subpart H—Emergency equipment

§393.95 Emergency equipment on all power units.

Each truck, truck tractor, and bus (except those towed in driveaway-towaway operations) must be equipped as follows:

(a) Fire Extinguishers

(1) Minimum ratings:

(i) A power unit that is used to transport hazardous materials in a quantity that requires placarding (See §177.823 of this title) must be equipped with a fire extinguisher having an Underwriters' Laboratories rating of 10 B:C or more.

(ii) A power unit that is not used to transport hazardous materials must be equipped with either:

(A) A fire extinguisher having an Underwriters' Laboratories rating of 5 B:C or more; or

(B) Two fire extinguishers, each of which has an Underwriters' Laboratories rating of 4 B:C or more.

(2) **Labeling and marking.** Each fire extinguisher required by this section must be labeled or marked by the manufacturer with its Underwriters' Laboratories rating.

(3) **Visual Indicators.** The fire extinguisher must be designed, constructed, and maintained to permit visual determination of whether it is fully charged.

(4) **Condition, location, and mounting.** The fire extinguisher(s) must be filled and located so that it is readily accessible for use. The extinguisher(s) must be securely mounted to prevent sliding, rolling, or vertical movement relative to the motor vehicle.

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(5) **Extinguishing agents.** The fire extinguisher must use an extinguishing agent that does not need protection from freezing. Extinguishing agents must comply with the toxicity provisions of the Environmental Protection Agency's Significant New Alternatives Policy (SNAP) regulations under 40 CFR Part 82, Subpart G.

(6) **Exception.** This paragraph (a) does not apply to the driven unit in a driveaway-towaway operation.

(b) **Spare fuses.** Power units for which fuses are needed to operate any required parts and accessories must have at least one spare fuse for each type/size of fuse needed for those parts and accessories.

(c)–(e) [Reserved]

(f) **Warning devices for stopped vehicles.** Except as provided in paragraph (g) of this section, one of the following options must be used:

(1) Three bidirectional emergency reflective triangles that conform to the requirements of Federal Motor Vehicle Safety Standard No. 125, §571.125 of this title; or

(2) At least 6 fusees or 3 liquid-burning flares. The vehicle must have as many additional fusees or liquid-burning flares as are necessary to satisfy the requirements of §392.22.

(3) Other warning devices may be used in addition to, but not in lieu of, the required warning devices, provided those warning devices do not decrease the effectiveness of the required warning devices.

(g) **Restrictions on the use of flame-producing devices.** Liquid-burning flares, fusees, oil lanterns, or any signal produced by a flame shall not be carried on any commercial motor vehicle transporting Division 1.1, 1.2, 1.3 (explosives) hazardous materials; any cargo tank motor vehicle used for the transportation of Division 2.1 (flammable gas) or Class 3 (flammable liquid) hazardous materials whether loaded or empty; or any commercial motor vehicle using compressed gas as a motor fuel.

(h)–(i) [Reserved]

(j) **Requirements for fusees and liquid-burning flares.** Each fusee shall be capable of burning for 30 minutes, and each liquid-burning flare shall contain enough fuel to burn continuously for at least 60 minutes. Fusees and liquid-burning flares shall conform to the requirements of Underwriters Laboratories, Inc., UL No. 912, Highway Emergency Signals, Fourth Edition, July 30, 1979, (with an amendment dated November 9, 1981). (See §393.7 for information on the incorporation by reference and availability of this document.) Each fusee and liquid-burning flare shall be marked with the UL symbol in accordance with the requirements of UL 912.

(k) **Requirements for red flags.** Red flags shall be not less than 12 inches square, with standards adequate to maintain the flags in an upright position.

Subpart I—Protection against shifting and falling cargo

§393.100 Which types of commercial motor vehicles are subject to the cargo securement standards of this subpart, and what general requirements apply?

(a) **Applicability.** The rules in this subpart are applicable to trucks, truck tractors, semitrailers, full trailers, and pole trailers.

(b) **Prevention against loss of load.** Each commercial motor vehicle must, when transporting cargo on public roads, be loaded and equipped, and the cargo secured, in accordance with this subpart to prevent the cargo from leaking, spilling, blowing or falling from the motor vehicle.

(c) **Prevention against shifting of load.** Cargo must be contained, immobilized or secured in accordance with this subpart to prevent shifting upon or within the vehicle to such an extent that the vehicle's stability or maneuverability is adversely affected.

§393.102 What are the minimum performance criteria for cargo securement devices and systems?

(a) **Performance criteria—(1) Breaking Strength.** Tiedown assemblies (including chains, wire rope, steel strapping, synthetic webbing, and cordage) and other attachment or fastening devices used to secure articles of cargo to, or in, commercial motor vehicles must be designed, installed, and maintained to ensure that the maximum forces acting on the devices or systems do not exceed the manufacturer's breaking strength rating under the following conditions, applied separately:

- (i) 0.8 g deceleration in the forward direction;
- (ii) 0.5 g acceleration in the rearward direction; and
- (iii) 0.5 g acceleration in a lateral direction.

(2) **Working Load Limit.** Tiedown assemblies (including chains, wire rope, steel strapping, synthetic webbing, and cordage) and other attachment or fastening devices used to secure articles of cargo to, or in, commercial motor vehicles must be designed, installed, and maintained to ensure that the forces acting on the devices or systems do not exceed the working load limit for the devices under the following conditions, applied separately:

- (i) 0.435 g deceleration in the forward direction;
- (ii) 0.5 g acceleration in the rearward direction; and
- (iii) 0.25 g acceleration in a lateral direction.

(b) **Performance criteria for devices to prevent vertical movement of loads that are not contained within the structure of the vehicle.** Securement systems must provide a downward force equivalent to at least 20 percent of the weight of the article of cargo if the article is not fully contained within the structure of the vehicle. If the article is fully contained within the structure of the vehicle, it may be secured in accordance with §393.106(b).

(c) **Equivalent means of securement.** The means of securing articles of cargo are considered to meet the performance requirements of this section if the cargo is:

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(1) Immobilized, such so that it cannot shift or tip to the extent that the vehicle's stability or maneuverability is adversely affected; or

(2) Transported in a sided vehicle that has walls of adequate strength, such that each article of cargo within the vehicle is in contact with, or sufficiently close to a wall or other articles, so that it cannot shift or tip to the extent that the vehicle's stability or maneuverability is adversely affected; or

(3) Secured in accordance with the applicable requirements of §§393.104 through 393.136.

§393.104 What standards must cargo securement devices and systems meet in order to satisfy the requirements of this subpart?

(a) **General.** All devices and systems used to secure cargo to or within a vehicle must be capable of meeting the requirements of §393.102.

(b) **Prohibition on the use of damaged securement devices.** All tiedowns, cargo securement systems, parts and components used to secure cargo must be in proper working order when used to perform that function with no damaged or weakened components, such as, but not limited to, cracks or cuts that will adversely affect their

performance for cargo securement purposes, including reducing the working load limit.

(c) **Vehicle structures and anchor points.** Vehicle structures, floors, walls, decks, tiedown anchor points, headerboards, bulkheads, stakes, posts, and associated mounting pockets used to contain or secure articles of cargo must be strong enough to meet the performance criteria of §393.102, with no damaged or weakened components, such as, but not limited to, cracks or cuts that will adversely affect their performance for cargo securement purposes, including reducing the working load limit.

(d) **Material for dunnage, chocks, cradles, shoring bars, blocking and bracing.** Material used as dunnage or dunnage bags, chocks, cradles, shoring bars, or used for blocking and bracing, must not have damage or defects which would compromise the effectiveness of the securement system.

(e) **Manufacturing standards for tiedown assemblies.** Tie-down assemblies (including chains, wire rope, steel strapping, synthetic webbing, and cordage) and other attachment or fastening devices used to secure articles of cargo to, or in, commercial motor vehicles must conform to the following applicable standards:

An assembly component of...	Must conform to...
(1) Steel strapping ^{1, 2}	Standard Specification for Strapping, Flat Steel and Seals, American Society for Testing and Materials (ASTM) D3953-97, February 1998. ⁴
(2) Chain	National Association of Chain Manufacturers' Welded Steel Chain Specifications, dated September 28, 2005. ⁴
(3) Webbing	Web Sling and Tiedown Association's Recommended Standard Specification for Synthetic Web Tiedowns, WSTDA-T1, 1998. ⁴
(4) Wire rope ³	Wire Rope Technical Board's Wire Rope Users Manual, 2nd Edition, November 1985. ⁴
(5) Cordage	Cordage Institute rope standard: (i) PETRS-2, Polyester Fiber Rope, three-Strand and eight-Strand Constructions, January 1993; ⁴ (ii) PPRS-2, Polypropylene Fiber Rope, three-Strand and eight-Strand Constructions, August 1992; ⁴ (iii) CRS-1, Polyester/Polypropylene Composite Rope Specifications, three-Strand and eight-Strand Standard Construction, May 1979; ⁴ (iv) NRS-1, Nylon Rope Specifications, three-Strand and eight-Strand Standard Construction, May 1979; ⁴ and (v) C-1, Double Braided Nylon Rope Specifications DBN, January 1984. ⁴

¹ Steel strapping not marked by the manufacturer with a working load limit will be considered to have a working load limit equal to one-fourth of the breaking strength listed in ASTM D3953-97.

² Steel strapping 25.4 mm (1 inch) or wider must have at least two pairs of crimps in each seal and, when an end-over-end lap joint is formed, must be sealed with at least two seals.

³ Wire rope which is not marked by the manufacturer with a working load limit shall be considered to have a working load limit equal to one-fourth of the nominal strength listed in the manual.

⁴ See §393.7 for information on the incorporation by reference and availability of this document.

(f) **Use of tiedowns.** (1) Tiedowns and securing devices must not contain knots.

(2) If a tiedown is repaired, it must be repaired in accordance with the applicable standards in paragraph (e) of this section, or the manufacturer's instructions.

(3) Each tiedown must be attached and secured in a manner that prevents it from becoming loose, unfastening, opening or releasing while the vehicle is in transit.

(4) Edge protection must be used whenever a tiedown would be subject to abrasion or cutting at the point where it touches an article of cargo. The edge protection must resist abrasion, cutting and crushing.

§393.106 What are the general requirements for securing articles of cargo?

(a) **Applicability.** The rules in this section are applicable to the transportation of all types of articles of cargo, except commodities in bulk that lack structure or fixed shape (e.g., liquids, gases, grain, liquid concrete, sand, gravel, aggregates) and are transported in a tank, hopper, box, or similar device that forms part of the structure of a commercial motor vehicle. The rules in this section apply to the cargo types covered by the commodity-specific rules of §393.116 through §393.136. The commodity-specific rules take precedence over the general

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requirements of this section when additional requirements are given for a commodity listed in those sections.

(b) **General.** Cargo must be firmly immobilized or secured on or within a vehicle by structures of adequate strength, dunnage or dunnage bags, shoring bars, tiedowns or a combination of these.

(c) **Cargo placement and restraint.** (1) Articles of cargo that are likely to roll must be restrained by chocks, wedges, a cradle or other equivalent means to prevent rolling. The means of preventing rolling must not be capable of becoming unintentionally unfastened or loose while the vehicle is in transit.

(2) Articles or cargo placed beside each other and secured by transverse tiedowns must either:

- (i) Be placed in direct contact with each other, or
- (ii) Be prevented from shifting towards each other while in transit.

(d) **Aggregate working load limit for tiedowns.** The aggregate working load limit of tiedowns used to secure an article or group of articles against movement must be at least one-half times the weight of the article or group of articles. The aggregate working load limit is the sum of:

(1) One-half the working load limit of each tiedown that goes from an anchor point on the vehicle to an anchor point on an article of cargo;

(2) One-half the working load limit of each tiedown that is attached to an anchor point on the vehicle, passes through, over, or around the article of cargo, and is then attached to an anchor point on the same side of the vehicle.

(3) The working load limit for each tiedown that goes from an anchor point on the vehicle, through, over, or around the article of cargo, and then attaches to another anchor point on the other side of the vehicle.

§393.108 How is the working load limit of a tiedown, or the load restraining value of a friction mat, determined?

(a) The working load limit (WLL) of a tiedown, associated connector or attachment mechanism is the lowest working load limit of any of its components (including tensioner), or the working load limit of the anchor points to which it is attached, whichever is less.

(b) The working load limits of tiedowns may be determined by using either the tiedown manufacturer's markings or by using the tables in this section. The working load limits listed in the tables are to be used when the tiedown material is not marked by the manufacturer with the working load limit. Tiedown materials which are marked by the manufacturer with working load limits that differ from the tables, shall be considered to have a working load limit equal to the value for which they are marked.

(c) Synthetic cordage (e.g., nylon, polypropylene, polyester) which is not marked or labeled to enable identification of its composition or working load limit shall be considered to have a working load limit equal to that for polypropylene fiber rope.

(d) Welded steel chain which is not marked or labeled to enable identification of its grade or working load limit

shall be considered to have a working load limit equal to that for grade 30 proof coil chain.

(e)(1) Wire rope which is not marked by the manufacturer with a working load limit shall be considered to have a working load limit equal to one-fourth of the nominal strength listed in the Wire Rope Users Manual.

(2) Wire which is not marked or labeled to enable identification of its construction type shall be considered to have a working load limit equal to that for 6 x 37, fiber core wire rope.

(f) Manila rope which is not marked by the manufacturer with a working load limit shall be considered to have a working load limit based on its diameter as provided in the tables of working load limits.

(g) Friction mats which are not marked or rated by the manufacturer shall be considered to provide resistance to horizontal movement equal to 50 percent of the weight placed on the mat.

TABLES TO §393.108 [WORKING LOAD LIMITS (WLL), CHAIN]

Size mm (inches)	WLL in kg (pounds)				
	Grade 30 proof coil	Grade 43 high test	Grade 70 transport	Grade 80 alloy	Grade 100 alloy
1. 7 (1/4)	580 (1,300)	1,180 (2,600)	1,430 (3,150)	1,570 (3,500)	1,950 (4,300)
2. 8 (5/16)	860 (1,900)	1,770 (3,900)	2,130 (4,700)	2,000 (4,500)	2,600 (5,700)
3. 10 (3/8) ...	1,200 (2,650)	2,450 (5,400)	2,990 (6,600)	3,200 (7,100)	4,000 (8,800)
4. 11 (7/16)	1,680 (3,700)	3,270 (7,200)	3,970 (8,750)		
5. 13 (1/2)	2,030 (4,500)	4,170 (9,200)	5,130 (11,300)	5,400 (12,000)	6,800 (15,000)
6. 16 (5/8)	3,130 (6,900)	5,910 (13,000)	7,170 (15,800)	8,200 (18,100)	10,300 (22,600)
Chain Mark Examples					
Example 1	3	4	7	8	10
Example 2	30	43	70	80	100
Example 3	300	430	700	800	1000

Synthetic Webbing	
Width mm (inches)	WLL kg (pounds)
45 (1 3/4)	790 (1,750)
50 (2)	910 (2,000)
75 (3)	1,360 (3,000)
100 (4)	1,810 (4,000)

Wire Rope (6 x 37, Fiber Core)	
Width mm (inches)	WLL kg (pounds)
7 (1/4)	640 (1,400)
8 (5/16)	950 (2,100)
10 (3/8)	1,360 (3,000)
11 (7/16)	1,860 (4,100)

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Wire Rope (6 x 37, Fiber Core)	
Width mm (inches)	WLL kg (pounds)
13 (½).....	2,400 (5,300)
16 (⅝).....	3,770 (8,300)
20 (¾).....	4,940 (10,900)
22 (⅞).....	7,300 (16,100)
25 (1).....	9,480 (20,900)

Manila Rope	
Width mm (inches)	WLL kg (pounds)
10 (⅜).....	90 (205)
11 (7/16).....	120 (265)
13 (½).....	150 (315)
16 (⅝).....	210 (465)
20 (¾).....	290 (640)
25 (1).....	480 (1,050)

Polypropylene Fiber Rope WLL (3-Strand and 8-Strand Constructions)	
Width mm (inches)	WLL kg (pounds)
10 (⅜).....	180 (400)
11 (7/16).....	240 (525)
13 (½).....	280 (625)
16 (⅝).....	420 (925)
20 (¾).....	580 (1,275)
25 (1).....	950 (2,100)

Polyester Fiber Rope WLL (3-Strand and 8-Strand Constructions)	
Width mm (inches)	WLL kg (pounds)
10 (⅜).....	250 (555)
11 (7/16).....	340 (750)
13 (½).....	440 (960)
16 (⅝).....	680 (1,500)
20 (¾).....	850 (1,880)
25 (1).....	1,500 (3,300)

Nylon Rope	
Width mm (inches)	WLL kg (pounds)
10 (⅜).....	130 (278)
11 (7/16).....	190 (410)
13 (½).....	240 (525)
16 (⅝).....	420 (935)
20 (¾).....	640 (1,420)
25 (1).....	1,140 (2,520)

Double Braided Nylon Rope	
Width mm (inches)	WLL kg (pounds)
10 (⅜).....	150 (336)
11 (7/16).....	230 (502)
13 (½).....	300 (655)
16 (⅝).....	510 (1,130)
20 (¾).....	830 (1,840)
25 (1).....	1,470 (3,250)

Steel Strapping	
Width mm (inches)	WLL kg (pounds)
31.7 x .74 (1 ¼ x 0.029).....	540 (1,190)
31.7 x .79 (1 ¼ x 0.031).....	540 (1,190)
31.7 x .89 (1 ¼ x 0.035).....	540 (1,190)
31.7 x 1.12 (1 ¼ x 0.044).....	770 (1,690)
31.7 x 1.27 (1 ¼ x 0.05).....	770 (1,690)
31.7 x 1.5 (1 ¼ x 0.057).....	870 (1,925)
50.8 x 1.12 (2 x 0.044).....	1,200 (2,650)
50.8 x 1.27 (2 x 0.05).....	1,200 (2,650)

§393.110 What else do I have to do to determine the minimum number of tiedowns?

(a) When tiedowns are used as part of a cargo securement system, the minimum number of tiedowns required to secure an article or group of articles against movement depends on the length of the article(s) being secured, and the requirements of paragraphs (b) and (c) of this section. These requirements are in addition to the rules under §393.106.

(b) When an article is not blocked or positioned to prevent movement in the forward direction by a headerboard, bulkhead, other cargo that is positioned to prevent movement, or other appropriate blocking devices, it must be secured by at least:

(1) One tiedown for articles 5 feet (1.52 meters) or less in length, and 1,100 pounds (500 kg) or less in weight;

(2) Two tiedowns if the article is:

(i) 5 feet (1.52 meters) or less in length and more than 1,100 pounds (500 kg) in weight; or

(ii) Longer than 5 feet (1.52 meters) but less than or equal to 10 feet (3.04 meters) in length, irrespective of the weight.

(3) Two tiedowns if the article is longer than 10 feet (3.04 meters), and one additional tiedown for every 10 feet (3.04 meters) of article length, or fraction thereof, beyond the first 10 feet (3.04 meters) of length.

(c) If an individual article is blocked, braced, or immobilized to prevent movement in the forward direction by a headerboard, bulkhead, other articles which are adequately secured or by an appropriate blocking or immobilization method, it must be secured by at least one tiedown for every 3.04 meters (10 feet) of article length, or fraction thereof.

(d) Special rule for special purpose vehicles. The rules in this section do not apply to a vehicle transporting one or more articles of cargo such as, but not limited to, machinery or fabricated structural items (e.g., steel or concrete beams, crane booms, girders, and trusses, etc.) which, because of their design, size, shape, or weight, must be fastened by special methods. However, any article of cargo carried on that vehicle must be securely and adequately fastened to the vehicle.

§393.112 Must a tiedown be adjustable?

Each tiedown, or its associated connectors, or its attachment mechanisms must be designed, constructed, and maintained so the driver of an in-transit commercial motor vehicle can tighten them. However, this requirement does not apply to the use of steel strapping.

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§393.114 What are the requirements for front end structures used as part of a cargo securement system?

(a) **Applicability.** The rules in this section are applicable to commercial motor vehicles transporting articles of cargo that are in contact with the front end structure of the vehicle. The front end structure on these cargo-carrying vehicles must meet the performance requirements of this section.

(b) **Height and width.** (1) The front end structure must extend either to a height of 4 feet above the floor of the vehicle or to a height at which it blocks forward movement of any item or article of cargo being carried on the vehicle, whichever is lower.

(2) The front end structure must have a width which is at least equal to the width of the vehicle or which blocks forward movement of any article of cargo being transported on the vehicle, whichever is narrower.

(c) **Strength.** The front end structure must be capable of withstanding the following horizontal forward static load:

(1) For a front end structure less than 6 feet in height, a horizontal forward static load equal to one-half (0.5) of the weight of the articles of cargo being transported on the vehicle uniformly distributed over the entire portion of the front end structure that is within 4 feet above the vehicle's floor or that is at or below a height above the vehicle's floor at which it blocks forward movement of any article of the vehicle's cargo, whichever is less; or

(2) For a front end structure 6 feet in height or higher, a horizontal forward static load equal to four-tenths (0.4) of the weight of the articles of cargo being transported on the vehicle uniformly distributed over the entire front end structure.

(d) **Penetration resistance.** The front end structure must be designed, constructed, and maintained so that it is capable of resisting penetration by any article of cargo that contacts it when the vehicle decelerates at a rate of 20 feet per second, per second. The front end structure must have no aperture large enough to permit any article of cargo in contact with the structure to pass through it.

(e) **Substitute devices.** The requirements of this section may be met by the use of devices performing the same functions as a front end structure, if the devices are at least as strong as, and provide protection against shifting articles of cargo at least equal to, a front end structure which conforms to those requirements.

Specific Securement Requirements by Commodity Type

§393.116 What are the rules for securing logs?

(a) **Applicability.** The rules in this section are applicable to the transportation of logs with the following exceptions:

(1) Logs that are unitized by banding or other comparable means may be transported in accordance with the general cargo securement rules of §§393.100 through 393.114.

(2) Loads that consist of no more than four processed logs may be transported in accordance with the general cargo securement rules of §§393.100 through 393.114.

(3) Firewood, stumps, log debris and other such short logs must be transported in a vehicle or container enclosed on both sides, front, and rear and of adequate strength to contain them. Longer logs may also be so loaded.

(b) **Components of a securement system.** (1) Logs must be transported on a vehicle designed and built, or adapted, for the transportation of logs. Any such vehicle must be fitted with bunks, bolsters, stakes or standards, or other equivalent means, that cradle the logs and prevent them from rolling.

(2) All vehicle components involved in securement of logs must be designed and built to withstand all anticipated operational forces without failure, accidental release or permanent deformation. Stakes or standards that are not permanently attached to the vehicle must be secured in a manner that prevents unintentional separation from the vehicle in transit.

(3) Tiedowns must be used in combination with the stabilization provided by bunks, stakes, and bolsters to secure the load unless the logs:

(i) are transported in a crib-type log trailer (as defined in 49 CFR 393.5), and

(ii) are loaded in compliance with paragraphs (b)(2) and (c) of this section.

(4) The aggregate working load limit for tiedowns used to secure a stack of logs on a frame vehicle, or a flatbed vehicle equipped with bunks, bolsters, or stakes must be at least one-sixth the weight of the stack of logs.

(c) **Use of securement system.** (1) Logs must be solidly packed, and the outer bottom logs must be in contact with and resting solidly against the bunks, bolsters, stakes or standards.

(2) Each outside log on the side of a stack of logs must touch at least two stakes, bunks, bolsters, or standards. If one end does not actually touch a stake, it must rest on other logs in a stable manner and must extend beyond the stake, bunk, bolster or standard.

(3) The center of the highest outside log on each side or end must be below the top of each stake, bunk or standard.

(4) Each log that is not held in place by contact with other logs or the stakes, bunks, or standards must be held in place by a tie-down. Additional tiedowns or securement devices must be used when the condition of the wood results in such low friction between logs that they are likely to slip upon each other.

(d) **Securement of shortwood logs loaded crosswise on frame, rail and flatbed vehicles.** In addition to the requirements of paragraphs (b) and (c) of this section, each stack of logs loaded crosswise must meet the following rules:

(1) In no case may the end of a log in the lower tier extend more than one-third of the log's total length beyond the nearest supporting structure on the vehicle.

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(2) When only one stack of shortwood is loaded crosswise, it must be secured with at least two tiedowns. The tiedowns must attach to the vehicle frame at the front and rear of the load, and must cross the load in this direction.

(3) When two tiedowns are used, they must be positioned at approximately one-third and two-thirds of the length of the logs.

(4) A vehicle that is more than 10 meters (33 feet) long must be equipped with center stakes, or comparable devices, to divide it into sections approximately equal in length. Where a vehicle is so divided, each tiedown must secure the highest log on each side of the center stake, and must be fastened below these logs. It may be fixed at each end and tensioned from the middle, or fixed in the middle and tensioned from each end, or it may pass through a pulley or equivalent device in the middle and be tensioned from one end.

(5) Any structure or stake that is subjected to an upward force when the tiedowns are tensioned must be anchored to resist that force.

(6) If two stacks of shortwood are loaded side-by-side, in addition to meeting the requirements of paragraphs (d)(1) through (d)(5) of this section, they must be loaded so that:

- (i) There is no space between the two stacks of logs;
- (ii) The outside of each stack is raised at least 2.5 cm (1 in) within 10 cm (4 in) of the end of the logs or the side of the vehicle;
- (iii) The highest log is no more than 2.44 m (8 ft) above the deck; and
- (iv) At least one tiedown is used lengthwise across each stack of logs.

(e) **Securement of logs loaded lengthwise on flatbed and frame vehicles.** (1) **Shortwood.** In addition to meeting the requirements of paragraphs (b) and (c) of this section, each stack of shortwood loaded lengthwise on a frame vehicle or on a flatbed must be cradled in a bunk unit or contained by stakes and

- (i) Secured to the vehicle by at least two tiedowns, or
- (ii) If all the logs in any stack are blocked in the front by a front-end structure strong enough to restrain the load, or by another stack of logs, and blocked in the rear by another stack of logs or vehicle end structure, the stack may be secured with one tiedown. If one tiedown is used, it must be positioned about midway between the stakes, or

(iii) Be bound by at least two tiedown-type devices such as wire rope, used as wrappers that encircle the entire load at locations along the load that provide effective securement. If wrappers are being used to bundle the logs together, the wrappers are not required to be attached to the vehicle.

(2) **Longwood.** Longwood must be cradled in two or more bunks and must either:

- (i) Be secured to the vehicle by at least two tiedowns at locations that provide effective securement, or
- (ii) Be bound by at least two tiedown-type devices, such as wire rope, used as wrappers that encircle the entire load at locations along the load that provide effective

securement. If a wrapper(s) is being used to bundle the logs together, the wrapper is not required to be attached to the vehicle.

(f) **Securement of logs transported on pole trailers.** (1) The load must be secured by at least one tiedown at each bunk, or alternatively, by at least two tiedowns used as wrappers that encircle the entire load at locations along the load that provide effective securement.

(2) The front and rear wrappers must be at least 3.04 meters (10 feet) apart.

(3) Large diameter single and double log loads must be immobilized with chock blocks or other equivalent means to prevent shifting.

(4) Large diameter logs that rise above bunks must be secured to the underlying load with at least two additional wrappers.

§393.118 What are the rules for securing dressed lumber or similar building products?

(a) **Applicability.** The rules in this section apply to the transportation of bundles of dressed lumber, packaged lumber, building products such as plywood, gypsum board or other materials of similar shape. Lumber or building products which are not bundled or packaged must be treated as loose items and transported in accordance with §§393.100 through 393.114 of this subpart. For the purpose of this section, “bundle” refers to packages of lumber, building materials or similar products which are unitized for securement as a single article of cargo.

(b) **Positioning of bundles.** Bundles must be placed side by side in direct contact with each other, or a means must be provided to prevent bundles from shifting towards each other.

(c) **Securement of bundles transported using no more than one tier.** Bundles carried on one tier must be secured in accordance with the general provisions of §§393.100 through 393.114.

(d) **Securement of bundles transported using more than one tier.** Bundles carried in more than one tier must be either:

(1) Blocked against lateral movement by stakes on the sides of the vehicle and secured by tiedowns laid out over the top tier, as outlined in the general provisions of §§393.100 through 393.114; or

(2) Restrained from lateral movement by blocking or high friction devices between tiers and secured by tiedowns laid out over the top tier, as outlined in the general provisions of §§393.100 through 393.114; or

(3) Placed directly on top of other bundles or on spacers and secured in accordance with the following:

(i) The length of spacers between bundles must provide support to all pieces in the bottom row of the bundle.

(ii) The width of individual spacers must be equal to or greater than the height.

(iii) If spacers are comprised of layers of material, the layers must be unitized or fastened together in a manner which ensures that the spacer performs as a single piece of material.

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(iv) The arrangement of the tiedowns for the bundles must be:

(A) Secured by tiedowns over the top tier of bundles, in accordance with the general provisions of §§393.100 through 393.114 with a minimum of two tiedowns for bundles longer than 1.52 meters (5 ft); and

(B) Secured by tiedowns as follows:

(1) If there are 3 tiers, the middle and top bundles must be secured by tiedowns in accordance with the general provisions of §§393.100 through 393.114; or

(2)(i) If there are more than 3 tiers, then one of the middle bundles and the top bundle must be secured by tiedown devices in accordance with the general provision of §§393.100 through 393.114, and the maximum height for the middle tier that must be secured may not exceed 6 feet above the deck of the trailer; or

(ii) Otherwise, the second tier from the bottom must be secured in accordance with the general provisions of §§393.100 through 393.114; or

(4) Secured by tiedowns over each tier of bundles, in accordance with §§393.100 through 393.114 using a minimum of two tiedowns over each of the top bundles longer than 1.52 meters (5 ft), in all circumstances; or

(e) When loaded in a sided vehicle or container of adequate strength, dressed lumber or similar building products may be secured in accordance with the general provisions of §§393.100 through 393.114.

§393.120 What are the rules for securing metal coils?

(a) **Applicability.** The rules in this section apply to the transportation of one or more metal coils which, individually or grouped together, weigh 2268 kg (5000 pounds) or more. Shipments of metal coils that weigh less than 2268 kg (5000 pounds) may be secured in accordance with the provisions of §§393.100 through 393.114.

(b) **Securement of coils transported with eyes vertical on a flatbed vehicle, in a sided vehicle or in an intermodal container with anchor points—**(1) An individual coil. Each coil must be secured by tiedowns arranged in a manner to prevent the coils from tipping in the forward, rearward, and lateral directions. The restraint system must include the following:

(i) At least one tiedown attached diagonally from the left side of the vehicle or intermodal container (near the forwardmost part of the coil), across the eye of the coil, to the right side of the vehicle or intermodal container (near the rearmost part of the coil);

(ii) At least one tiedown attached diagonally from the right side of the vehicle or intermodal container (near the forwardmost part of the coil), across the eye of the coil, to the left side of the vehicle or intermodal container (near the rearmost part of the coil);

(iii) At least one tiedown attached transversely over the eye of the coil; and

(iv) Either blocking and bracing, friction mats or tiedowns to prevent longitudinal movement in the forward direction.

(2) Coils grouped in rows. When coils are grouped and loaded side by side in a transverse or longitudinal row, then each row of coils must be secured by the following:

(i) At least one tiedown attached to the front of the row of coils, restraining against forward motion, and whenever practicable, making an angle no more than 45 degrees with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container;

(ii) At least one tiedown attached to the rear of the row of coils, restraining against rearward motion, and whenever practicable, making an angle no more than 45 degrees with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container;

(iii) At least one tiedown over the top of each coil or transverse row of coils, restraining against vertical motion. Tiedowns going over the top of a coil(s) must be as close as practicable to the eye of the coil and positioned to prevent the tiedown from slipping or becoming unintentionally unfastened while the vehicle is in transit; and

(iv) Tiedowns must be arranged to prevent shifting or tipping in the forward, rearward and lateral directions.

(c) **Securement of coils transported with eyes crosswise on a flatbed vehicle, in a sided vehicle or in an intermodal container with anchor points—**

(1) An individual coil. Each coil must be secured by the following:

(i) A means (e.g., timbers, chocks or wedges, a cradle, etc.) to prevent the coil from rolling. The means of preventing rolling must support the coil off the deck, and must not be capable of becoming unintentionally unfastened or loose while the vehicle is in transit. If timbers, chocks or wedges are used, they must be held in place by coil bunks or similar devices to prevent them from coming loose. The use of nailed blocking or cleats as the sole means to secure timbers, chocks or wedges, or a nailed wood cradle, is prohibited;

(ii) At least one tiedown through its eye, restricting against forward motion, and whenever practicable, making an angle no more than 45 degrees with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container; and

(iii) At least one tiedown through its eye, restricting against rearward motion, and whenever practicable, making an angle no more than 45 degrees with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container.

(2) Prohibition on crossing of tiedowns when coils are transported with eyes crosswise. Attaching tiedowns diagonally through the eye of a coil to form an X-pattern when viewed from above the vehicle is prohibited.

(d) **Securement of coils transported with eyes lengthwise on a flatbed vehicle, in a sided vehicle or in an intermodal container with anchor points—**

(1) An individual coil-option 1. Each coil must be secured by:

(i) A means (e.g., timbers, chocks or wedges, a cradle, etc.) to prevent the coil from rolling. The means of preventing rolling must support the coil off the deck, and must not be capable of becoming unintentionally unfastened or loose while the vehicle is in transit. If timbers, chocks or wedges are used, they must be held in place by

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coil bunks or similar devices to prevent them from coming loose. The use of nailed blocking or cleats as the sole means to secure timbers, chocks or wedges, or a nailed wood cradle, is prohibited;

(ii) At least one tiedown attached diagonally through its eye from the left side of the vehicle or intermodal container (near the forward-most part of the coil), to the right side of the vehicle or intermodal container (near the rearmost part of the coil), making an angle no more than 45 degrees, whenever practicable, with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container;

(iii) At least one tiedown attached diagonally through its eye, from the right side of the vehicle or intermodal container (near the forward-most part of the coil), to the left side of the vehicle or intermodal container (near the rearmost part of the coil), making an angle no more than 45 degrees, whenever practicable, with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container;

(iv) At least one tiedown attached transversely over the top of the coil; and

(v) Either blocking or friction mats to prevent longitudinal movement.

(2) An individual coil-option 2. Each coil must be secured by:

(i) A means (e.g., timbers, chocks or wedges, a cradle, etc.) to prevent the coil from rolling. The means of preventing rolling must support the coil off the deck, and must not be capable of becoming unintentionally unfastened or loose while the vehicle is in transit. If timbers, chocks or wedges are used, they must be held in place by coil bunks or similar devices to prevent them from coming loose. The use of nailed blocking or cleats as the sole means to secure timbers, chocks or wedges, or a nailed wood cradle, is prohibited;

(ii) At least one tiedown attached straight through its eye from the left side of the vehicle or intermodal container (near the forward-most part of the coil), to the left side of the vehicle or intermodal container (near the rearmost part of the coil), and, whenever practicable, making an angle no more than 45 degrees with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container;

(iii) At least one tiedown attached straight through its eye, from the right side of the vehicle or intermodal container (near the forward-most part of the coil), to the right side of the vehicle or intermodal container (near the rearmost part of the coil), and whenever practicable, making an angle no more than 45 degrees with the floor of the vehicle or intermodal container when viewed from the side of the vehicle or container;

(iv) At least one tiedown attached transversely over the top of the coil; and

(v) Either blocking or friction mats to prevent longitudinal movement.

(3) An individual coil-option 3. Each coil must be secured by:

(i) A means (e.g., timbers, chocks or wedges, a cradle, etc.) to prevent the coil from rolling. The means of preventing rolling must support the coil off the deck, and

must not be capable of becoming unintentionally unfastened or loose while the vehicle is in transit. If timbers, chocks or wedges are used, they must be held in place by coil bunks or similar devices to prevent them from coming loose. The use of nailed blocking or cleats as the sole means to secure timbers, chocks or wedges, or a nailed wood cradle, is prohibited;

(ii) At least one tiedown over the top of the coil, located near the forward-most part of the coil;

(iii) At least one tiedown over the top of the coil located near the rearmost part of the coil; and

(iv) Either blocking or friction mats to prevent longitudinal movement.

(4) Rows of coils. Each transverse row of coils having approximately equal outside diameters must be secured with:

(i) A means (e.g., timbers, chocks or wedges, a cradle, etc.) to prevent each coil in the row of coils from rolling. The means of preventing rolling must support each coil off the deck, and must not be capable of becoming unintentionally unfastened or loose while the vehicle is in transit. If timbers, chocks or wedges are used, they must be held in place by coil bunks or similar devices to prevent them from coming loose. The use of nailed blocking or cleats as the sole means to secure timbers, chocks or wedges, or a nailed wood cradle, is prohibited;

(ii) At least one tiedown over the top of each coil or transverse row, located near the forward-most part of the coil;

(iii) At least one tiedown over the top of each coil or transverse row, located near the rearmost part of the coil; and

(iv) Either blocking, bracing or friction mats to prevent longitudinal movement.

(e) Securement of coils transported in a sided vehicle without anchor points or an intermodal container without anchor points. Metal coils transported in a vehicle with sides without anchor points or an intermodal container without anchor points must be loaded in a manner to prevent shifting and tipping. The coils may also be secured using a system of blocking and bracing, friction mats, tiedowns, or a combination of these to prevent any horizontal movement and tipping.

§393.122 What are the rules for securing paper rolls?

(a) **Applicability.** The rules in this section apply to shipments of paper rolls which, individually or together, weigh 2268 kg (5000 lb) or more. Shipments of paper rolls that weigh less than 2268 kg (5000 lb), and paper rolls that are unitized on a pallet, may either be secured in accordance with the rules in this section or the requirements of §§393.100 through 393.114.

(b) **Securement of paper rolls transported with eyes vertical in a sided vehicle.** (1) Paper rolls must be placed tightly against the walls of the vehicle, other paper rolls, or other cargo, to prevent movement during transit.

(2) If there are not enough paper rolls in the shipment to reach the walls of the vehicle, lateral movement must be prevented by filling the void, blocking, bracing,

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tiedowns or friction mats. The paper rolls may also be banded together.

(3) When any void behind a group of paper rolls, including that at the rear of the vehicle, exceeds the diameter of the paper rolls, rearward movement must be prevented by friction mats, blocking, bracing, tiedowns, or banding to other rolls.

(4)(i) If a paper roll is not prevented from tipping or falling sideways or rearwards by vehicle structure or other cargo, and its width is more than 2 times its diameter, it must be prevented from tipping or falling by banding it to other rolls, bracing, or tiedowns.

(ii) If the forwardmost roll(s) in a group of paper rolls has a width greater than 1.75 times its diameter and it is not prevented from tipping or falling forwards by vehicle structure or other cargo, then it must be prevented from tipping or falling forwards by banding it to other rolls, bracing, or tiedowns.

(iii) If the forwardmost roll(s) in a group of paper rolls has a width equal to or less than 1.75 times its diameter, and it is restrained against forward movement by friction mat(s) alone, then banding, bracing, or tiedowns are not required to prevent tipping or falling forwards.

(iv) If a paper roll or the forwardmost roll in a group of paper rolls has a width greater than 1.25 times its diameter, and it is not prevented from tipping or falling forwards by vehicle structure or other cargo, and it is not restrained against forward movement by friction mat(s) alone, then it must be prevented from tipping or falling by banding it to other rolls, bracing or tiedowns.

(5) If paper rolls are banded together, the rolls must be placed tightly against each other to form a stable group. The bands must be applied tightly, and must be secured so that they cannot fall off the rolls or to the deck.

(6) A friction mat used to provide the principal securement for a paper roll must protrude from beneath the roll in the direction in which it is providing that securement.

(c) Securement of split loads of paper rolls transported with eyes vertical in a sided vehicle. (1) If a paper roll in a split load is not prevented from forward movement by vehicle structure or other cargo, it must be prevented from forward movement by filling the open space, or by blocking, bracing, tiedowns, friction mats, or some combination of these.

(2) A friction mat used to provide the principal securement for a paper roll must protrude from beneath the roll in the direction in which it is providing that securement.

(d) Securement of stacked loads of paper rolls transported with eyes vertical in a sided vehicle. (1) Paper rolls must not be loaded on a layer of paper rolls beneath unless the lower layer extends to the front of the vehicle.

(2) Paper rolls in the second and subsequent layers must be prevented from forward, rearward or lateral movement by means as allowed for the bottom layer, or by use of a blocking roll from a lower layer.

(3) The blocking roll must be at least 38 mm (1.5 in) taller than other rolls, or must be raised at least 38 mm (1.5 in) using dunnage.

(4) A roll in the rearmost row of any layer raised using dunnage may not be secured by friction mats alone.

(e) Securement of paper rolls transported with eyes crosswise in a sided vehicle. (1) The paper rolls must be prevented from rolling or shifting longitudinally by contact with vehicle structure or other cargo, by chocks, wedges or blocking and bracing of adequate size, or by tiedowns.

(2) Chocks, wedges or blocking must be held securely in place by some means in addition to friction, so they cannot become unintentionally unfastened or loose while the vehicle is in transit.

(3) The rearmost roll must not be secured using the rear doors of the vehicle or intermodal container, or by blocking held in place by those doors.

(4) If there is more than a total of 203 mm (8 in) of space between the ends of a paper roll, or a row of rolls, and the walls of the vehicle, void fillers, blocking, bracing, friction mats, or tie-downs must be used to prevent the roll from shifting towards either wall.

(f) Securement of stacked loads of paper rolls transported with eyes crosswise in a sided vehicle. (1) Rolls must not be loaded in a second layer unless the bottom layer extends to the front of the vehicle.

(2) Rolls must not be loaded in a third or higher layer unless all wells in the layer beneath are filled.

(3) The foremost roll in each upper layer, or any roll with an empty well in front of it, must be secured against forward movement by:

(i) Banding it to other rolls, or

(ii) Blocking against an adequately secured eye-vertical blocking roll resting on the floor of the vehicle which is at least 1.5 times taller than the diameter of the roll being blocked, or

(iii) Placing it in a well formed by two rolls on the lower row whose diameter is equal to or greater than that of the roll on the upper row.

(4) The rearmost roll in each upper layer must be secured by banding it to other rolls if it is located in either of the last two wells formed by the rearmost rolls in the layer below.

(5) Rolls must be secured against lateral movement by the same means allowed for the bottom layer when there is more than a total of 203 mm (8 in) of space between the ends of a paper roll, or a row of rolls, and the walls of the vehicle.

(g) Securement of paper rolls transported with the eyes lengthwise in a sided vehicle.

(1) Each roll must be prevented from forward movement by contact with vehicle structure, other cargo, blocking or tie-downs.

(2) Each roll must be prevented from rearward movement by contact with other cargo, blocking, friction mats or tiedowns.

(3) The paper rolls must be prevented from rolling or shifting laterally by contact with the wall of the vehicle or other cargo, or by chocks, wedges or blocking of adequate size.

(4) Chocks, wedges or blocking must be held securely in place by some means in addition to friction, so they

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cannot become unintentionally unfastened or loose while the vehicle is in transit.

(h) **Securement of stacked loads of paper rolls transported with the eyes lengthwise in a sided vehicle.** (1) Rolls must not be loaded in a higher layer if another roll will fit in the layer beneath.

(2) An upper layer must be formed by placing paper rolls in the wells formed by the rolls beneath.

(3) A roll in an upper layer must be secured against forward and rearward movement by any of the means allowed for the bottom layer, by use of a blocking roll, or by banding to other rolls.

(i) **Securement of paper rolls transported on a flatbed vehicle or in a curtain-sided vehicle—** (1) Paper rolls with eyes vertical or with eyes lengthwise.

(i) The paper rolls must be loaded and secured as described for a sided vehicle, and the entire load must be secured by tie-downs in accordance with the requirements of §§393.100 through 393.114.

(ii) Stacked loads of paper rolls with eyes vertical are prohibited.

(2) Paper rolls with eyes crosswise. (i) The paper rolls must be prevented from rolling or shifting longitudinally by contact with vehicle structure or other cargo, by chocks, wedges or blocking and bracing of adequate size, or by tiedowns.

(ii) Chocks, wedges or blocking must be held securely in place by some means in addition to friction so that they cannot become unintentionally unfastened or loose while the vehicle is in transit.

(iii) Tiedowns must be used in accordance with the requirements of §§393.100 through 393.114 to prevent lateral movement.

§393.124 What are the rules for securing concrete pipe?

(a) **Applicability.** (1) The rules in this section apply to the transportation of concrete pipe on flatbed trailers and vehicles, and lowboy trailers.

(2) Concrete pipe bundled tightly together into a single rigid article that has no tendency to roll, and concrete pipe loaded in a sided vehicle or container must be secured in accordance with the provisions of §§393.100 through 393.114.

(b) **General specifications for tiedowns.** (1) The aggregate working load limit of all tiedowns on any group of pipes must not be less than half the total weight of all the pipes in the group.

(2) A transverse tiedown through a pipe on an upper tier or over longitudinal tiedowns is considered to secure all those pipes beneath on which that tiedown causes pressure.

(c) **Blocking.** (1) Blocking may be one or more pieces placed symmetrically about the center of a pipe.

(2) One piece must extend at least half the distance from the center to each end of the pipe, and two pieces must be placed on the opposite side, one at each end of the pipe.

(3) Blocking must be placed firmly against the pipe, and must be secured to prevent it moving out from under the pipe.

(4) Timber blocking must have minimum dimensions of at least 10 x 15 cm (4 x 6 in).

(d) **Arranging the load—(1) Pipe of different diameter.** If pipe of more than one diameter are loaded on a vehicle, groups must be formed that consist of pipe of only one size, and each group must be separately secured.

(2) **Arranging a bottom tier.** The bottom tier must be arranged to cover the full length of the vehicle, or as a partial tier in one group or two groups.

(3) **Arranging an upper tier.** Pipe must be placed only in the wells formed by adjacent pipes in the tier beneath. A third or higher tier must not be started unless all wells in the tier beneath are filled.

(4) **Arranging the top tier.** The top tier must be arranged as a complete tier, a partial tier in one group, or a partial tier in two groups.

(5) **Arranging bell pipe.** (i) Bell pipe must be loaded on at least two longitudinal spacers of sufficient height to ensure that the bell is clear of the deck.

(ii) Bell pipe loaded in one tier must have the bells alternating on opposite sides of the vehicle.

(iii) The ends of consecutive pipe must be staggered, if possible, within the allowable width, otherwise they must be aligned.

(iv) Bell pipe loaded in more than one tier must have the bells of the bottom tier all on the same side of the vehicle.

(v) Pipe in every upper tier must be loaded with bells on the opposite side of the vehicle to the bells of the tier below.

(vi) If the second tier is not complete, pipe in the bottom tier which do not support a pipe above must have their bells alternating on opposite sides of the vehicle.

(e) **Securing pipe with an inside diameter up to 1,143 mm (45 in).** In addition to the requirements of paragraphs (b), (c) and (d) of this section, the following rules must be satisfied:

(1) **Stabilizing the bottom tier.** (i) The bottom tier must be immobilized longitudinally at each end by blocking, vehicle end structure, stakes, a locked pipe unloader, or other equivalent means.

(ii) Other pipe in the bottom tier may also be held in place by blocks and/or wedges; and

(iii) Every pipe in the bottom tier must also be held firmly in contact with the adjacent pipe by tiedowns through the front and rear pipes:

(A) At least one tiedown through the front pipe of the bottom tier must run aft at an angle not more than 45 degrees with the horizontal, whenever practicable.

(B) At least one tiedown through the rear pipe of the bottom tier must run forward at an angle not more than 45 degrees with the horizontal, whenever practicable.

(2) **Use of tiedowns.** (i) Each pipe may be secured individually with tiedowns through the pipe.

(ii) If each pipe is not secured individually with a tiedown, then:

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(A) Either one ½-inch diameter chain or wire rope, or two ⅜-inch diameter chain or wire rope, must be placed longitudinally over the group of pipes;

(B) One transverse tiedown must be used for every 3.04 m (10 ft) of load length. The transverse tiedowns may be placed through a pipe, or over both longitudinal tiedowns between two pipes on the top tier;

(C) If the first pipe of a group in the top tier is not placed in the first well formed by pipes at the front of the tier beneath, it must be secured by an additional tiedown that runs rearward at an angle not more than 45 degrees to the horizontal, whenever practicable. This tiedown must pass either through the front pipe of the upper tier, or outside it and over both longitudinal tie-downs; and

(D) If the last pipe of a group in the top tier is not placed in the last well formed by pipes at the rear of the tier beneath, it must be secured by an additional tiedown that runs forward at an angle not more than 45 degrees to the horizontal, whenever practicable. This tiedown must pass either through the rear pipe of the upper tier or outside it and over both longitudinal tiedowns.

(f) **Securing large pipe, with an inside diameter over 1143 mm (45 in).** In addition to the requirements of paragraphs (b), (c) and (d) of this section, the following rules must be satisfied:

(1) The front pipe and the rear pipe must be immobilized by blocking, wedges, vehicle end structure, stakes, locked pipe unloader, or other equivalent means.

(2) Each pipe must be secured by tiedowns through the pipe:

(i) At least one tiedown through each pipe in the front half of the load, which includes the middle one if there is an odd number, and must run rearward at an angle not more than 45 degrees with the horizontal, whenever practicable;

(ii) At least one tiedown through each pipe in the rear half of the load, and must run forward at an angle not more than 45 degrees with the horizontal, whenever practicable, to hold each pipe firmly in contact with adjacent pipe; and

(iii) If the front or rear pipe is not also in contact with vehicle end structure, stakes, a locked pipe unloader, or other equivalent means, at least two tiedowns positioned as described in paragraphs (f)(2)(i) and (ii) of this section, must be used through that pipe.

(3) If only one pipe is transported, or if several pipes are transported without contact between other pipes, the requirements in this paragraph apply to each pipe as a single front and rear article.

§393.126 What are the rules for securing intermodal containers?

(a) **Applicability.** The rules in this section apply to the transportation of intermodal containers. Cargo contained within an intermodal container must be secured in accordance with the provisions of §§393.100 through 393.114 or, if applicable, the commodity specific rules of this part.

(b) **Securement of intermodal containers transported on container chassis vehicle(s).** (1) All lower corners of the intermodal container must be secured to

the container chassis with securement devices or integral locking devices that cannot unintentionally become unfastened while the vehicle is in transit.

(2) The securement devices must restrain the container from moving more than 1.27 cm (½ in) forward, more than 1.27 cm (½ in) aft, more than 1.27 cm (½ in) to the right, more than 1.27 cm (½ in) to the left, or more than 2.54 cm (1 in) vertically.

(3) The front and rear of the container must be secured independently.

(c) **Securement of loaded intermodal containers transported on vehicles other than container chassis vehicle(s).** (1) All lower corners of the intermodal container must rest upon the vehicle, or the corners must be supported by a structure capable of bearing the weight of the container and that support structure must be independently secured to the motor vehicle.

(2) Each container must be secured to the vehicle by:

(i) Chains, wire ropes or integral devices which are fixed to all lower corners; or

(ii) Crossed chains which are fixed to all upper corners; and,

(3) The front and rear of the container must be secured independently. Each chain, wire rope, or integral locking device must be attached to the container in a manner that prevents it from being unintentionally unfastened while the vehicle is in transit.

(d) **Securement of empty intermodal containers transported on vehicles other than container chassis vehicle(s).** Empty intermodal containers transported on vehicles other than container chassis vehicles do not have to have all lower corners of the intermodal container resting upon the vehicle, or have all lower corners supported by a structure capable of bearing the weight of the empty container, provided:

(1) The empty intermodal container is balanced and positioned on the vehicle in a manner such that the container is stable before the addition of tiedowns or other securement equipment; and,

(2) The amount of overhang for the empty container on the trailer does not exceed five feet on either the front or rear of the trailer;

(3) The empty intermodal container must not interfere with the vehicle's maneuverability; and,

(4) The empty intermodal container is secured to prevent lateral, longitudinal, or vertical shifting.

§393.128 What are the rules for securing automobiles, light trucks and vans?

(a) **Applicability.** The rules in this section apply to the transportation of automobiles, light trucks, and vans which individually weigh 4,536 kg. (10,000 lb) or less.

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Vehicles which individually are heavier than 4,536 kg (10,000 lb) must be secured in accordance with the provisions of §393.130 of this part.

(b) Securement of automobiles, light trucks, and vans.

(1) Automobiles, light trucks, and vans must be restrained at both the front and rear to prevent lateral, forward, rearward, and vertical movement using a minimum of two tiedowns.

(2) Tiedowns that are designed to be affixed to the structure of the automobile, light truck, or van must use the mounting points on those vehicles that have been specifically designed for that purpose.

(3) Tiedowns that are designed to fit over or around the wheels of an automobile, light truck, or van must provide restraint in the lateral, longitudinal and vertical directions.

(4) Edge protectors are not required for synthetic webbing at points where the webbing comes in contact with the tires.

§393.130 What are the rules for securing heavy vehicles, equipment and machinery?

(a) **Applicability.** The rules in this section apply to the transportation of heavy vehicles, equipment and machinery which operate on wheels or tracks, such as front end loaders, bulldozers, tractors, and power shovels and which individually weigh 4,536 kg (10,000 lb.) or more. Vehicles, equipment and machinery which is lighter than 4,536 kg (10,000 lb.) may also be secured in accordance with the provisions of this section, with §393.128, or in accordance with the provisions of §§393.100 through 393.114.

(b) Preparation of equipment being transported.

(1) Accessory equipment, such as hydraulic shovels, must be completely lowered and secured to the vehicle.

(2) Articulated vehicles shall be restrained in a manner that prevents articulation while in transit.

(c) **Securement of heavy vehicles, equipment or machinery with crawler tracks or wheels.** (1) In addition to the requirements of paragraph (b) of this section, heavy equipment or machinery with crawler tracks or wheels must be restrained against movement in the lateral, forward, rearward, and vertical direction using a minimum of four tiedowns.

(2) Each of the tiedowns must be affixed as close as practicable to the front and rear of the vehicle, or mounting points on the vehicle that have been specifically designed for that purpose.

§393.132 What are the rules for securing flattened or crushed vehicles?

(a) **Applicability.** The rules in this section apply to the transportation of vehicles such as automobiles, light trucks, and vans that have been flattened or crushed.

(b) **Prohibition on the use of synthetic webbing.** The use of synthetic webbing to secure flattened or crushed vehicles is prohibited except that such webbing may be used to connect wire rope or chain to anchor points on the commercial motor vehicle. However, the webbing (regardless of whether edge protection is used)

must not come into contact with the flattened or crushed cars.

(c) **Securement of flattened or crushed vehicles.** Flattened or crushed vehicles must be transported on vehicles which have:

(1) Containment walls or comparable means on four sides which extend to the full height of the load and which block against movement of the cargo in the forward, rearward and lateral directions; or

(2)(i) Containment walls or comparable means on three sides which extend to the full height of the load and which block against movement of the cargo in the direction for which there is a containment wall or comparable means, and

(ii) A minimum of two tiedowns are required per vehicle stack; or

(3)(i) Containment walls on two sides which extend to the full height of the load and which block against movement of the cargo in the forward and rearward directions, and

(ii) A minimum of three tiedowns are required per vehicle stack; or

(4) A minimum of four tiedowns per vehicle stack.

(5) In addition to the requirements of paragraphs (c)(2), (3), and (4), the following rules must be satisfied:

(i) Vehicles used to transport flattened or crushed vehicles must be equipped with a means to prevent liquids from leaking from the bottom of the vehicle, and loose parts from falling from the bottom and all four sides of the vehicle extending to the full height of the cargo.

(ii) The means used to contain loose parts may consist of structural walls, sides or sideboards, or suitable covering material, alone or in combinations.

(iii) The use of synthetic material for containment of loose parts is permitted.

§393.134 What are the rules for securing roll-on/roll-off or hook lift containers?

(a) **Applicability.** The rules in this section apply to the transportation of roll-on/roll-off or hook lift containers.

(b) **Securement of a roll-on/roll-off and hook lift container.** Each roll-on/roll-off and hook lift container carried on a vehicle which is not equipped with an integral securement system must be:

(1) Blocked against forward movement by the lifting device, stops, a combination of both or other suitable restraint mechanism;

(2) Secured to the front of the vehicle by the lifting device or other suitable restraint against lateral and vertical movement;

(3) Secured to the rear of the vehicle with at least one of the following mechanisms:

(i) One tiedown attached to both the vehicle chassis and the container chassis;

(ii) Two tiedowns installed lengthwise, each securing one side of the container to one of the vehicle's side rails; or

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(iii) Two hooks, or an equivalent mechanism, securing both sides of the container to the vehicle chassis at least as effectively as the tiedowns in the two previous items.

(4) The mechanisms used to secure the rear end of a roll-on/roll off or hook lift container must be installed no more than two meters (6 ft 7 in) from the rear of the container.

(5) In the event that one or more of the front stops or lifting devices are missing, damaged or not compatible, additional manually installed tiedowns must be used to secure the container to the vehicle, providing the same level of securement as the missing, damaged or incompatible components.

§393.136 What are the rules for securing large boulders?

(a) **Applicability.** (1) The rules in this section are applicable to the transportation of any large piece of natural, irregularly shaped rock weighing in excess of 5,000 kg (11,000 lb.) or with a volume in excess of 2 cubic-meters on an open vehicle, or in a vehicle whose sides are not designed and rated to contain such cargo.

(2) Pieces of rock weighing more than 100 kg (220 lb.), but less than 5,000 kg (11,000 lb.) must be secured, either in accordance with this section, or in accordance with the provisions of §§393.100 through 393.114, including:

(i) Rock contained within a vehicle which is designed to carry such cargo; or

(ii) Secured individually by tiedowns, provided each piece can be stabilized and adequately secured.

(3) Rock which has been formed or cut to a shape and which provides a stable base for securement must also be secured, either in accordance with the provisions of this section, or in accordance with the provisions of §§393.100 through 393.114.

(b) **General requirements for the positioning of boulders on the vehicle.** (1) Each boulder must be placed with its flattest and/or largest side down.

(2) Each boulder must be supported on at least two pieces of hard wood blocking at least 10 cm x 10 cm (4 inches x 4 inches) side dimensions extending the full width of the boulder.

(3) Hardwood blocking pieces must be placed as symmetrically as possible under the boulder and should support at least three-fourths of the length of the boulder.

(4) If the flattest side of a boulder is rounded or partially rounded, so that the boulder may roll, it must be placed in a crib made of hardwood timber fixed to the deck of the vehicle so that the boulder rests on both the deck and the timber, with at least three well-separated points of contact that prevent its tendency to roll in any direction.

(5) If a boulder is tapered, the narrowest end must point towards the front of the vehicle.

(c) **General tiedown requirements.** (1) Only chain may be used as tiedowns to secure large boulders.

(2) Tiedowns which are in direct contact with the boulder should, where possible, be located in valleys or

notches across the top of the boulder, and must be arranged to prevent sliding across the rock surface.

(d) **Securement of a cubic shaped boulder.** In addition to the requirements of paragraphs (b) and (c) of this section, the following rules must be satisfied:

(1) Each boulder must be secured individually with at least two chain tiedowns placed transversely across the vehicle.

(2) The aggregate working load limit of the tiedowns must be at least half the weight of the boulder.

(3) The tiedowns must be placed as closely as possible to the wood blocking used to support the boulder.

(e) **Securement of a non-cubic shaped boulder-with a stable base.** In addition to the requirements of paragraphs (b) and (c) of this section, the following rules must be satisfied:

(1) The boulder must be secured individually with at least two chain tiedowns forming an "X" pattern over the boulder.

(2) The aggregate working load limit of the tiedowns must be at least half the weight of the boulder.

(3) The tiedowns must pass over the center of the boulder and must be attached to each other at the intersection by a shackle or other connecting device.

(f) **Securement of a non-cubic shaped boulder-with an unstable base.** In addition to the requirements of paragraphs (b) and (c) of this section, each boulder must be secured by a combination of chain tiedowns as follows:

(1) One chain must surround the top of the boulder (at a point between one-half and two-thirds of its height). The working load limit of the chain must be at least half the weight of the boulder.

(2) Four chains must be attached to the surrounding chain and the vehicle to form a blocking mechanism which prevents any horizontal movement. Each chain must have a working load limit of at least one-fourth the weight of the boulder. Whenever practicable, the angle of the chains must not exceed 45 degrees from the horizontal.

Subpart J—Frames, cab and body components, wheels, steering, and suspension systems

§393.201 Frames.

(a) The frame or chassis of each commercial motor vehicle shall not be cracked, loose, sagging or broken.

(b) Bolts or brackets securing the cab or the body of the vehicle to the frame must not be loose, broken, or missing.

(c) The frame rail flanges between the axles shall not be bent, cut or notched, except as specified by the manufacturer.

(d) Parts and accessories shall not be welded to the frame or chassis of a commercial motor vehicle except in accordance with the vehicle manufacturer's recommendations. Any welded repair of the frame must also be in accordance with the vehicle manufacturer's recommendations.

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(e) No holes shall be drilled in the top or bottom rail flanges, except as specified by the manufacturer.

§393.203 Cab and body components.

(a) The cab compartment doors or door parts used as an entrance or exit shall not be missing or broken. Doors shall not sag so that they cannot be properly opened or closed. No door shall be wired shut or otherwise secured in the closed position so that it cannot be readily opened. Exception: When the vehicle is loaded with pipe or bar stock that blocks the door and the cab has a roof exit.

(b) Bolts or brackets securing the cab or the body of the vehicle to the frame shall not be loose, broken, or missing.

(c) The hood must be securely fastened.

(d) All seats must be securely mounted.

(e) The front bumper must not be missing, loosely attached, or protruding beyond the confines of the vehicle so as to create a hazard.

§393.205 Wheels.

(a) Wheels and rims shall not be cracked or broken.

(b) Stud or bolt holes on the wheels shall not be elongated (out of round).

(c) Nuts or bolts shall not be missing or loose.

§393.207 Suspension systems.

(a) **Axles.** No axle positioning part shall be cracked, broken, loose or missing. All axles must be in proper alignment.

(b) **Adjustable axles.** Adjustable axle assemblies shall not have locking pins missing or disengaged.

(c) **Leaf springs.** No leaf spring shall be cracked, broken, or missing nor shifted out of position.

(d) **Coil springs.** No coil spring shall be cracked or broken.

(e) **Torsion bar.** No torsion bar or torsion bar suspension shall be cracked or broken.

(f) **Air Suspensions.** The air pressure regulator valve shall not allow air into the suspension system until at least 55 psi is in the braking system. The vehicle shall be level (not tilting to the left or right). Air leakage shall not be greater than 3 psi in a 5-minute time period when the vehicle's air pressure gauge shows normal operating pressure.

(g) **Air suspension exhaust controls.** The air suspension exhaust controls must not have the capability to exhaust air from the suspension system of one axle of a two-axle air suspension trailer unless the controls are either located on the trailer, or the power unit and trailer combination are not capable of traveling at a speed greater than 10 miles per hour while the air is exhausted from the suspension system. This paragraph shall not be construed to prohibit—

(1) Devices that could exhaust air from both axle systems simultaneously; or

(2) Lift axles on multi-axle units.

§393.209 Steering wheel systems.

(a) The steering wheel shall be secured and must not have any spokes cracked through or missing.

(b) **Steering wheel lash.** (1) The steering wheel lash shall not exceed the following parameters:

Steering wheel diameter	Manual steering system	Power steering system
406 mm or less (16 inches or less)	51 mm (2 inches)	108 mm (4 ¼ inches)
457 mm (18 inches)...	57 mm (2 ¼ inches)	121 mm (4 ¾ inches)
483 mm (19 inches)...	60 mm (2 ⅜ inches)	127 mm (5 inches)
508 mm (20 inches)...	64 mm (2 ½ inches)	133 mm (5 ¼ inches)
533 mm (21 inches)...	67 mm (2 ⅝ inches)	140 mm (5 ½ inches)
559 mm (22 inches)...	70 mm (2 ¾ inches)	146 mm (5 ¾ inches)

(2) For steering wheel diameters not listed in paragraph (b)(1) of this section the steering wheel lash shall not exceed 14 degrees angular rotation for manual steering systems, and 30 degrees angular rotation for power steering systems.

(c) **Steering column.** The steering column must be securely fastened.

(d) **Steering system.** Universal joints and ball-and-socket joints shall not be worn, faulty or repaired by welding. The steering gear box shall not have loose or missing mounting bolts or cracks in the gear box or mounting brackets. The pitman arm on the steering gear output shaft shall not be loose. Steering wheels shall turn freely through the limit of travel in both directions.

(e) **Power steering systems.** All components of the power system must be in operating condition. No parts shall be loose or broken. Belts shall not be frayed, cracked or slipping. The system shall not leak. The power steering system shall have sufficient fluid in the reservoir.

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Interpretations to Part 393 — Parts and accessories necessary for safe operation

Sections Interpreted

- 393.11 Lighting Devices and Reflectors
- 393.17 Lamps and Reflectors-Combinations in Driveaway-Towaway Operation
- 393.24 Requirements for Head Lamps and Auxiliary Road Lighting Lamps
- 393.25 Requirements for Lamps Other Than Head Lamps
- 393.28 Wiring To Be Protected
- 393.31 Overload Protective Devices
- 393.40 Required Brake Systems
- 393.41 Parking Brake Systems
- 393.42 Brakes Required on All Wheels
- 393.43 Breakaway and Emergency Braking System
- 393.44 Front Brake Lines, Protection
- 393.48 Brakes To Be Operative
- 393.49 Single Valve To Operate All Brakes
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- 393.71 Coupling Devices and Towing Methods, Driveaway-Towaway Operations
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- 393.100 General Rules for Protection Against Shifting or Falling Cargo
- 393.102 Securement Systems
- 393.106 Front-end Structure
- 393.130 What are the Rules for Securing Heavy Vehicles, Equipment and Machinery?
- 393.201 Frames
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§393.11 Lighting Devices and Reflectors

Question 1: What is the definition of “body” with respect to trucks and trailers?

Guidance: The FMCSRs do not include a definition of “body.” However, a truck or trailer body generally means the structure or fixture designed to contain, or support, the material or property to be transported on the vehicle.

Question 2: May retroreflective tape be used in place of side reflex reflectors?

Guidance: §393.26(b) cross references FMVSS 108 (49 CFR 571.108, S5.1.1.4) which allows reflective material to be used for side reflex reflectors under the conditions described below. Retro-reflective tape conforming to Federal specification L-S-300, “Sheeting and Tape, Reflective; Non-exposed Lens, Adhesive Backing,” September 7, 1965, may be used in place of side *reflex reflectors* if this material as used on the vehicle, meets the performance standards in either Table I or Table IA of Society of Automotive Engineers J594f, Reflex Reflectors, January 1977.

Question 3: §393.11, Footnote 5, requires that each converter dolly be equipped with turn signals at the rear if the converter dolly obscures the turn signals at the rear of the towing vehicle when towed singly by another vehicle. Are turn signals required on the rear of the converter dolly when the towing of the unladen dolly prevents other motorists from seeing only a portion of the lenses of the turn signals on the towing vehicle?

Guidance: Yes. Although a portion of the rear turn signal lenses on the towing vehicle may be visible to other drivers, the turn signal generally would not satisfy the visibility requirements of FMVSS No. 108 (49 CFR 571.108) if the converter dolly prevents other motorists from seeing the entire lens. The visibility requirements of FMVSS No. 108 help to ensure that other drivers can see the turn signal from a range of positions to the rear of the vehicle. Therefore, turn signals on the towing vehicle are considered to be obscured by the converter dolly if other motorists’ view of the lens is even partially blocked.

Question 4: Does a CMV equipped with amber tail lamps in addition to the red tail lamps required to designate the rear of a CMV meet the lighting requirements of §393.11?

Guidance: No. §393.11 requires that lighting devices on CMVs placed in operation after March 7, 1989, meet the requirements of FMVSS No. 108 in effect at the time of manufacture. The NHTSA has issued interpretations which indicate that the use of amber tail lamps impairs the effectiveness of the required lighting equipment and as such is prohibited by FMVSS No. 108 (S5.1.3). Since NHTSA does not allow vehicle manufacturers to install amber tail lamps, the FHWA has concluded that the use of amber tail lamps on vehicles placed in operation after March 7, 1989, is prohibited by §393.11.

In the case of vehicles placed in operation on or before March 7, 1989, §393.11 requires that vehicles meet *either* the lighting requirements of part 393 or FMVSS No. 108 in effect at the time of manufacture. Prior to the December 7, 1988, final rule on part 393 (53 FR 49397), amber tail lamps were prohibited by §393.25.

§393.25(e)(3) (in the October 1, 1988 edition of the Code of Federal Regulations) required all rear lamps, with certain exceptions, to be red. Since tail lamps were not included in the exceptions, the use of amber tail lamps was implicitly prohibited. Therefore, a vehicle placed in operation on or before March 7, 1989, must not be equipped with amber tail lamps because the use of such lamps meets *neither* the lighting requirements of part 393 *nor* FMVSS No. 108 in effect at the time of manufacture.

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§393.17 Lamps and Reflectors-Combinations in Driveaway-Towaway Operation

Question 1: What are the lighting requirements when a tow truck is pulling a wrecked or disabled vehicle?

Guidance: A wrecker pulling a vehicle would be considered a driveaway-towaway operation and would have to be equipped with the lighting devices specified in §393.17 when operating in interstate commerce.

§393.24 Requirements for Head Lamps and Auxiliary Road Lighting Lamps

Question 1: Must additional lamps that are not required be operative if all required lamps are operative?

Guidance: No.

§393.25 Requirements for Lamps Other Than Head Lamps

Question 1: Are lighting devices on mobile homes/house trailers required to be permanently mounted?

Guidance: No. The movement of mobile homes/house trailers is considered to be a driveaway-towaway operation.

Question 2: Are there any special lighting requirements for large containers?

Guidance: No.

Question 3: What are the lighting requirements when a container assumes the structural requirements of a trailer?

Guidance: All relevant requirements of the regulations must be met by this container/trailer.

§393.28 Wiring to be Protected

Question 1: Does a frame channel of a CMV constitute a protective “sheath or tube” as specified in §393.28?

Guidance: No. To be acceptable, a sheath or tube must enclose the wires throughout their circumference. In the absence of a sheath or tube, the group of wires must be protected by nonconductive tape, braid, or other covering capable of withstanding severe abrasion.

§393.31 Overload Protective Devices

Question 1: Must all trailers be equipped with overload protective devices?

Guidance: No. Trailers do not need overload protective devices when protection of trailer circuits is provided on the towing vehicle. A circuit breaker is required only when the head lamp circuit is protected in common with one or more other circuits. A circuit breaker, if required, must be an automatic reset type.

§393.40 Required Brake Systems

Question 1: May a system such as “driveline brakes” be used as an emergency brake provided it complies with the requirements of §393.52?

Guidance: Yes. CMVs which were not subject to the emergency brake requirements of FMVSS Nos. 105 or 121 may use “drive line brakes” provided those vehicles meet the requirements of §393.52.

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§393.41 Parking Brake Systems

Question 1: May the “park” position of a CMV’s transmission be used as a parking brake to comply with the §393.41?

Guidance: No. The “park” position of the transmission is only a locking device used to lock the transmission.

Question 2: Does §393.41 prohibit air brake systems from being equipped with a means to release the spring brakes for purposes of towing disabled vehicles in emergency situations?

Guidance: No, provided the brakes are designed and maintained so they cannot be released unless adequate energy is available to make immediate reapplication of the brakes when the brake system is operable.

Question 3: Are parking brakes required on every CMV manufactured before March 7, 1990?

Guidance: No.

§393.42 Brakes Required on all Wheels

Question 1: Do retractable or lift axles have to be equipped with brakes?

Guidance: Yes, when the wheels are in contact with the roadway.

Question 2: Are unladen converter dollies covered by the exemption in §393.42(b)(3)?

Guidance: Yes. However, if the converter dolly is laden, the brakes must be operable.

Question 3: §393.42(b)(3) of the FMCSRs states that any full trailer, any semi-trailer, or any pole trailer having a GVWR of 3,000 pounds or less must be equipped with brakes if the weight of the towed vehicle resting on the towing vehicle exceeds 40 percent of the GVWR of the towing vehicle. Is the manufacturer of the trailer responsible for ensuring that the trailer is equipped with brakes when required?

Guidance: No. The motor carrier pulling the trailer is responsible for ensuring that the trailer is in compliance with all applicable FMCSRs.

§393.43 Breakaway and Emergency Braking System

Question 1: Are tractor protection valves required by §393.43(b), or may similar devices be used?

Guidance: No. Similar devices may be used provided the devices meet the performance requirements of §393.43(b).

Question 2: Are all brakes on a trailer required to be applied automatically upon breakaway?

Guidance: Yes.

§393.44 Front Brake Lines, Protection

Question 1: Does the term “rear wheels” include the tag axle on a bus/motorcoach?

Guidance: Yes. The braking system on a bus/motorcoach must be constructed so that if any brake line to either front wheel is broken, the driver can apply the brakes to all of the wheels on each rear axle.

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§393.48 Brakes to be Operative

Question 1: If a CMV manufactured on or after July 25, 1980 (see §393.42) has brake components on the front axle, and the brakes are not operable, does the vehicle comply with §393.48?

Guidance: No.

Question 2: If a truck or truck tractor manufactured prior to July 25, 1980, and having 3 or more axles, has inoperable brakes on the front axle or some of the brake components are missing, would the vehicle be in violation of §393.48?

Guidance: Yes. §393.48(a) requires that all brakes with which the vehicle is equipped must be operable at all times. Although §393.42(b)(1) provides an exception to the requirement for brakes on all wheels for trucks and truck tractors with 3 or more axles and manufactured prior to July 25, 1980, the exception does not affect the applicability of §393.48 for those cases in which the vehicle is equipped with inoperable front wheel brakes or only has certain portions of the front wheel brake system (e.g., shoes, linings, chambers, hoses) in place.

Question 3: Are the brakes on a vehicle towed in a driveaway-towaway operation or towed disabled vehicle required to be operable at all times?

Guidance: §393.48(c) provides an exception to the requirement that brakes be operable at all times. This exception covers disabled vehicles being towed and vehicles towed in driveaway-towaway operation.

The driveaway-towaway exception in §393.48(c) is contingent upon the conditions outlined in §393.42(b)(2). Towed vehicles must have brakes as may be necessary to ensure compliance with the performance requirements of §393.52. A motor vehicle towed by means of a tow-bar when any other vehicle is full-mounted on the towed vehicle, or any combination of motor vehicles utilizing 3 or more saddle-mounts, would not be covered under the exception found at §393.48(c).

With regard to the disabled-vehicle provision of §393.48(c)(1), the combination vehicle would have to meet the applicable performance requirements of §393.52.

§393.51 Warning Devices and Gauges

Question 1: Is the low pressure warning device required to activate before the tractor protection valve?

Guidance: No. §393.51 does not explicitly require the warning device to operate before the protection valve. It is implied that if the operating pressure of the warning device is at least ½ of the governor cut-out pressure, and that pressure is not less than the pressure at which the protection valve (or similar device) activates, the requirements of §393.51 are satisfied.

Question 2: Is the vacuum portion of vacuum-assisted hydraulic brake systems required to have a warning device?

Guidance: No. Only the hydraulic portion of vacuum-assisted hydraulic brake systems is required to have a warning device. FMVSS No. 105 does not require a warning device for the vacuum portion of the vacuum-assisted hydraulic brake systems. It is the intention of the FHWA that §393.51 be consistent with FMVSS No. 105.

Question 3: Are vacuum gauges required on the vacuum portion of vacuum-assisted hydraulic brakes?

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Guidance: No. §393.51(d)(2) requires only that CMVs with vacuum brakes (not hydraulic brakes applied or assisted by vacuum) be equipped with a vacuum gauge.

Question 4: Is a warning device required in a CMV with a single hydraulic brake system which uses the driveline parking brake as the emergency brake system?

Guidance: No. Warning devices are not required on such CMVs because the driver will be given ample warning of system failure by the movement and feel of the brake pedal.

Question 5: What difference, if any, is there between a warning device and a warning signal?

Guidance: For purposes of §393.51, the terms may be used interchangeably.

§393.52 Brake Performance

Question 1: May the information in the stopping distance table be used to determine the stopping distances at speeds greater than 20 mph?

Guidance: No, the table is not intended to be used to predict or determine stopping distances at speeds greater than 20 mph.

§393.60 Glazing in Specified Openings

Question 1: May windshields and side windows be tinted?

Guidance: Yes, as long as the light transmission is not restricted to less than 70 percent of normal (refer to the American Standards Association publication Z26.1-1966 and Z26.1a-1969).

Question 2: May a decal designed to comply with the periodic inspection documentation requirements of §396.17 be displayed on the windshields or side windows of a CMV?

Guidance: Yes, provided the decal is being used in lieu of an inspection report and is in compliance with §393.60(c).

Question 3: If a crack extended into the thickness of the glass at such an angle as to measure ¼" or more, measuring from the top edge of the crack on the outside surface of the windshield to vertical line drawn through the windshield to the far edge of this angled crack on the inside of the windshield, would this constitute a crack of ¼" or more in width as defined in §393.60(b)(2)?

Guidance: No. The crack, in order to fall outside the exception, would have to be a gap of ¼" or more on the same surface of the windshield.

§393.61 Window Construction

Question 1: Do school buses used for purposes other than school bus operations (as defined in §390.5), have to meet additional emergency exits requirements under §393.61?

Guidance: Yes. §393.61(b)(2) says that "a bus, including a school bus, manufactured on and after September 1, 1973," must conform with NHTSA's §571.217 (FMVSS 217). At the time this provision was adopted, FMVSS 217 applied only to other buses and it was optional for school buses. The FHWA inserted the language, "including school buses," in §393.61(b)(2) to make clear that school buses used in interstate commerce and, therefore, subject to the FMCSRs, were required to comply with the bus exit standards in Standard FMVSS 217.

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Sec. 393.61(b)(3) regarding push-out windows provides that older buses must conform with the requirements of §§393.61(b) or 571.217. Buses which are subject to §571.217 would follow NHTSA's interpretation on push-out windows. Buses which are subject to §393.61(b)(1) of the FMCSRs are required to have emergency windows that are either push-out windows or that have laminated safety glass that can be pushed out in a manner similar to a push-out window.

Question 2: For emergency exits which consist of laminated safety glass, is the window frame or sash required to move outward from the bus as is the case with push-out windows?

Guidance: No. Laminated safety glass is an alternative to the use of push-out windows for buses manufactured before September 1, 1973. §393.61(c) requires that every glazed opening used to satisfy the emergency exit space requirements, "if not glazed with laminated safety glass, shall have a frame or sash so designed, constructed, and maintained that it will yield outwardly to provide the required free opening. * * *" Laminated safety glass meeting Test No. 25, Egress, American National Standard "Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways," Z26.1-1966 as supplemented by Z26.1a-1969 (referenced in §§393.61(c) and 393.60(a)) is intended to provide an adequate means of emergency exit on older buses without resorting to push-out windows.

However, buses with a seating capacity of more than 10 people manufactured after September 1, 1973, must have push-out windows that conform to 49 CFR 571.217

Question 3: When calculating the minimum emergency exit space required on school buses used in non-school bus operations, should two or three passengers per bench seat be used in determining the adult seating capacity?

Guidance: The NHTSA has indicated that "School buses can transport 3 to a seat if the passengers are in grades 1 through 5, and 2 per seat in grades 9 through 12." (May 9, 1995, 60 FR 24562, 24567) Therefore, for vehicles originally manufactured as school buses, the total pupil seating capacity provided by the bus manufacturer should be multiplied by $\frac{2}{3}$ to determine the adult seating capacity for the purposes of §393.61. This generally yields the same result as using two adults per bench seat.

Question 4: Do school buses which meet the school bus emergency exit requirements established by the NHTSA's November 2, 1992, final rule on FMVSS No. 217 have to be retrofitted with additional emergency exits when used in interstate commerce for non-school bus operations?

Guidance: No. On May 9, 1995, the NHTSA amended FMVSS No. 217 to permit non-school buses to meet either the current non-school bus emergency exit requirements or the upgraded school bus exit requirements established by the November 2, 1992 (57 FR 49413), final rule which became effective on September 1, 1994. Therefore, school buses which meet the upgraded emergency exit standards meet the requirements of §393.61 without the retrofitting of additional exits.

Question 5: Which edition of FMVSS No. 217 is required to be used in determining the emergency exit space requirements when retrofitting buses?

Guidance: The cross reference to FMVSS No. 217 applies to the requirements in effect at the time of manufacture of the bus. Motor carriers are not, however, prohibited from retrofitting their buses to the most up-to-date requirements in FMVSS No. 217. Therefore, at a minimum, motor carriers must meet the non-school bus emergency exit requirements in effect at the time of manufacture, and

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have the option of retrofitting their buses to meet the emergency exit requirements established by the November 2, 1992 (57 FR 49413), final rule which became effective on September 1, 1994.

§393.62 Window Obstructions

Question 1: May a bus being operated by a for-hire motor carrier of passengers, under contract with a governmental agency to provide transportation of prisoners in interstate commerce, be allowed to operate with security bars covering the emergency push-out windows and with locked emergency door exits?

Guidance: Yes. Even when the transportation is performed by a contract carrier, the welfare, safety, and security of the prisoners is under the authority of the governmental corrections agency and, thus, the agency may require additional security measures. For these types of operations, a carrier may meet the special security requirements of the governmental corrections agency regarding emergency exits. However, CMVs that have been modified to meet the security requirements of the corrections agency may not be used for other purposes that are subject to the FMCSRs unless they meet the emergency exit requirements.

§393.65 All Fuel Systems

Question 1: May a fuel fill pipe opening be placed above the passenger floor level if it is not physically within the passenger compartment?

Guidance: Yes. In addition, the fill pipe may intrude into the passenger compartment as long as the fill pipe opening complies with §393.65(b)(4), and the fill pipe is protected by a housing or covering to prevent leakage of fuel or fumes into the passenger compartment.

Question 2: Must a motor vehicle that meets the definition of a “commercial motor vehicle” in §390.5 because it transports hazardous materials in a quantity requiring placarding under the Hazardous Materials Regulations (49 CFR parts 171-180) comply with the fuel system requirements of Subpart E of Part 393, even though it has a gross vehicle weight rating (GVWR) of 10,000 pounds or less?

Guidance: No. FMVSS No.301 contains fuel system integrity requirements for passenger cars and multipurpose passenger vehicles, trucks, and buses that have a GVWR of 10,000 pounds or less and use fuel with a boiling point above 0 deg. Celsius (32 deg. Fahrenheit). Subpart E of part 393 was issued to provide fuel system requirements to cover motor vehicles with a GVWR of 10,001 or more pounds. The fuel systems of placarded motor vehicles with a GVWR of less than 10,001 pounds are adequately addressed by FMVSS No. 301 and compliance with subpart E of part 393 would be redundant. However, commercial motor vehicles that are not covered by FMVSS No. 301 must continue to comply with subpart E of part 393.

§393.67 Liquid Fuel Tanks

Question 1: May a properly vented fuel cap be used on a fuel tank equipped with another fuel venting system?

Guidance: Yes (see §393.3).

Question 2: Do the FMCSRs specify a particular pressure relief system?

Guidance: No, but the performance standards of §393.67(d) must be met.

Question 3: What standards under the FMCSRs must be met when a liquid fuel tank is repaired or replaced?

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Guidance: A replacement/repaired tank must meet the applicable standards in §393.67.

§393.70 Coupling Devices and Towing Methods, Except for Driveaway-Towaway Operations

Question 1: Is there a minimum number of fasteners required to fasten the upper fifth wheel plate to the frame of a trailer?

Guidance: The FMCSRs do not specify a minimum number of fasteners. However, the industry recommends that a minimum of ten $\frac{5}{8}$ inch bolts be used. If $\frac{1}{2}$ inch bolts are used, the industry recommends at least 14 bolts. The CVSA has adopted these industry standards as a part of its vehicle out-of-service criteria.

Question 2: When two safety chains are used, must the ultimate combined breaking strength of each chain be equal to the gross weight of the towed vehicle(s) or would the requirements be met if the combined breaking strength of the two chains is equal to the gross weight of the towed vehicle(s)?

Guidance: If the ultimate combined breaking strength of the two chains is equal to the gross weight of the towed vehicle(s), the requirements of §393.70(d) are satisfied. It should be noted that some States may have more stringent requirements for safety chains.

Question 3: §393.70(d) requires that every full trailer must be coupled to the frame, or an extension of the frame, of the motor vehicle which tows it with one or more safety devices to prevent the towed vehicle from breaking loose in the event the tow-bar fails or becomes disconnected. The safety device must be connected to the towed and towing vehicles and to the tow-bar in a manner which prevents the tow-bar from dropping to the ground in the event it fails or becomes disconnected. Would the use of a pair of safety chains/cables between the towing vehicle and the front of a fixed-length draw bar, or an extendible draw bar, with a separate pair of safety chains/cables between the end of the draw bar and the front of the towed vehicle meet the requirements of §393.70(d)?

Guidance: Generally, separate safety devices at the front and rear of the draw bar could be used to satisfy the requirements of §393.70(d) provided the safety devices are attached to the draw-bar and the vehicles in a manner that prevents the drawbar from dropping to the ground in the event that it fails or becomes disconnected. Also, the arrangement of the safety device(s) must be such that the vehicles will not separate if the draw bar fails or becomes disconnected.

If the drawbar design is such that bolts, connecting pins, etc., are used to connect structural members of the drawbar, and are located at or near the midpoint of the drawbar (beyond the attachment points for the safety chain at the ends of the draw bar) the safety devices would have to extend from either the frame of the towed or towing vehicle to a point beyond the bolts, connecting pins or similar devices.

In the case of an extendible draw bar or reach, if a separate safety device(s) is used for the front and rear of the drawbar, a means must be provided to ensure that the draw bar will not separate at the movable portion of the drawbar. The use of welded tube stops would satisfy the intent of §393.70(d) if the ultimate strength of the welds exceeds the impact forces associated with the drawbar extending suddenly with a fully loaded trailer attached.

§393.71 Coupling Devices and Towing Methods, Driveaway-Towaway Operations

Question 1: May a fifth wheel be considered as a coupling device when towing a semi-trailer in a driveaway-towaway operation?

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Guidance: Yes. §393.71(g) requires the use of a tow-bar or a saddle-mount. Since a saddle-mount performs the function of a conventional fifth wheel, the use of a fifth wheel is consistent with the requirements of this section.

§393.75 Tires

Question 1: If a CMV has a defective tire, may the driver remove the defective tire from the axle and drive with three tires on an axle instead of four?

Guidance: Yes, provided the weight on all of the remaining tires does not exceed the maximum allowed under §393.75(f).

Question 2: May a CMV be operated with tires that carry a greater weight than the weight marked on the side wall of the tires?

Guidance: Yes, but only if the CMV is being operated under the terms of a State-issued special permit, and at a reduced speed that is appropriate to compensate for tire loading in excess of the rated capacity.

Question 3: May a vehicle transport HM when equipped with retreaded tires?

Guidance: Yes. The only CMV that may not utilize retreaded tires is a bus, and then only on its front wheels.

Question 4: May tires be filled with materials other than air (e.g., silicone, polyurethane)?

Guidance: §393.75 does not prohibit the use of tires filled with material other than air. However, §393.3 may prohibit the use of such tires under certain circumstances. Some substances used in place of air in tires may not maintain a constant physical state at different temperatures. While these substances are solid at lower temperatures, the increase in temperature from highway use may result in the substance changing from a solid to a liquid. The use of a substance which could undergo such a change in its physical characteristics is not safe, and is not in compliance with §393.3.

§393.76 Sleeper Berths

Question 1: If a compartment in a CMV is no longer used as a sleeper berth, must it be maintained and equipped as a sleeper berth as required in §393.76?

Guidance: No.

§393.78 Windshield Wipers

Question 1: Are windshield washer systems required?

Guidance: No, only windshield wipers are required.

§393.81 Horn

Question 1: Do the FMCSRs specify what type of horn is to be used on a CMV?

Guidance: No.

Question 2: Are there established criteria in the FMCSRs to determine the minimum sound level of horns on CMVs?

Guidance: No.

§393.82 Speedometer

Question 1: What does the phrase “reasonable accuracy” mean?

Guidance: “Reasonable accuracy” is interpreted to mean accuracy to within plus or minus 5 mph at a speed of 50 mph.

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§393.83 Exhaust System

Question 1: Is a heat shield mandatory on a vertical exhaust stack?

Guidance: No. However, §393.83 requires the placement of the exhaust system in such a manner as to prevent the burning, charring, or damaging of the electrical wiring, the fuel supply, or any combustible part of the CMV.

Question 2: Does §393.83 specify the type of exhaust system, vertical or horizontal, to be used on trucks or truck tractors?

Guidance: No.

§393.87 Flags on Projecting Loads

Question 1: May a triangular-shaped flag or device be used by itself to mark an oversized load?

Guidance: No. However, nothing prohibits using a triangular-shaped flag in conjunction with the prescribed flag.

§393.88 Television Receivers

Question 1: Does §393.88 restrict the use of closed circuit monitor devices being used as a safety viewing system that would eliminate blind-side motor carrier accidents?

Guidance: No. The restriction of this section would not apply because the device cannot receive television broadcasts or be used for the viewing of video tapes.

§393.89 Buses, Drive Shaft Protection

Question 1: For the purposes of §393.89, would a spline and yoke that is secured by a nut be considered a sliding connection?

Guidance: No. To be considered a sliding connection, the spline must be able to move within the sleeve. When the end of the spline is secured by a nut, it no longer has that freedom.

Question 2: On multiple drive shaft buses, does §393.89 require that all segments of the drive shaft be protected no matter the segments' length?

Guidance: Yes. Each drive shaft must have one guard or bracket for each end of a shaft which is provided with a sliding connection (spline or other such device).

Question 3: How does an existing pillow bearing (shaft support) on a multiple driveshaft system affect the requirement?

Guidance: It does not affect the requirement. It is part of the requirement.

§393.92 Buses, Marking Emergency Doors

Question 1: Is a contractor-operated school bus operating in interstate commerce required to have emergency lights over the exit door?

Guidance: Yes. Any bus used in interstate commerce for other than school bus operations, as defined in §390.5, is subject to the FMCSRs.

§393.93 Seats, Seat Belt Assemblies, and Seat Belt Assembly Anchorages

Question 1: If a CMV, other than a motor coach, is equipped with a passenger seat, is a seat belt required for the passenger seat?

Guidance: Yes.

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§393.95 Emergency equipment on all power units

Question 1: Are pressure gauges the only acceptable means for a visual determination that a fire extinguisher is fully charged?

Guidance: No, as long as there is some means to permit a visual determination that a fire extinguisher is fully charged.

§393.100 General rules for protection against shifting or falling cargo

Question 1: When securing cargo, is the use of a tiedown every 10 linear feet, or fraction thereof, adequate?

Guidance: Yes, as long as the aggregate strength of the tie-downs is equal to the requirements of §393.102, and each article is secured.

Question 2: [Removed and reserved]

Question 3: Are the requirements of §393.100 the only cargo securement requirements motor carriers must comply with?

Guidance: No. A motor carrier, when transporting cargo, must comply with all the applicable cargo securement requirements of subpart I and §392.9.

Question 4: Do the rules for protection against shifting or falling cargo apply to CMVs with enclosed cargo areas?

Guidance: Yes. All CMVs transporting cargo must comply with the applicable provisions of §§393.100-393.106(subpart I) to prevent the shifting or falling of cargo aboard the vehicle.

Question 5: [Removed and reserved]

Question 6: [Removed and reserved]

§393.102 Securement systems

Question 1: Does §393.102(b) prohibit the use of securement devices for which manufacturing standards have not been incorporated by reference?

Guidance: §393.102(b) requires that chain, wire rope, synthetic webbing, cordage, and steel strapping meet minimum manufacturing standards. It does not, however, prohibit the use of other types of securement devices or establish manufacturing standards for those devices. Therefore, if the securement device(s) has an aggregate working load limit of at least ½ the weight of the article, and the load is secured to prevent it from shifting or falling from the vehicle, §§393.100 and 393.102(b) would be satisfied.

If the cargo is not firmly braced against a front-end structure that conforms to the requirements of §393.106, the securement system would have to provide protection against longitudinal movement [§393.104(a)]. If the load may shift sideways in transit then §393.104(b) would also be applicable.

Question 2: Does §393.102(b) require that securement devices be marked or labeled with their working load limit or any other information?

Guidance: No. Although §393.102(b) requires chain, wire rope, synthetic webbing, cordage, and steel strapping tiedowns to meet applicable manufacturing standards, it explicitly excludes marking identification provisions of those manufacturing standards. Since §393.102(b) does not establish manufacturing standards or marking requirements for other types of securement devices, such devices are not required to be marked with their working load limit.

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§393.106 Front-end structure

Question 1: When describing a headerboard or cab protection device, the regulations state that similar devices may be used. What is meant by the term “similar devices”?

Guidance: The term “similar devices” has reference to devices equivalent in strength and function, though not necessarily in appearance and construction, to headerboards.

§393.130 What are the rules for securing heavy vehicles, equipment and machinery?

***Question 1:** If an item of construction equipment which weighs less than 4,536 kg (10,000 lb.) is transported on a flatbed or drop-deck trailer, must the accessory equipment be lowered to the deck of the trailer?

Guidance: No. However, the accessory equipment must be properly secured using locking pins or similar devices in order to prevent either the accessory equipment or the item of construction equipment itself from shifting during transport.

***Question 2:** How should I secure the accessories for an item of construction equipment which weighs 4,536 kg (10,000 lb.) or more, if the accessory devices would extend beyond the width of the trailer if they are lowered to the deck for transport?

Guidance: The accessory devices (plows, trencher bars, and the like) may be transported in a raised position, provided they are designed to be transported in that manner. However, the accessory equipment must be locked in place for transport to ensure that neither the accessories nor the equipment itself shifts during transport.

***Question 3:** A tractor loader-backhoe weighing over 10,000 pounds is being transported on a trailer. The loader and backhoe accessories are each equipped with locking devices or mechanisms that prevent them from moving up and down and from side-to-side while the construction equipment is being transported on the trailer. Must these accessories also be secured to the trailer with chains?

Guidance: No. However, if the construction equipment does not have a means of preventing the loader bucket, backhoe, or similar accessories from moving while it is being transported on the trailer, then a chain would be required to secure those accessories to the trailer.

***Editor’s Note:** This interpretation was issued after the interpretations were published in the *Federal Register* in April 1997.

§393.201 Frames

Question 1: Are cross members of CMVs considered part of the frame?

Guidance: Yes.

Special topics — CMV parts and accessories

Question 1: Do tires marked “NHS” (not for highway service) mean that highway use is prohibited by §393.75?

Guidance: No, provided the use of such tires does not decrease the safety of operations (see Periodic Inspection Requirements, Appendix G to subpart B).

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Part 396—Inspection, repair, and maintenance

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§396.1 Scope.

(a) Every motor carrier, its officers, drivers, agents, representatives, and employees directly concerned with the inspection or maintenance of commercial motor vehicles must be knowledgeable of and comply with the rules of this part.

(b) Every intermodal equipment provider, its officers, agents, representatives, and employees directly concerned with the inspection or maintenance of intermodal equipment interchanged or offered for interchange to motor carriers must be knowledgeable of and comply with the rules of this part.

(c) This part does not apply to “covered farm vehicles,” as defined in 49 CFR 390.5, or to the drivers of such vehicles.

§396.3 Inspection, repair and maintenance.

(a) **General.** Every motor carrier and intermodal equipment provider must systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles and intermodal equipment subject to its control.

(1) Parts and accessories shall be in safe and proper operating condition at all times. These include those specified in Part 393 of this subchapter and any additional parts and accessories which may affect safety of operation, including but not limited to, frame and frame assemblies, suspension systems, axles and attaching parts, wheels and rims, and steering systems.

(2) Pushout windows, emergency doors, and emergency door marking lights in buses shall be inspected at least every 90 days.

(b) **Required records.** Motor carriers, except for a private motor carrier of passengers (nonbusiness), must maintain, or cause to be maintained, records for each motor vehicle they control for 30 consecutive days. Intermodal equipment providers must maintain or cause to be maintained, records for each unit of intermodal

equipment they tender or intend to tender to a motor carrier. These records must include:

(1) An identification of the vehicle including company number, if so marked, make, serial number, year, and tire size. In addition, if the motor vehicle is not owned by the motor carrier, the record shall identify the name of the person furnishing the vehicle;

(2) A means to indicate the nature and due date of the various inspection and maintenance operations to be performed;

(3) A record of inspection, repairs and maintenance indicating their date and nature; and

(4) A record of tests conducted on pushout windows, emergency doors, and emergency door marking lights on buses.

(c) **Record retention**—The records required by this section shall be retained where the vehicle is either housed or maintained for a period of 1 year and for 6 months after the motor vehicle leaves the motor carrier’s control.

§396.5 Lubrication.

Every motor carrier shall ensure that each motor vehicle subject to its control is—

(a) properly lubricated; and

(b) free of oil and grease leaks.

§396.7 Unsafe operations forbidden.

(a) **General**—A motor vehicle shall not be operated in such a condition as to likely cause an accident or a breakdown of the vehicle.

(b) **Exemption**—Any motor vehicle discovered to be in an unsafe condition while being operated on the highway may be continued in operation only to the nearest place where repairs can safely be effected. Such operation shall be conducted only if it is less hazardous to the public than to permit the vehicle to remain on the highway.

§396.9 Inspection of motor vehicles and intermodal equipment in operation.

(a) Personnel authorized to perform inspections—Every special agent of the FMCSA (as defined in Appendix B to this subchapter) is authorized to enter upon and perform inspections of a motor carrier’s vehicles in operation and intermodal equipment in operation.

(b) Prescribed inspection report—The Driver Vehicle Examination Report shall be used to record results of motor vehicle inspections and results of intermodal equipment inspections conducted by authorized FMCSA personnel.

(c) **Motor vehicles and intermodal equipment declared “out-of-service.”** (1) Authorized personnel shall declare and mark “out-of-service” any motor vehicle or intermodal equipment which by reason of its mechanical condition or loading would likely cause an accident or a breakdown. An “Out-of-Service Vehicle” sticker shall be used to mark vehicles and intermodal equipment “out-of-service.”

(2) No motor carrier or intermodal equipment provider shall require or permit any person to operate nor shall

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any person operate any motor vehicle or intermodal equipment declared and marked “out-of-service” until all repairs required by the “out-of-service notice” have been satisfactorily completed. The term *operate* as used in this section shall include towing the vehicle or intermodal equipment, except that vehicles or intermodal equipment marked “out-of-service” may be towed away by means of a vehicle using a crane or hoist. A vehicle combination consisting of an emergency towing vehicle and an “out-of-service” vehicle shall not be operated unless such combination meets the performance requirements of this subchapter except for those conditions noted on the Driver Vehicle Examination Report.

(3) No person shall remove the “Out-of-Service Vehicle” sticker from any motor vehicle or intermodal equipment prior to completion of all repairs required by the “out-of-service notice.”

(d) Motor carrier or intermodal equipment provider disposition.

(1) The driver of any motor vehicle, including a motor vehicle transporting intermodal equipment, who receives an inspection report shall deliver a copy to both the motor carrier operating the vehicle and the intermodal equipment provider upon his/her arrival at the next terminal or facility. If the driver is not scheduled to arrive at a terminal or facility of the motor carrier operating the vehicle or at a facility of the intermodal equipment provider within 24 hours, the driver shall immediately mail, fax, or otherwise transmit the report to the motor carrier and intermodal equipment provider.

(2) Motor carriers and intermodal equipment providers shall examine the report. Violations or defects noted thereon shall be corrected. Repairs of items of intermodal equipment placed out-of-service are also to be documented in the maintenance records for such equipment.

(3) Within 15 days following the date of the inspection, the motor carrier or intermodal equipment provider shall—

(i) Certify that all violations noted have been corrected by completing the “Signature of Carrier/Intermodal Equipment Provider Official, Title, and Date Signed” portions of the form; and

(ii) Return the completed roadside inspection form to the issuing agency at the address indicated on the form and retain a copy at the motor carrier’s principal place of business, at the intermodal equipment provider’s principal place of business, or where the vehicle is housed for 12 months from the date of the inspection.

§396.11 Driver vehicle inspection report(s).

(a) **Equipment provided by motor carrier.** (1) **Report required.** Every motor carrier shall require its drivers to report, and every driver shall prepare a report in writing at the completion of each day’s work on each vehicle operated, except for intermodal equipment tendered by an intermodal equipment provider. The report shall cover at least the following parts and accessories:

- (i) Service brakes including trailer brake connections;
- (ii) Parking brake;
- (iii) Steering mechanism;
- (iv) Lighting devices and reflectors;

- (v) Tires;
- (vi) Horn;
- (vii) Windshield wipers;
- (viii) Rear vision mirrors;
- (ix) Coupling devices;
- (x) Wheels and rims;
- (xi) Emergency equipment.

(2) **Report content.** The report shall identify the vehicle and list any defect or deficiency discovered by or reported to the driver which would affect the safety of operation of the vehicle or result in its mechanical breakdown. If no defect or deficiency is discovered by or reported to the driver, the report shall so indicate. In all instances, the driver shall sign the report. On two-driver operations, only one driver needs to sign the driver vehicle inspection report, provided both drivers agree as to the defects or deficiencies identified. If a driver operates more than one vehicle during the day, a report shall be prepared for each vehicle operated.

(3) **Corrective action.** (i) Prior to requiring or permitting a driver to operate a vehicle, every motor carrier or its agent shall repair any defect or deficiency listed on the driver vehicle inspection report which would be likely to affect the safety of operation of the vehicle.

(ii) Every motor carrier or its agent shall certify on the original driver vehicle inspection report which lists any defect or deficiency that the defect or deficiency has been repaired or that repair is unnecessary before the vehicle is operated again.

(4) **Retention period for reports.** Every motor carrier shall maintain the original driver vehicle inspection report, the certification of repairs, and the certification of the driver’s review for three months from the date the written report was prepared.

(5) **Exceptions.** The rules in this section shall not apply to a private motor carrier of passengers (nonbusiness), a driveaway-towaway operation, or any motor carrier operating only one commercial motor vehicle.

(b) **Equipment provided by intermodal equipment provider.** (1) **Report required.** Every intermodal equipment provider must have a process to receive driver reports of, and each driver or motor carrier transporting intermodal equipment must report to the intermodal equipment provider or its designated agent, any known damage, defects, or deficiencies in the intermodal equipment at the time the equipment is returned to the provider or the provider’s designated agent. The report must include, at a minimum, the following parts and accessories:

- (i) Brakes;
- (ii) Lighting devices, lamps, markers, and conspicuity marking material;
- (iii) Wheels, rims, lugs, tires;
- (iv) Air line connections, hoses, and couplers;
- (v) King pin upper coupling device;
- (vi) Rails or support frames;
- (vii) Tie down bolsters;
- (viii) Locking pins, clevises, clamps, or hooks;

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(ix) Sliders or sliding frame lock.

(2) **Report content.** (i) Name of the motor carrier responsible for the operation of the intermodal equipment at the time the damage, defects, or deficiencies were discovered by, or reported to, the driver.

(ii) Motor carrier's USDOT number; intermodal equipment provider's USDOT number, and a unique identifying number for the item of intermodal equipment.

(iii) Date and time the report was submitted.

(iv) All damage, defects, or deficiencies of the intermodal equipment reported to the equipment provider and discovered by, or reported to, the motor carrier or its driver which would

(A) Affect the safety of operation of the intermodal equipment, or

(B) Result in its mechanical breakdown while transported on public roads.

(v) The signature of the driver who prepared the report.

(3) **Corrective action.** (i) Prior to allowing or permitting a motor carrier to transport a piece of intermodal equipment for which a motor carrier or driver has submitted a report about damage, defects or deficiencies, each intermodal equipment provider or its agent must repair the reported damage, defects, or deficiencies that are likely to affect the safety of operation of the vehicle.

(ii) Each intermodal equipment provider or its agent must certify on the original driver's report which lists any damage, defects, or deficiencies of the intermodal equipment that the reported damage, defects, or deficiencies have been repaired, or that repair is unnecessary, before the vehicle is operated again.

(4) **Retention period for reports.** Each intermodal equipment provider must maintain all documentation required by this section, including the original driver report and the certification of repairs on all intermodal equipment, for a period of three months from the date that a motor carrier or its driver submits the report to the intermodal equipment provider or its agent.

(c) **Corrective action.** Prior to requiring or permitting a driver to operate a vehicle, every motor carrier or its agent shall repair any defect or deficiency listed on the driver vehicle inspection report which would be likely to affect the safety of operation of the vehicle.

(1) Every motor carrier or its agent shall certify on the original driver vehicle inspection report which lists any defect or deficiency that the defect or deficiency has been repaired or that repair is unnecessary before the vehicle is operated again.

(2) Every motor carrier shall maintain the original driver vehicle inspection report, the certification of repairs, and the certification of the driver's review for three months from the date the written report was prepared.

(d) **Exceptions.** The rules in this section shall not apply to a private motor carrier of passengers (nonbusiness), a driveaway-towaway operation, or any motor carrier operating only one commercial motor vehicle.

§396.12 Procedures for intermodal equipment providers to accept reports required by §390.42(b) of this chapter.

(a) **System for reports.** Each intermodal equipment provider must establish a system for motor carriers and drivers to report to it any damage, defects, or deficiencies of intermodal equipment discovered by, or reported to, the motor carrier or driver which would—

(1) Affect the safety of operation of the intermodal equipment, or

(2) Result in its mechanical breakdown while transported on public roads.

(b) **Report content.** The system required by paragraph (a) of this section must include documentation of all of the following:

(1) Name of the motor carrier responsible for the operation of the intermodal equipment at the time the damage, defects, or deficiencies were discovered by, or reported to, the driver.

(2) Motor carrier's USDOT number; intermodal equipment provider's USDOT number, and a unique identifying number for the item of intermodal equipment.

(3) Date and time the report was submitted.

(4) All damage, defects, or deficiencies of the intermodal equipment must be reported to the equipment provider by the motor carrier or its driver. If no defect or deficiency in the intermodal equipment is discovered by or reported to the driver, no written report is required.

(5) The signature of the driver who prepared the report.

(c) **Corrective action.** (1) Prior to allowing or permitting a motor carrier to transport a piece of intermodal equipment for which a motor carrier or driver has submitted a report about damage, defects or deficiencies, each intermodal equipment provider or its agent must repair the reported damage, defects, or deficiencies that are likely to affect the safety of operation of the vehicle.

(2) Each intermodal equipment provider or its agent must certify on the original driver's report which lists any damage, defects, or deficiencies of the intermodal equipment that the reported damage, defects, or deficiencies have been repaired, or that repair is unnecessary, before the vehicle is operated again.

(d) **Retention period for reports.** Each intermodal equipment provider must maintain all documentation required by this section, including the original driver report and the certification of repairs on all intermodal equipment, for a period of three months from the date that a motor carrier or its driver submits the report to the intermodal equipment provider or its agent.

§396.13 Driver inspection.

Before driving a motor vehicle, the driver shall:

(a) Be satisfied that the motor vehicle is in safe operating condition;

(b) Review the last driver vehicle inspection report; and

(c) Sign the report, only if defects or deficiencies were noted by the driver who prepared the report, to acknowledge that the driver has reviewed it and that there is a

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certification that the required repairs have been performed. The signature requirement does not apply to listed defects on a towed unit which is no longer part of the vehicle combination.

§396.15 Driveaway-towaway operations and inspections.

(a) **General.** Effective December 7, 1989, every motor carrier, with respect to motor vehicles engaged in driveaway-tow-away operations, shall comply with the requirements of this part. Exception: Maintenance records required by §396.3, the vehicle inspection report required by §396.11, and the periodic inspection required by §396.17 of this part shall not be required for any vehicle which is part of the shipment being delivered.

(b) **Pre-trip inspection.** Before the beginning of any driveaway-towaway operation of motor vehicles in combination, the motor carrier shall make a careful inspection and test to ascertain that:

(1) The tow-bar or saddle-mount connections are properly secured to the towed and towing vehicle;

(2) They function adequately without cramping or binding of any of the parts; and

(3) The towed motor vehicle follows substantially in the path of the towing vehicle without whipping or swerving.

(c) **Post-trip inspection.** Motor carriers shall maintain practices to ensure that following completion of any trip in driveaway-towaway operation of motor vehicles in combination, and before they are used again, the tow-bars and saddle-mounts are disassembled and inspected for worn, bent, cracked, broken, or missing parts. Before reuse, suitable repair or replacement shall be made of any defective parts and the devices shall be properly reassembled.

§396.17 Periodic inspection.

(a) Every commercial motor vehicle must be inspected as required by this section. The inspection must include, at a minimum, the parts and accessories set forth in appendix G of this subchapter. The term *commercial motor vehicle* includes each vehicle in a combination vehicle. For example, for a tractor semitrailer, full trailer combination, the tractor, semitrailer, and the full trailer (including the converter dolly if so equipped) must each be inspected.

(b) Except as provided in §396.23 and this paragraph, motor carriers must inspect or cause to be inspected all motor vehicles subject to their control. Intermodal equipment providers must inspect or cause to be inspected intermodal equipment that is interchanged or intended for interchange to motor carriers in intermodal transportation.

(c) A motor carrier must not use a commercial motor vehicle, and an intermodal equipment provider must not tender equipment to a motor carrier for interchange, unless each component identified in appendix G of this subchapter has passed an inspection in accordance with the terms of this section at least once during the preceding 12 months and documentation of such inspection is on the vehicle. The documentation may be:

(1) The inspection report prepared in accordance with §396.21(a), or

(2) Other forms of documentation, based on the inspection report (e.g., sticker or decal), which contains the following information:

(i) The date of inspection;

(ii) Name and address of the motor carrier, intermodal equipment provider, or other entity where the inspection report is maintained;

(iii) Information uniquely identifying the vehicle inspected if not clearly marked on the motor vehicle; and

(iv) A certification that the vehicle has passed an inspection in accordance with §396.17.

(d) A motor carrier may perform the required annual inspection for vehicles under the carrier's control which are not subject to an inspection under §396.23(b)(1). An intermodal equipment provider may perform the required annual inspection for intermodal equipment interchanged or intended for interchange to motor carriers that are not subject to an inspection under §396.23(b)(1).

(e) In lieu of the self-inspection provided for in paragraph (d) of this section, a motor carrier or intermodal equipment provider responsible for the inspection may choose to have a commercial garage, fleet leasing company, truck stop, or other similar commercial business perform the inspection as its agent, provided that business operates and maintains facilities appropriate for commercial vehicle inspections and it employs qualified inspectors, as required by §396.19.

(f) Vehicles passing roadside or periodic inspections performed under the auspices of any State government or equivalent jurisdiction or the FMCSA, meeting the minimum standards contained in appendix G of this subchapter, will be considered to have met the requirements of an annual inspection for a period of 12 months commencing from the last day of the month in which the inspection was performed. If a vehicle is subject to a mandatory State inspection program, as provided in §396.23(b)(1), a roadside inspection may only be considered equivalent if it complies with the requirements of that program.

(g) It is the responsibility of the motor carrier or intermodal equipment provider to ensure that all parts and accessories on commercial motor vehicles intended for use in interstate commerce for which they are responsible are maintained at, or promptly repaired to, the minimum standards set forth in appendix G to this subchapter.

(h) Failure to perform properly the annual inspection required by this section shall cause the motor carrier or intermodal equipment provider to be subject to the penalty provisions of 49 U.S.C. 521(b).

§396.19 Inspector qualifications.

(a) Motor carriers and intermodal equipment providers must ensure that individuals performing annual inspections under §396.17(d) or (e) are qualified as follows:

(1) Understand the inspection criteria set forth in part 393 and appendix G of this subchapter and can identify defective components;

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(2) Are knowledgeable of and have mastered the methods, procedures, tools and equipment used when performing an inspection; and

(3) Are capable of performing an inspection by reason of experience, training, or both as follows:

(i) Successfully completed a Federal- or State-sponsored training program or have a certificate from a State or Canadian Province that qualifies the individuals to perform commercial motor vehicle safety inspections, or

(ii) Have a combination of training or experience totaling at least 1 year. Such training or experience may consist of:

(A) Participation in a commercial motor vehicle manufacturer-sponsored training program or similar commercial training program designed to train students in commercial motor vehicle operation and maintenance;

(B) Experience as a mechanic or inspector in a motor carrier or intermodal equipment maintenance program;

(C) Experience as a mechanic or inspector in commercial motor vehicle maintenance at a commercial garage, fleet leasing company, or similar facility; or

(D) Experience as a commercial motor vehicle inspector for a State, Provincial or Federal government.

(b) Motor carriers and intermodal equipment providers must retain evidence of that individual's qualifications under this section. They must retain this evidence for the period during which that individual is performing annual motor vehicle inspections for the motor carrier or intermodal equipment provider, and for one year thereafter. However, motor carriers and intermodal equipment providers do not have to maintain documentation of inspector qualifications for those inspections performed either as part of a State periodic inspection program or at the roadside as part of a random roadside inspection program.

§396.21 Periodic inspection recordkeeping requirements.

(a) The qualified inspector performing the inspection shall prepare a report that:

(1) Identifies the individual performing the inspection;

(2) Identifies the motor carrier operating the vehicle or intermodal equipment provider intending to interchange the vehicle to a motor carrier;

(3) Identifies the date of the inspection;

(4) Identifies the vehicle inspected;

(5) Identifies the vehicle components inspected and describes the results of the inspection, including the identification of those components not meeting the minimum standards set forth in appendix G to this subchapter; and

(6) Certifies the accuracy and completeness of the inspection as complying with all the requirements of this section.

(b)(1) The original or a copy of the inspection report shall be retained by the motor carrier, intermodal equipment provider, or other entity that is responsible for the inspection for a period of fourteen months from the date of the inspection report. The original or a copy of the

inspection report must be retained where the vehicle is either housed or maintained.

(2) The original or a copy of the inspection report must be available for inspection upon demand of an authorized Federal, State or local official.

(3) **Exception.** If the motor carrier operating the commercial motor vehicles did not perform the commercial motor vehicle's last annual inspection, or if an intermodal equipment provider did not itself perform the annual inspection on equipment intended for interchange to a motor carrier, the motor carrier or intermodal equipment provider is responsible for obtaining the original or a copy of the last annual inspection report upon demand of an authorized Federal, State, or local official.

§396.23 Equivalent to periodic inspection.

(a) A motor carrier or an intermodal equipment provider may meet the requirements of §396.17 through a State or other jurisdiction's roadside inspection program. The inspection must have been performed during the preceding 12 months. In using the roadside inspection, the motor carrier or intermodal equipment provider would need to retain a copy of an annual inspection report showing that the inspection was performed in accordance with the minimum periodic inspection standards set forth in appendix G to this subchapter. If the motor carrier operating the commercial vehicle is not the party directly responsible for its maintenance, the motor carrier must deliver the roadside inspection report to the responsible party in a timely manner. Before accepting such an inspection report, the motor carrier or intermodal equipment provider must ensure that the report complies with the requirements of §396.21(a).

(b)(1) If a commercial motor vehicle is subject to a mandatory State inspection program which is determined by the Administrator to be as effective as §396.17, the motor carrier or intermodal equipment provider must meet the requirement of §396.17 through that State's inspection program. Commercial motor vehicle inspections may be conducted by State personnel, at State authorized commercial facilities, or by the motor carrier or intermodal equipment provider itself under the auspices of a State authorized self-inspection program.

(2) Should the FMCSA determine that a State inspection program, in whole or in part, is not as effective as §396.17, the motor carrier or intermodal equipment provider must ensure that the periodic inspection required by §396.17 is performed on all commercial motor vehicles under its control in a manner specified in §396.17.

§396.25 Qualifications of brake inspectors.

(a) Motor carriers and intermodal equipment providers must ensure that all inspections, maintenance, repairs or service to the brakes of its commercial motor vehicles, are performed in compliance with the requirements of this section.

(b) For purposes of this section, *brake inspector* means any employee of a motor carrier or intermodal equipment provider who is responsible for ensuring that all brake inspections, maintenance, service, or repairs to

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any commercial motor vehicle, subject to the motor carrier's or intermodal equipment provider's control, meet the applicable Federal standards.

(c) No motor carrier or intermodal equipment provider may require or permit any employee who does not meet the minimum brake inspector qualifications of paragraph (d) of this section to be responsible for the inspection, maintenance, service or repairs of any brakes on its commercial motor vehicles.

(d) The motor carrier or intermodal equipment provider must ensure that each brake inspector is qualified as follows:

(1) Understands the brake service or inspection task to be accomplished and can perform that task; and

(2) Is knowledgeable of and has mastered the methods, procedures, tools and equipment used when performing an assigned brake service or inspection task; and

(3) Is capable of performing the assigned brake service or inspection by reason of experience, training, or both as follows:

(i) Has successfully completed an apprenticeship program sponsored by a State, a Canadian Province, a Federal agency or a labor union, or a training program approved by a State, Provincial or Federal agency, or has a certificate from a State or Canadian Province that qualifies the person to perform the assigned brake service or inspection task (including passage of Commercial Driver's License air brake tests in the case of a brake inspection); or

(ii) Has brake-related training or experience or a combination thereof totaling at least one year. Such training or experience may consist of:

(A) Participation in a training program sponsored by a brake or vehicle manufacturer or similar commercial training program designed to train students in brake maintenance or inspection similar to the assigned brake service or inspection tasks; or

(B) Experience performing brake maintenance or inspection similar to the assigned brake service or inspection task in a motor carrier or intermodal equipment provider maintenance program; or

(C) Experience performing brake maintenance or inspection similar to the assigned brake service or inspection task at a commercial garage, fleet leasing company, or similar facility.

(e) No motor carrier or intermodal equipment provider may employ any person as a brake inspector unless the evidence of the inspector's qualifications, required under this section, is maintained by the motor carrier or intermodal equipment provider at its principal place of business, or at the location at which the brake inspector is employed. The evidence must be maintained for the period during which the brake inspector is employed in that capacity and for one year thereafter. However, motor carriers and intermodal equipment providers do not have to maintain evidence of qualifications to inspect air brake systems for such inspections performed by persons who have passed the air brake knowledge and skills test for a Commercial Driver's License.

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Interpretations to Part 396 — Inspection, repair, and maintenance

Sections Interpreted

396.3	Inspection, Repair, and Maintenance
396.9	Inspection of Motor Vehicles in Operation
396.11	Driver Vehicle Inspection Report(s)
396.13	Driver Inspection
396.17	Periodic Inspection
396.19	Inspector Qualifications
396.21	Periodic Inspection Recordkeeping Requirements
396.23	Equivalent to a Periodic Inspection
396.25	Qualifications of Brake Inspectors

§396.3 Inspection, Repair, and Maintenance

Question 1: What is meant by “systematic inspection, repair, and maintenance”?

Guidance: Generally, systematic means a regular or scheduled program to keep vehicles in a safe operating condition. §396.3 does not specify inspection, maintenance, or repair intervals because such intervals are fleet specific and, in some instances, vehicle specific. The inspection, repair, and maintenance intervals are to be determined by the motor carrier. The requirements of §§396.11, 396.13, and 396.17 are in addition to the systematic inspection, repair, and maintenance required by §396.3.

Question 2: 396.3(b)(4) refers to a record of tests. What tests are required of push-out windows and emergency door lamps on buses?

Guidance: Generally, inspection of a push-out window would require pushing out the window. However, if the window may be destroyed by pushing out to test its proper functioning, a visual inspection may qualify as a test if the inspector can ascertain the proper functioning of the window without opening it. Checking to ensure that the rubber push-out molding is properly in place and has not deteriorated and that any handles or marking instructions have not been tampered with would meet the test requirement. Inspection of emergency door marking lights would require opening the door to test the lights.

Question 3: Who has the responsibility of inspecting and maintaining leased vehicles and their maintenance records?

Guidance: The motor carrier must either inspect, repair, maintain, and keep suitable records for all vehicles subject to its control for 30 consecutive days or more, or cause another party to perform such activities. The motor carrier is solely responsible for ensuring that the vehicles under its control are in safe operating condition and that defects have been corrected.

Question 4: Is computerized recordkeeping of CMV inspection and maintenance information permissible under §396.3 of the FMCSRs?

Guidance: Yes, if the minimum inspection, repair, and maintenance records required are included in the computer information system and can be reproduced on demand.

Question 5: Where must vehicle inspection and maintenance records be retained if a vehicle is not housed or maintained at a single location?

Guidance: The motor carrier may retain the records at a location of its choice. If the vehicle maintenance records are retained at a location apart from the vehicle, the motor carrier is not relieved of its responsibility for ensuring that the records

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are current and factual. In all cases, however, upon request of the FHWA the maintenance records must be made available within a reasonable period of time (2 working days).

§396.9 Inspection of Motor Vehicles in Operation

Question 1: Under what conditions may a vehicle that has been placed “out of service” under §396.3 be moved?

Guidance: The vehicle may be moved by being placed entirely upon another vehicle, towed by a vehicle equipped with a crane or hoist, or driven if the “out of service” condition no longer exists.

Question 2: Is it the intent of §396.9 to allow “out of service” vehicles to be towed?

Guidance: Yes; however, not all out of service vehicles may be towed away from the inspection location. The regulation sets up a flexible situation that will permit the inspecting officer to use his/her best judgment on a case-by-case basis.

§396.11 Driver Vehicle Inspection Report(s)

Question 1: Does §396.11 require the DVIR to be turned in each day by a driver dispatched on a trip of more than one day’s duration?

Guidance: A driver must prepare a DVIR at the completion of each day’s work and shall submit those reports to the motor carrier upon his/her return to the home terminal. This does not relieve the motor carrier from the responsibility of effecting repairs and certification of any items listed on the DVIR, prepared at the end of each day’s work, that would be likely to affect the safety of the operation of the motor vehicle.

Question 2: Does §396.11 require that the power unit and the trailer be inspected?

Guidance: Yes. A driver must be satisfied that both the power unit and the trailer are in safe operating condition before operating the combination.

Question 3: May more than one power unit be included on the DVIR if two or more power units were used by a driver during one day’s work?

Guidance: No. A separate DVIR must be prepared for each power unit operated during the day’s work.

Question 4: Does §396.11 require a motor carrier to use a specific type of DVIR?

Guidance: A motor carrier may use any type of DVIR as long as the report contains the information and signatures required.

Question 5: Does §396.11 require a separate DVIR for each vehicle and a combination of vehicles or is one report adequate to cover the entire combination?

Guidance: One vehicle inspection report may be used for any combination, provided the defects or deficiencies, if any, are identified for each vehicle and the driver signs the report.

Question 6: Does §396.11(c) require a motor carrier to effect repairs of all items listed on a DVIR prepared by a driver before the vehicle is subsequently driven?

Guidance: The motor carrier must effect repairs of defective or missing parts and accessories listed in Appendix G to the FMCSRs before allowing the vehicle to be driven.

Question 7: What constitutes a “certification” as required by §396.11(c)(1) and (2)?

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Guidance: A motor carrier or its agent must state, in writing, that certain defects or deficiencies have been corrected or that correction was unnecessary. The declaration must be immediately followed by the signature of the person making it.

Question 8: Who must certify under §396.11(c) that repairs have been made when a motor vehicle is repaired en route by the driver or a commercial repair facility?

Guidance: Either the driver or the commercial repair facility.

Question 9: Must certification for trailer repairs be made?

Guidance: Yes. Certification must be made that all reported defects or deficiencies have been corrected or that correction was unnecessary. The certification need only appear on the carrier's copy of the report if the trailer is separated from the tractor.

Question 10: What responsibility does a vehicle leasing company, engaged in the daily rental of CMVs, have regarding the placement of the DVIR in the power unit?

Guidance: A leasing company has no responsibility to comply with §396.11 unless it is the carrier. It is the responsibility of a motor carrier to comply with part 396 regardless of whether the vehicles are owned or leased.

Question 11: Which carrier is to be provided the original of the DVIR in a trip lease arrangement?

Guidance: The motor carrier controlling the vehicle during the term of the lease (i.e. the lessee) must be given the original of the DVIR. The controlling motor carrier is also responsible for obtaining and retaining records relating to repairs.

Question 12: Must the motor carrier's certification be shown on all copies of the DVIR?

Guidance: Yes.

Question 13: Must a DVIR carried on a power unit during operation cover both the power unit and trailer being operated at the time?

Guidance: No. The DVIR must cover the power unit being operated at the time. The trailer identified on there port may represent one pulled on the preceding trip.

Question 14: In instances where the DVIR has not been prepared or cannot be located, is it permissible under §396.11 for a driver to prepare a DVIR based on a pretrip inspection and a short drive of a motor vehicle?

Guidance: Yes. §396.11 of the FMCSRs places the responsibility on the motor carrier to require its drivers to prepare and submit the DVIR. If, in unusual circumstances, the DVIR has not been prepared or cannot be located the motor carrier may cause a road test and inspection to be performed for safety of operation and the DVIR to be prepared.

Question 15: Is it permissible to use the back of a record of duty status (daily log) as a DVIR?

Guidance: Yes, but the retention requirements of §396.11 and §395.8 must be met.

Question 16: Does §396.11 require that specific parts and accessories that are inspected be identified on the DVIR?

Guidance: No.

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Question 17: Is the Ontario pretrip/posttrip inspection report acceptable as a DVIR under §396.11?

Guidance: Yes, provided the report from the preceding trip is carried on board the motor vehicle while in operation and all entries required by §396.11 and 396.13 are contained on the reports.

Question 18: Where must DVIRs be maintained?

Guidance: Since §396.11 is not specific, the DVIRs may be kept at either the motor carrier's principal place of business or the location where the vehicle is housed or maintained.

Question 19: Who is responsible for retaining DVIRs for leased vehicles including those of owner-operators?

Guidance: The motor carrier is responsible for retaining the original copy of each DVIR and the certification of repairs for at least 3 months from the date the report was prepared.

Question 20: Is a multi-day DVIR acceptable under §396.11 and 396.13?

Guidance: Yes, provided all information and certifications required by §§396.11 and 396.13 are contained on the report.

Question 21: Is a DVIR required by a motor carrier operating only one tractor trailer combination?

Guidance: No. One tractor semitrailer/full trailer combination is considered one motor vehicle. However, a carrier operating a single truck tractor and multiple semitrailers, which are not capable of being operated as one combination unit, would be required to prepare DVIRs.

Question 22: Are motor carriers required to retain the "legible copy" of the last vehicle inspection report (referenced in §396.11(c)(3)) which is carried on the power unit?

Guidance: No. The record retention requirement refers only to the original copy retained by the motor carrier.

Question 23: Does the record retention requirement of §396.11(c)(2) apply to all DVIRs, or only those reports on which defects or deficiencies have been noted?

Guidance: The record retention requirement applies to all DVIRs.

Question 24: How would the DVIR requirements apply to a driver who works two or more shifts in a single calendar day?

Guidance: Section 396.11(a) requires every driver to prepare a DVIR at the completion of each day's work on each vehicle operated. A driver who operates two or more vehicles in a 24-hour-period must prepare a DVIR at the completion of the tour of duty in each vehicle.

Question 25: Section 396.11 requires the driver, at the completion of each day's work, to prepare a written report on each vehicle operated that day. Does this section require a "post trip inspection" of the kind described in §396.15?

Guidance: No. However, the written report must include all defects in the parts and accessories listed in §396.11(a) that were discovered by or reported to the driver during that day.

Question 26: Is the motor carrier official or agent who certifies that defects or deficiencies have been corrected or that correction was unnecessary required to be a mechanic or have training concerning commercial motor vehicle maintenance?

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Guidance: No. Section 396.11 does not establish minimum qualifications for motor carrier officials or agents who certify that defects or deficiencies on DVIRs are corrected. With the exception of individuals performing the periodic or annual inspection (§396.19), and motor carrier employees responsible for ensuring that brake-related inspection, repair, or maintenance tasks are performed correctly (§396.25), Part 396 of the FMCSRs does not establish minimum qualifications for maintenance personnel. Motor carriers, therefore, are not prohibited from having DVIRs certified by company officials or agents who do not have experience repairing or maintaining commercial motor vehicles.

§396.13 Driver Inspection

Question 1: If a DVIR does not indicate that certain defects have been repaired, and the motor carrier has not certified in writing that such repairs were considered unnecessary, may the driver refuse to operate the motor vehicle?

Guidance: The driver is prohibited from operating the motor vehicle if the motor carrier fails to make that certification. Operation of the vehicle by the driver would cause the driver and the motor carrier to be in violation of §396.11(c) and both would be subject to appropriate penalties. However, a driver may sign the certification of repairs as an agent of the motor carrier if he/she is satisfied that the repairs have been performed.

Question 2: At the end of the day's work and upon completion of the required DVIR, what does the driver do with the copy of the previous DVIR carried on the power unit?

Guidance: There is no requirement that the driver submit the copy of that previous DVIR to the motor carrier nor is there a retention requirement for the motor carrier.

§396.17 Periodic Inspection

Question 1: Some of a motor carrier's vehicles are registered in a State with a mandated inspection program which has been determined to be as effective as the Federal periodic inspection program, but these vehicles are not used in that State. Is the motor carrier required to make sure the vehicles are inspected under that State's program in order to meet the Federal periodic inspection requirements?

Guidance: If the State requires all vehicles registered in the State to be inspected through its mandatory program then the motor carrier must go through the State program to satisfy the Federal requirements. If, however, the State inspection program includes an exception or exemption for vehicles which are registered in the State but domiciled outside of the State, then the motor carrier may meet the Federal requirements through a self-inspection, a third party inspection, a CVSA inspection, or a periodic inspection performed in any State with a program that the FHWA determines is comparable to, or as effective as, the part 396 requirements.

Question 2: May the due date for the next inspection satisfy the requirements for the inspection date on the sticker or decal?

Guidance: No. The rule requires that the date of the inspection be included on the report and sticker or decal. This date may consist of a month and a year.

Question 3: Must each vehicle in a combination carry separate periodic inspection documentation?

Guidance: Yes, unless a single document clearly identifies all of the vehicles in the CMV combination.

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Question 4: Does the sticker have to be located in a specific location on the vehicle?

Guidance: No. The rule does not specify where the sticker, decal or other form of documentation must be located. It is the responsibility of the driver to produce the documentation when requested. Therefore, the driver must know the location of the sticker and ensure that all information on it is legible and current. The driver must also be able to produce the inspection report if that form of documentation is used.

Question 5: Is new equipment required to pass a periodic inspection under §396.17?

Guidance: Yes, but a dealer who meets the inspection requirements may provide the documentation for the initial periodic inspection.

Question 6: Are the Federal periodic inspection requirements applicable to U.S. Government trailers operated by motor carriers engaged in interstate commerce?

Guidance: Yes. The transportation is not performed by a governmental entity but by a for-hire carrier in interstate commerce.

Question 7: Does a CMV equipped with tires marked “Not for Highway Use” meet the periodic inspection requirements?

Guidance: No. Appendix G to subchapter B—Minimum Periodic Inspection Standards, lists tires so labeled as a defect or deficiency which would prevent a vehicle from passing an inspection.

Question 8: Is a CMV subject to a road side inspection by State or Federal inspectors if it displays a periodic inspection decal or other evidence of a periodic inspection being conducted in the past 12 months?

Guidance: Yes. Evidence of a valid periodic inspection only precludes a citation for a violation of §396.17.

Question 9: Is a State required to accept the periodic inspection program of another State having a periodic inspection program meeting minimum FHWA standards as contained in appendix G to the FMCSRs?

Guidance: Yes. Section 210 of the MCSA (49 U.S.C. 31142) establishes the principle that State inspections meeting federally approved criteria must be recognized by every other State.

Question 10: Do vehicles inspected under a periodic Canadian inspection program comply with the FHWA periodic inspection standards?

Guidance: Yes. The FHWA has determined that the inspection programs of all of the Canadian Provinces meet or exceed the Federal requirements for a periodic inspection program.

Question 11: Must a specific form be used to record the periodic inspection mandated by §396.17?

Guidance: No. Section 396.21 does not designate any particular form, decal, or sticker, but does specify the information which must be shown on these documents.

Question 12: May an inspector certify a CMV as meeting the periodic inspection standards of §396.17 if he/she cannot see all components required to be inspected under appendix G?

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Guidance: No. The affixing of a decal or sticker or preparation of a report as proof of inspection indicates compliance with all requirements of appendix G to part 396.

Question 13: If an inter modal container is attached to a chassis at the time of a periodic inspection, must the container also be inspected to comply with §396.17 inspection requirements?

Guidance: Yes. Safe loading is one of the inspection areas covered under appendix G. If the chassis is loaded at the time of inspection, the method of securement of the container to the chassis must be included in the inspection. Although integral securement devices such as twist locks are not listed in appendix G, the operation of these devices must be included in the inspection without removal of the container.

Question 14: Is it acceptable for the proof of periodic inspection to be written in Spanish?

Guidance: Yes. There is no requirement under §396.17, or appendix G to subchapter B that the proof of periodic inspection be written in English.

§396.19 Inspector Qualifications

Question 1: May an entity other than a motor carrier maintain the evidence of inspector qualifications required by §396.19(b)?

Guidance: Yes. In those cases in which the inspection is performed by a commercial garage or similar facility or a leasing company, the motor carrier may allow the commercial garage or leasing company to maintain a copy of the inspector's qualifications on behalf of the motor carrier. The motor carrier, however, is responsible for obtaining copies of evidence of the inspector's qualifications upon the request of Federal, State, or local officials. If, for whatever reason, the motor carrier is unable to obtain this information from the third party, the motor carrier may be cited for noncompliance with §396.19.

Question 2: Is there a specific form or format to be used in ensuring that inspectors are qualified in accordance with §396.19?

Guidance: No. Section 396.19(b) requires the motor carrier to retain evidence satisfying the standards without specifying any particular form.

§396.21 Periodic Inspection Recordkeeping Requirements

Question 1: What recordkeeping requirements under §396.21 is a carrier subject to when it utilizes an FHWA-approved State inspection program?

Guidance: The motor carrier must comply with the record-keeping requirements of the State. The requirements specified in §396.21 (a) and (b) are applicable only in those instances where the motor carrier self-inspects its CMVs or has an agent perform the periodic inspection.

§396.23 Equivalent to a Periodic Inspection

Question 1: Is a CVSA Level I or Level V inspection a "State * * * roadside inspection program" through which a motor carrier may meet the periodic inspection requirements of §396.17? If so, what evidence of inspection is required?

Guidance: A CVSA Level I or Level V inspection is equivalent to the Federal periodic inspection requirements. A CMV that passes such an inspection has therefore met §396.17, unless the vehicle is subject to a mandatory State inspection program that the FHWA has determined is comparable to, or as effective as, the Federal requirements [see §396.23(b)(1)]. A CVSA decal displayed on the

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CMV, or a copy of the Level I or Level V inspection report maintained in the vehicle, constitutes sufficient evidence of inspection.

§396.25 Qualifications of Brake Inspectors

Question 1: Does a CDL with an airbrake endorsement qualify a person as a brake inspector under §396.25?

Guidance: No.

Question 2: May a driver who does not have the necessary experience perform the adjustment under directions issued by telephone by a qualified inspector?

Guidance: Yes. A driver is permitted to perform brake adjustments at a roadside inspection providing they are done under the supervision of a qualified brake adjuster and the carrier is willing to assume responsibility for the proper adjustment.

Question 3: May a driver or other motor carrier employee be qualified as a brake inspector under §396.25 by way of experience or training to perform brake adjustments without being qualified to perform other brake-related tasks such as the repair or replacement of brake components?

Guidance: Yes. A driver may be qualified by the motor carrier to perform a limited number of tasks in connection with the brake system, e.g., inspect and/or adjust the vehicle's brakes, but not repair them.

Question 4: Would a mechanic who is employed by a leasing company and only works on CMVs that the leasing company leases to other motor carriers be required to meet the brake inspector certification requirements?

Guidance: No. The mechanic is not required to meet the certification requirements of §396.25(d) since he/she is not employed by a motor carrier.

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Appendix G to Subchapter B of Chapter III—Minimum Periodic Inspection Standards

A vehicle does not pass an inspection if it has one of the following defects or deficiencies:

1. Brake System.

a. Service Brakes.

(1) Absence of braking action on any axle required to have brakes upon application of the service brakes (such as missing brakes or brake shoe(s) failing to move upon application of a wedge. S-cam, cam, or disc brake).

(2) Missing or broken mechanical components including: shoes, lining pads, springs, anchor pins, spiders, cam rollers, push-rods, and air chamber mounting bolts.

(3) Loose brake components including air chambers, spiders, and cam shaft support brackets.

(4) Audible air leak at brake chamber (Example-ruptured diaphragm, loose chamber clamp, etc.).

(5) Readjustment limits.

(a) The maximum pushrod stroke must not be greater than the values given in the tables below and at §393.47(e). Any brake stroke exceeding the readjustment limit will be rejected. Stroke must be measured with engine off and reservoir pressure of 80 to 90 psi with brakes fully applied.

CLAMP-TYPE BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit: standard stroke chamber	Brake readjustment limit: long stroke chamber
6.....	4 1/2 in. (114 mm)	1 1/4 in. (31.8 mm).	
9.....	5 1/4 in. (133 mm)	1 3/8 in. (34.9 mm).	
12.....	5 11/16 in. (145 mm)	1 3/8 in. (34.9 mm)	1 3/4 in. (44.5 mm).
16.....	6 3/8 in. (162 mm)	1 3/4 in. (44.5 mm)	2 in. (50.8 mm).
20.....	6 25/32 in. (172 mm)	1 3/4 in. (44.5 mm)	2 in. (50.8 mm). 2 1/2 in. (63.5 mm). ¹
24.....	7 7/32 in. (184 mm)	1 3/4 in. (44.5 mm)	2 in. (50.8 mm). 2 1/2 in. (63.5 mm). ²
30.....	8 3/32 in. (206 mm)	2 in. (50.8 mm)	2 1/2 in. (63.5 mm).
36.....	9 in. (229 mm)	2 1/4 in. (57.2 mm).	

¹ For type 20 chambers with a 3-inch (76 mm) rated stroke.

² For type 24 chambers with a 3-inch (76 mm) rated stroke.

BENDIX DD-3 BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit
30.....	8 1/8 in. (206 mm)	2 1/4 in. (57.2 mm).

BOLT-TYPE BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit
A.....	6 15/16 in. (176 mm)	1 3/8 in. (34.9 mm).
B.....	9 3/16 in. (234 mm)	1 3/4 in. (44.5 mm).
C.....	8 1/16 in. (205 mm)	1 3/4 in. (44.5 mm).
D.....	5 1/4 in. (133 mm)	1 1/4 in. (31.8 mm).
E.....	6 3/16 in. (157 mm)	1 3/8 in. (34.9 mm).
F.....	11 in. (279 mm)	2 1/4 in. (57.2 mm).
G.....	9 7/8 in. (251 mm)	2 in. (50.8 mm).

ROTOCHAMBER-TYPE BRAKE CHAMBERS

Type	Outside diameter	Brake readjustment limit
9.....	4 9/32 in. (109 mm)	1 1/2 in. (38.1 mm).

ROTOCHAMBER-TYPE BRAKE CHAMBERS, Continued

Type	Outside diameter	Brake readjustment limit
12.....	4 13/16 in. (122 mm)	1 1/2 in. (38.1 mm).
16.....	5 13/32 in. (138 mm)	2 in. (50.8 mm).
20.....	5 15/16 in. (151 mm)	2 in. (50.8 mm).
24.....	6 13/32 in. (163 mm)	2 in. (50.8 mm).
30.....	7 1/16 in. (180 mm)	2 1/4 in. (57.2 mm).
36.....	7 5/8 in. (194 mm)	2 3/4 in. (69.9 mm).
50.....	8 7/8 in. (226 mm)	3 in. (76.2 mm).

(b) For actuator types not listed in these tables, the pushrod stroke must not be greater than 80 percent of the rated stroke marked on the actuator by the actuator manufacturer, or greater than the readjustment limit marked on the actuator by the actuator manufacturer.

(6) Brake linings or pads.

(a) Lining or pad is not firmly attached to the shoe;

(b) Saturated with oil, grease, or brake fluid; or

(c) Non-steering axles: Lining with a thickness less than 1/4 inch at the shoe center for air drum brakes, 1/16 inch or less at the shoe center for hydraulic and electric drum brakes, and less than 1/8 inch for air disc brakes.

(d) Steering axles: Lining with a thickness less than 1/4 inch at the shoe center for drum brakes, less than 1/8 inch for air disc brakes and 1/16 inch or less for hydraulic disc and electric brakes.

(7) Missing brake on any axle required to have brakes.

(8) Mismatch across any power unit steering axle of:

(a) Air chamber sizes.

(b) Slack adjuster length.

Wedge Brake Data—Movement of the scribe mark on the lining shall not exceed 1/16 inch.

b. **Parking Brake System.** No brakes on the vehicle or combination are applied upon actuation of the parking brake control, including driveline hand controlled parking brakes.

c. Brake Drum or Rotors.

(1) With any external crack or cracks that open upon brake application (do not confuse short hairline heat check cracks with flexural cracks).

(2) Any portion of the drum or rotor missing or in danger of falling away.

d. Brake Hose.

(1) Hose with any damage extending through the outer reinforcement ply. (Rubber impregnated fabric cover is not a reinforcement ply). (Thermoplastic nylon may have braid reinforcement or color difference between cover and inner tube. Exposure of second color is cause for rejection.

(2) Bulge or swelling when air pressure is applied.

(3) Any audible leaks.

(4) Two hoses improperly joined (such as a splice made by sliding the hose ends over a piece of tubing and clamping the hose to the tube).

(5) Air hose cracked, broken or crimped.

e. Brake Tubing.

(1) Any audible leak.

(2) Tubing cracked, damaged by heat, broken or crimped.

f. **Low Pressure Warning Device** missing, inoperative, or does not operate at 55 psi and below, or 1/2 the governor cut-out pressure, whichever is less.

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g. **Tractor Protection Valve.** Inoperable or missing tractor protection valve(s) on power unit.

h. **Air Compressor.**

(1) Compressor drive belts in condition of impending or probable failure.

(2) Loose compressor mounting bolts.

(3) Cracked, broken or loose pulley.

(4) Cracked or broken mounting brackets, braces or adapters.

i. **Electric Brakes.**

(1) Absence of braking action on any wheel required to have brakes.

(2) Missing or inoperable breakaway braking device.

j. **Hydraulic Brakes. (Including Power Assist Over Hydraulic and Engine Drive Hydraulic Booster).**

(1) Master cylinder less than $\frac{1}{4}$ full.

(2) No pedal reserve with engine running except by pumping pedal.

(3) Power assist unit fails to operate.

(4) Seeping or swelling brake hose(s) under application of pressure.

(5) Missing or inoperative check valve.

(6) Has any visually observed leaking hydraulic fluid in the brake system.

(7) Has hydraulic hose(s) abraded (chafed) through outer cover-to-fabric layer.

(8) Fluid lines or connections leaking restricted, crimped, cracked or broken.

(9) Brake failure or low fluid warning light on and/or inoperative.

k. **Vacuum Systems.** Any vacuum system which:

(1) Has insufficient vacuum reserve to permit one full brake application after engine is shut off.

(2) Has vacuum hose(s) or line(s) restricted, abraded (chafed) through outer cover to cord ply, crimped, cracked, broken or has collapse of vacuum hose(s) when vacuum is applied.

(3) Lacks an operative low-vacuum warning device as required.

2. **Coupling Devices.**

a. **Fifth Wheels.**

(1) Mounting to frame.

(a) Any fasteners missing or ineffective.

(b) Any movement between mounting components.

(c) Any mounting angle iron cracked or broken.

(2) Mounting plates and pivot brackets.

(a) Any fasteners missing or ineffective.

(b) Any welds or parent metal cracked.

(c) More than $\frac{3}{8}$ inch horizontal movement between pivot bracket pin and bracket.

(d) Pivot bracket pin missing or not secured.

(3) Sliders.

(a) Any latching fasteners missing or ineffective.

(b) Any fore or aft stop missing or not securely attached.

(c) Movement more than $\frac{3}{8}$ inch between slider bracket and slider base.

(d) Any slider component cracked in parent metal or weld.

(4) Lower coupler.

(a) Horizontal movement between the upper and lower fifth wheel halves exceeds $\frac{1}{2}$ inch.

(b) Operating handle not in closed or locked position.

(c) Kingpin not properly engaged.

(d) Separation between upper and lower coupler allowing light to show through from side to side.

(e) Cracks in the fifth wheel plate.

Exceptions: Cracks in fifth wheel approach ramps and casting shrinkage cracks in the ribs of the body of a cast fifth wheel.

(f) Locking mechanism parts missing, broken, or deformed to the extent the kingpin is not securely held.

b. **Pintle Hooks.**

(1) Mounting to frame.

(a) Any missing or ineffective fasteners (a fastener is not considered missing if there is an empty hole in the device but no corresponding hole in the frame or vice versa).

(b) Mounting surface cracks extending from point of attachment (e.g., cracks in the frame at mounting bolt holes).

(c) Loose mounting.

(d) Frame crossmember providing pintle hook attachment cracked.

(2) Integrity.

(a) Cracks anywhere in pintle hook assembly.

(b) Any welded repairs to the pintle hook.

(c) Any part of the horn section reduced by more than 20%.

(d) Latch insecure.

c. **Drawbar/Towbar Eye.**

(1) Mounting.

(a) Any cracks in attachment welds.

(b) Any missing or ineffective fasteners.

(2) Integrity.

(a) Any cracks.

(b) Any part of the eye reduced by more than 20%.

d. **Drawbar/Towbar Tongue..**

(1) Slider (power or manual).

(a) Ineffective latching mechanism.

(b) Missing or ineffective stop.

(c) Movement of more than $\frac{1}{4}$ inch between slider and housing.

(d) Any leaking, air or hydraulic cylinders, hoses, or chambers (other than slight oil weeping normal with hydraulic seals).

(2) Integrity.

(a) Any cracks.

(b) Movement of $\frac{1}{4}$ inch between subframe and drawbar at point of attachment.

e. **Safety Devices.**

(1) Safety devices missing.

(2) Unattached or incapable of secure attachment.

(3) Chains and hooks.

(a) Worn to the extent of a measurable reduction in link cross section.

(b) Improper repairs including welding, wire, small bolts, rope and tape.

(4) Cable.

(a) Kinked or broken cable strands.

(b) Improper clamps or clamping.

f. **Saddle-Mounts.**

(1) Method of attachment.

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- (a) Any missing or ineffective fasteners.
- (b) Loose mountings.
- (c) Any cracks or breaks in a stress or load bearing member.
- (d) Horizontal movement between upper and lower saddle-mount halves exceeds $\frac{1}{4}$ inch.

3. Exhaust System.

- a. Any exhaust system determined to be leaking at a point forward of or directly below the driver/sleeper compartment.
- b. A bus exhaust system leaking or discharging to the atmosphere:

(1) **Gasoline powered**—excess of 6 inches forward of the rearmost part of the bus.

(2) **Other than gasoline powered**—in excess of 15 inches forward of the rearmost part of the bus.

(3) **Other than gasoline powered**—forward of a door or window designed to be opened. (Exception: emergency exits).

c. No part of the exhaust system of any motor vehicle shall be so located as would be likely to result in burning, charring, or damaging the electrical wiring, the fuel supply, or any combustible part of the motor vehicle.

4. Fuel System.

- a. A fuel system with a visible leak at any point.
- b. A fuel tank filler cap missing.
- c. A fuel tank not securely attached to the motor vehicle by reason of loose, broken or missing mounting bolts or brackets (some fuel tanks use springs or rubber bushings to permit movement).

5. Lighting Devices.

All lighting devices and reflectors required by part 393 shall be operable.

6. Safe loading.

- a. Part(s) of vehicle or condition of loading such that the spare tire or any part of the load or dunnage can fall onto the roadway.
- b. Protection Against Shifting Cargo—Any vehicle without a front-end structure or equivalent device as required.
- c. Container securement devices on intermodal equipment—All devices used to secure an intermodal container to a chassis, including rails or support frames, tiedown bolsters, locking pins, clevises, clamps, and hooks that are cracked, broken, loose, or missing.

7. Steering Mechanism

a. **Steering Wheel Free Play** (on vehicles equipped with power steering the engine must be running).

Steering wheel diameter	Manual steering system	Power steering system
16"	2"	4 $\frac{1}{2}$ "
18"	2 $\frac{1}{4}$ "	4 $\frac{3}{4}$ "
20"	2 $\frac{1}{2}$ "	5 $\frac{1}{4}$ "
22"	2 $\frac{3}{4}$ "	5 $\frac{3}{4}$ "

b. Steering Column.

- (1) Any absence or looseness of U-bolt(s) or positioning part(s).
- (2) Worn, faulty or obviously repair welded universal joint(s).
- (3) Steering wheel not properly secured.

c. Front Axle Beam and All Steering Components Other Than Steering Column.

- (1) Any crack(s).
- (2) Any obvious welded repair(s).

d. Steering Gear Box.

- (1) Any mounting bolt(s) loose or missing.
- (2) Any crack(s) in gear box or mounting brackets.

e. **Pitman Arm.** Any looseness of the pitman arm on the steering gear output shaft.

f. **Power Steering.** Auxiliary power assist cylinder loose.

g. Ball and Socket Joints.

- (1) Any movement under steering load of a stud nut.
- (2) Any motion, other than rotational, between any linkage member and it's attachment point of more than $\frac{1}{4}$ inch.

h. Tie Rods and Drag Links.

- (1) Loose clamp(s) or clamp bolt(s) on tie rods or drag links.
- (2) Any looseness in any threaded joint.

i. **Nuts.** Nut(s) loose or missing on tie rods pitman arm, drag link, steering arm or tie rod arm.

j. **Steering System.** Any modification or other condition that interferes with free movement of any steering component.

8. Suspension.

a. Any U-bolt(s), spring hanger(s), or other axle positioning part(s) cracked, broken, loose or missing resulting in shifting of an axle from its normal position. (After a turn, lateral axle displacement is normal with some suspensions. Forward or rearward operation in a straight line will cause the axle to return to alignment).

b. Spring Assembly.

- (1) Any leaves in a leaf spring assembly broken or missing.
- (2) Any broken main leaf in a leaf spring assembly. (Includes assembly with more than one main spring).
- (3) Coil spring broken.
- (4) Rubber spring missing.
- (5) One or more leaves displaced in a manner that could result in contact with a tire, rim, brake drum or frame.
- (6) Broken torsion bar spring in a torsion bar suspension.
- (7) Deflated air suspension, i.e., system failure, leak, etc.

c. Torque, Radius or Tracking Components.

Any part of a torque, radius or tracking component assembly or any part used for attaching the same to the vehicle frame or axle that is cracked, loose, broken or missing. (Does not apply to loose bushings in torque or track rods.)

9. Frame.

a. Frame Members.

- (1) Any cracked, broken, loose, or sagging frame member.
- (2) Any loose or missing fasteners including fasteners attaching functional component such as engine, transmission, steering gear, suspension, body parts, and fifth wheel.

b. **Tire and Wheel Clearance.** Any condition, including loading, that causes the body or frame to be in contact with a tire or any part of the wheel assemblies.

c. (1) **Adjustable Axle Assemblies (Sliding Subframes).** Adjustable axle assembly with locking pins missing or not engaged.

10. Tires.

a. Any tire on any steering axle of a power unit.

- (1) With less than $\frac{4}{32}$ inch tread when measured at any point on a major tread groove.
- (2) Has body ply or belt material exposed through the tread or sidewall.

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- (3) Has any tread or sidewall separation.
- (4) Has a cut where the ply or belt material is exposed.
- (5) Labeled "Not for Highway Use" or displaying other marking which would exclude use on steering axle.
- (6) A tube-type radial tire without radial tube stem markings. These markings include a red band around the tube stem, the word "radial" embossed in metal stems, or the word "radial" molded in rubber stems.
- (7) Mixing bias and radial tires on the same axle.
- (8) Tire flap protrudes through valve slot in rim and touches stem.
- (9) Regrooved tire except motor vehicles used solely in urban or suburban service (see exception in §393.75(e)).
- (10) Boot, blowout patch or other ply repair.
- (11) Weight carried exceeds tire load limit. This includes overloaded tire resulting from low air pressure.
- (12) Tire is flat or has noticeable (e.g., can be heard or felt) leak.
- (13) Any bus equipped with recapped or retreaded tire(s).
- (14) So mounted or inflated that it comes in contact with any part of the vehicle.

b. All tires other than those found on the steering axle of a power unit.

- (1) Weight carried exceeds tire load limit. This includes overloaded tire resulting from low air pressure.
- (2) Tire is flat or has noticeable (e.g., can be heard or felt) leak.
- (3) Has body ply or belt material exposed through the tread or sidewall.
- (4) Has any tread or sidewall separation.
- (5) Has a cut where ply or belt material is exposed.
- (6) So mounted or inflated that it comes in contact with any part of the vehicle. (This includes a tire that contacts its mate.)
- (7) Is marked "Not for highway use" or otherwise marked and having like meaning.
- (8) With less than $\frac{2}{32}$ inch tread when measured at any point on a major tread groove.

11. Wheels and Rims.

a. **Lock or Side Ring.** Bent, broken, cracked, improperly seated, sprung or mismatched ring(s).

b. **Wheels and Rims.** Cracked or broken or has elongated bolt holes.

c. **Fasteners (both spoke and disc wheels).** Any loose, missing, broken, cracked, stripped or otherwise ineffective fasteners.

d. Welds.

- (1) Any cracks in welds attaching disc wheel disc to rim.
- (2) Any crack in welds attaching tubeless demountable rim to adapter.
- (3) Any welded repair on aluminum wheel(s) on a steering axle.
- (4) Any welded repair other than disc to rim attachment on steel wheel(s) mounted on the steering axle.

12. Windshield Glazing.

(Not including a 2 inch border at the top, a 1 inch border at each side and the area below the topmost portion of the steering wheel.) Any crack, discoloration or vision reducing matter except: (1) coloring or tinting applied at time of manufacture; (2) any crack not over $\frac{1}{4}$ inch wide, if not intersected by any other crack; (3) any damaged area not more than $\frac{3}{4}$ inch in diameter, if not closer than

3 inches to any other such damaged area; (4) labels, stickers, decalcomania, etc. (see §393.60 for exceptions).

13. Windshield Wipers.

Any power unit that has an inoperative wiper, or missing or damaged parts that render it ineffective.

Comparison of Appendix G, and the new North American Uniform Driver-Vehicle Inspection Procedure (North American Commercial Vehicle Critical Safety Inspection Items and Out-Of-Service Criteria)

The vehicle portion of the FMCSA's North American Uniform Driver-Vehicle Inspection Procedure (NAUD-VIP) requirements, CVSA's North American Commercial Vehicle Critical Safety Inspection Items and Out-Of-Service Criteria and Appendix G of subchapter B are similar documents and follow the same inspection procedures. The same items are required to be inspected by each document. FMCSA's and CVSA's out-of-service criteria are intended to be used in random roadside inspections to identify critical vehicle inspection items and provide criteria for placing a vehicle(s) out-of-service. A vehicle(s) is placed out-of-service only when by reason of its mechanical condition or loading it is determined to be so imminently hazardous as to likely cause an accident or breakdown, or when such condition(s) would likely contribute to loss of control of the vehicle(s) by the driver. A certain amount of flexibility is given to the inspecting official whether to place the vehicle out-of-service at the inspection site or if it would be less hazardous to allow the vehicle to proceed to a repair facility for repair. The distance to the repair facility must not exceed 25 miles. The roadside type of inspection, however, does not necessarily mean that a vehicle has to be defect-free in order to continue in service.

In contrast, the Appendix G inspection procedure requires that all items required to be inspected are in proper adjustment, are not defective and function properly prior to the vehicle being placed in service.

Differences Between the Out-Of-Service Criteria & FMCSA's Annual Inspection

1. Brake System.

The Appendix G criteria rejects vehicles with any defective brakes, any air leaks, etc. The out-of-service criteria allows 20% defective brakes on non-steering axles and a certain latitude on air leaks before placing a vehicle out-of-service.

2. Coupling Devices.

Appendix G rejects vehicles with any fifth wheel mounting fastener missing or ineffective. The out-of-service criteria allows up to 20% missing or ineffective fasteners on frame mountings and pivot bracket mountings and 25% on sliderlatching fasteners. The out-of-service criteria also allows some latitude on cracked welds.

3. Exhaust System.

Appendix G follows §393.83 verbatim. The CVSA out-of-service criteria allows vehicles to exhaust forward of the dimensions given in §393.83 as long as the exhaust does not leak or exhaust under the chassis.

4. Fuel System.

Same for Appendix G and the out-of-service criteria.

5. Lighting Devices.

Appendix G requires all lighting devices required by part 393 to be operative at all times. The out-of-service criteria only requires one stop light and functioning turn signals on the rear most vehicle of a combination vehicle to be operative at all times. In addition one operative head lamp and tail lamp are required during the hours of darkness.

6. Safe Loading.

Same for both Appendix G and the out-of-service criteria.

7. Steering Mechanism.

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Steering lash requirements of Appendix G follows the new requirements of §393.209.

8. Suspension.

Appendix G follows the new requirements of §393.207 which does not allow any broken leaves in a leaf spring assembly. The out-of-service criteria allows up to 25% broken or missing leaves before being placed out-of-service.

9. Frame.

The out-of-service criteria allows a certain latitude in frame cracks before placing a vehicle out-of-service. Appendix G follows the new requirements of §393.201 which does not allow any frame cracks.

10. Tires.

Appendix G follows the requirements of §393.75 which requires a tire tread depth of $\frac{4}{32}$ inch on power unit steering axles and $\frac{2}{32}$ inch on all other axles. The out-of-service criteria only requires $\frac{2}{32}$ inch tire tread depth on power unit steering axles and $\frac{1}{32}$ inch on all other axles.

11. Wheel and Rims.

The out-of-service criteria allows a certain amount latitude for wheel and rim cracks and missing or defective fasteners. Appendix G meets the requirements of the new §393.205 which does not allow defective wheels and rims non-effective nuts and bolts.

12. Windshield Glazing.

The out-of-service criteria places in a restricted service condition any vehicle that has a crack or discoloration in the windshield area lying within the sweep of the wiper on the drivers side and does not address the remaining area of the wind shield. Appendix G addresses requirements for the whole windshield as specified in §393.60.

13. Windshield Wipers.

Appendix G requires windshield wipers to be operative at all times. The out-of-service criteria only requires that the windshield wiper on the driver's side to be inspected during inclement weather.

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Selected regulations from Part 571 — Federal Motor Vehicle Safety Standards

This section contains only the standards from 49 CFR 571 that apply to vehicles with a gross weight vehicle rating of 10,000 pounds or more, or are designed to carry passengers (buses and school buses). The standards that apply entirely to personal passenger vehicles and the related safety equipment (child car seats, helmets, etc.) have not been included.

Subpart A—General

§571.1 Scope

This part contains the Federal Motor Vehicle Safety Standards for motor vehicles and motor vehicle equipment established under section 103 of the National Traffic and Motor Vehicle Safety Act of 1966 (80 Stat. 718).

§571.3 Definitions.

(a) Statutory definitions. All terms defined in section 102 of the Act are used in their statutory meaning.

(b) Other definitions. As used in this chapter—

Act means the National Traffic and Motor Vehicle Safety Act of 1966 (80 Stat. 718).

Approved, unless used with reference to another person, means approved by the Secretary.

Boat trailer means a trailer designed with cradle-type mountings to transport a boat and configured to permit launching of the boat from the rear of the trailer.

Bus means a motor vehicle with motive power, except a trailer, designed for carrying more than 10 persons.

Curb weight means the weight of a motor vehicle with standard equipment; maximum capacity of engine fuel, oil, and coolant; and, if so equipped, air conditioning and additional weight optional engine.

Designated seating capacity means the number of designated seating positions provided.

Designated seating position means

(1) For vehicles manufactured prior to September 1, 2011, any plan view location capable of accommodating a person at least as large as a 5th percentile adult female, if the overall seat configuration and design and vehicle design is such that the position is likely to be used as a seating position while the vehicle is in motion, except for auxiliary seating accommodations such as temporary or folding jump seats. Any bench or split-bench seat in a passenger car, truck or multipurpose passenger vehicle with a GVWR less than 4,536 kilograms (10,000 pounds), having greater than 127 centimeters (50 inches) of hip room (measured in accordance with Society of Automotive Engineers (SAE) Recommended Practice J1100a, revised September 1975, "Motor Vehicle Dimensions" (incorporated by reference, see §571.5), shall have not less than three designated seating positions, unless the seat design or vehicle design is such that the center position cannot be used for seating. For the sole purpose of determining the classification of any vehicle sold or intro-

duced into interstate commerce for purposes that include carrying students to and from school or related events, any location in such vehicle intended for securement of an occupied wheelchair during vehicle operation shall be regarded as four designated seating positions.

(2) For vehicles manufactured on and after September 1, 2011, *designated seating position* means a seat location that has a seating surface width, as described in §571.10(c) of this part, of at least 330 mm (13 inches). The number of designated seating positions at a seat location is determined according to the procedure set forth in §571.10(b) of this part. However, for trucks and multipurpose passenger vehicles with a gross vehicle weight rating greater than 10,000 lbs, police vehicles as defined in S7 of FMVSS No. 208, firefighting vehicles, ambulances, and motor homes, a seating location that is labeled in accordance with S4.4 of FMVSS No. 207 will not be considered a designated seating position. For the sole purpose of determining the classification of any vehicle sold or introduced into interstate commerce for purposes that include carrying students to and from school or related events, any location in such a vehicle intended for securement of an occupied wheelchair during vehicle operation is regarded as four designated seating positions. means:

Driver means the occupant of a motor vehicle seated immediately behind the steering control system.

Emergency brake means a mechanism designed to stop a motor vehicle after a failure of the service brake system.

5th percentile adult female means a person possessing the dimensions and weight of the 5th percentile adult female specified for the total age group in "Weight, Height, and Selected Body Dimensions of Adults: United States— 1960–1962," first published as Public Health Service Publication No. 1000 Series 11–No. 8, June 1965 and republished as DHEW Publication No. (HRA) 76–1074 (incorporated by reference, see §571.5).

Firefighting vehicle means a vehicle designed exclusively for the purpose of fighting fires.

Fixed collision barrier means a flat, vertical, unyielding surface with the following characteristics:

(1) The surface is sufficiently large that when struck by a tested vehicle, no portion of the vehicle projects or passes beyond the surface.

(2) The approach is a horizontal surface that is large enough for the vehicle to attain a stable attitude during its approach to the barrier, and that does not restrict vehicle motion during impact.

(3) When struck by a vehicle, the surface and its supporting structure absorb no significant portion of the vehicle's kinetic energy, so that a performance requirement described in terms of impact with a fixed collision barrier must be met no matter how small an amount of energy is absorbed by the barrier.

Forward control means a configuration in which more than half of the engine length is rearward of the foremost point of the windshield base and the steering wheel hub is in the forward quarter of the vehicle length.

Full trailer means a trailer, except a pole trailer, that is equipped with two or more axles that support the entire weight of the trailer.

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Gross axle weight rating or GAWR means the value specified by the vehicle manufacturer as the load-carrying capacity of a single axle system, as measured at the tire-ground interfaces.

Gross combination weight rating or GCWR means the value specified by the manufacturer as the loaded weight of a combination vehicle.

Gross vehicle weight rating or GVWR means the value specified by the manufacturer as the loaded weight of a single vehicle.

H point means the pivot center of the torso and thigh on the three-dimensional device used in defining and measuring vehicle seating accommodation, as defined in Society of Automotive Engineers (SAE) Recommended Practice J1100, revised February 2001, "Motor Vehicle Dimensions" (incorporated by reference, see §571.5).

Head impact area means all nonglazed surfaces of the interior of a vehicle that are statically contactable by a 6.5-inch diameter spherical head form of a measuring device having a pivot point to "top-of-head" dimension infinitely adjustable from 29 to 33 inches in accordance with the following procedure, or its graphic equivalent:

(a) At each designated seating position, place the pivot point of the measuring device—

- (1) For seats that are adjustable fore and aft, at—
 - (i) The seating reference point; and
 - (ii) A point 5 inches horizontally forward of the seating reference point and vertically above the seating reference point an amount equal to the rise which results from a 5-inch forward adjustment of the seat or 0.75 inch; and

(2) For seats that are not adjustable fore and aft, at the seating reference point.

(b) With the pivot point to "top-of-head" dimension at each value allowed by the device and the interior dimensions of the vehicle, determine all contact points above the lower windshield glass line and forward of the seating reference point.

(c) With the head form at each contact point, and with the device in a vertical position if no contact points exists for a particular adjusted length, pivot the measuring device forward and downward through all arcs in vertical planes to 90° each side of the vertical longitudinal plane through the seating reference point, until the head form contacts an interior surface or until it is tangent to a horizontal plane 1 inch above the seating reference point, whichever occurs first.

Interior compartment door means any door in the interior of the vehicle installed by the manufacturer as a cover for storage space normally used for personal effects.

Longitudinal or longitudinally means parallel to the longitudinal centerline of the vehicle.

Low-speed vehicle (LSV) means a motor vehicle,

- (1) That is 4-wheeled,
- (2) Whose speed attainable in 1.6 km (1 mile) is more than 32 kilometers per hour (20 miles per hour) and not more than 40 kilometers per hour (25 miles per hour) on a paved level surface, and
- (3) Whose GVWR is less than 1,361 kilograms (3,000 pounds).

Motorcycle means a motor vehicle with motive power having a seat or saddle for the use of the rider and designed to travel on not more than three wheels in contact with the ground.

Motor-driven cycle means a motorcycle with a motor that produces 5-brake horsepower or less.

Motor home means a multipurpose passenger vehicle with motive power that is designed to provide temporary residential accommodations, as evidenced by the presence of at least four of the following facilities: Cooking; refrigeration or ice box; self-contained toilet; heating and/or air conditioning; a potable water supply system including a faucet and a sink; and a separate 110-125 volt electrical power supply and/or propane.

Multifunction school activity bus (MFSAB) means a school bus whose purposes do not include transporting students to and from home or school bus stops.

Multipurpose passenger vehicle means a motor vehicle with motive power, except a low-speed vehicle or trailer, designed to carry 10 persons or less which is constructed either on a truck chassis or with special features for occasional off-road operation.

Open-body type vehicle means a vehicle having no occupant compartment top or an occupant compartment top that can be installed or removed by the user at his convenience.

Outboard designated seating position means a designated seating position where a longitudinal vertical plane tangent to the outboard side of the seat cushion is less than 12 inches from the innermost point on the inside surface of the vehicle at a height between the design H-point and the shoulder reference point (as shown in fig. 1 of Federal Motor Vehicle Safety Standard No. 210) and longitudinally between the front and rear edges of the seat cushion.

Overall vehicle width means the nominal design dimension of the widest part of the vehicle, exclusive of signal lamps, marker lamps, outside rearview mirrors, flexible fender extensions, and mud flaps, determined with doors and windows closed and the wheels in the straight-ahead position.

Parking brake means a mechanism designed to prevent the movement of a stationary motor vehicle.

Passenger car means a motor vehicle with motive power, except a low-speed vehicle, multipurpose passenger vehicle, motorcycle, or trailer, designed for carrying 10 persons or less.

Pelvic impact area means that area of the door or body side panel adjacent to any outboard designated seating position which is bounded by horizontal planes 7 inches above and 4 inches below the seating reference point and vertical transverse planes 8 inches forward and 2 inches rearward of the seating reference point.

Pole trailer means a motor vehicle without motive power designed to be drawn by another motor vehicle and attached to the towing vehicle by means of a reach or pole, or by being boomed or otherwise secured to the towing vehicle, for transporting long or irregularly shaped loads such as poles, pipes, or structural members capable generally of sustaining themselves as beams between the supporting connections.

Recreation vehicle trailer means a trailer, except a trailer designed primarily to transport cargo, designed

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to be drawn by a vehicle with motive power by means of a bumper, frame or fifth wheel hitch and designed to provide temporary residential accommodations, as evidenced by the presence of at least four of the following facilities: cooking; refrigeration or ice box; self-contained toilet; heating and/or air conditioning; a potable water supply system including a faucet and a sink; and a separate 110–125 volt electrical power supply and/or propane. “Recreation vehicle trailer” includes trailers used for personal purposes, commonly known as “sport utility RVs” or “toy haulers,” which usually have spacious rather than incidental living quarters and provide a cargo area for smaller items for personal use such as motorcycles, mountain bikes, all terrain vehicles (ATVs), snowmobiles, canoes or other types of recreational gear.

School bus means a bus that is sold, or introduced in interstate commerce, for purposes that include carrying students to and from school or related events, but does not include a bus designed and sold for operation as a common carrier in urban transportation.

Seating reference point (SgRP) means the unique design H-point, as defined in Society of Automotive Engineers (SAE) Recommended Practice J1100, revised June 1984, “Motor Vehicle Dimensions” (incorporated by reference, see §571.5), which:

(1) Establishes the rearmost normal design driving or riding position of each designated seating position, which includes consideration of all modes of adjustment, horizontal, vertical, and tilt, in a vehicle;

(2) Has X, Y, and Z coordinates, as defined in Society of Automotive Engineers (SAE) Recommended Practice J1100, revised June 1984, “Motor Vehicle Dimensions” (incorporated by reference, see §571.5), established relative to the designed vehicle structure;

(3) Simulates the position of the pivot center of the human torso and thigh; and

(4) Is the reference point employed to position the two-dimensional drafting template with the 95th percentile leg described in Society of Automotive Engineers (SAE) Standard J826, revised May 1987, “Devices for Use in Defining and Measuring Vehicle Seating Accommodation” (incorporated by reference, see §571.5), or, if the drafting template with the 95th percentile leg cannot be positioned in the seating position, is located with the seat in its most rearward adjustment position.

Semitrailer means a trailer, except a pole trailer, so constructed that a substantial part of its weight rests upon or is carried by another motor vehicle.

Service brake means the primary mechanism designed to stop a motor vehicle.

Speed attainable in 1 mile means the speed attainable by accelerating at maximum rate from a standing start for 1 mile, on a level surface.

Speed attainable in 2 miles means the speed attainable by accelerating at maximum rate from a standing start for 2 miles, on a level surface.

Torso line means the line connecting the “H” point and the shoulder reference point as defined in Society of Automotive Engineers (SAE) Standard J787b, revised September 1966, “Motor Vehicle Seat Belt Anchorage” (incorporated by reference, see §571.5).

Trailer means a motor vehicle with or without motive power, designed for carrying persons or property and for being drawn by another motor vehicle.

Trailer converter dolly means a trailer chassis equipped with one or more axles, a lower half of a fifth wheel and a drawbar.

Truck means a motor vehicle with motive power, except a trailer, designed primarily for the transportation of property or special purpose equipment.

Truck tractor means a truck designed primarily for drawing other motor vehicles and not so constructed as to carry a load other than a part of the weight of the vehicle and the load so drawn.

Unloaded vehicle weight means the weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use.

95th percentile adult male means a person possessing the dimensions and weight of the 95th percentile adult male specified “Weight, Height, and Selected Body Dimensions of Adults: United States—1960–1962,” first published as Public Health Service Publication No. 1000 Series 11-No. 8, June 1965 and republished as DHEW Publication No. (HRA) 76–1074 (incorporated by reference, see §571.5).

Vehicle fuel tank capacity means the tank’s unusable capacity (i.e., the volume of fuel left at the bottom of the tank when the vehicle’s fuel pump can no longer draw fuel from the tank) plus its usable capacity (i.e., the volume of fuel that can be pumped into the tank through the filler pipe with the vehicle on a level surface and with the unusable capacity already in the tank). The term does not include the vapor volume of the tank (i.e., the space above the fuel tank filler neck) nor the volume of the fuel tank filler neck.

EDITORIAL NOTE: For *Federal Register* citations affecting § 571.3, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and on GPO Access.

§571.4 Explanation of usage.

The word any, used in connection with a range of values or set of items in the requirements, conditions, and procedures of the standards or regulations in this chapter, means generally the totality of the items or values, any one of which may be selected by the Administration for testing, except where clearly specified otherwise.

Examples: “The vehicle shall meet the requirements of S4.1 when tested at any point between 18 and 22 inches above the ground.” This means that the vehicle must be capable of meeting the specified requirements at every point between 18 and 22 inches above the ground. The test in question for a given vehicle may call for a single test (a single impact, for example), but the vehicle must meet the requirement at whatever point the Administration selects, within the specified range.

“Each tire shall be capable of meeting the requirements of this standard when mounted on any rim specified by the manufacturer as suitable for use with that tire.” This means that, where the manufacturer specifies more than one rim as suitable for use with a tire,

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the tire must meet the requirements with whatever rim the Administration selects from the specified group.

“Any one of the items listed below may, at the option of the manufacturer, be substituted for the hardware specified in S4.1.” Here the wording clearly indicates that the selection of items is at the manufacturer’s option.

§571.5 Matter incorporated by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the *Federal Register* under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, the National Highway Traffic Safety Administration (NHTSA) must publish notice of change in the *Federal Register* and the material must be available to the public. All approved material is available for inspection at NHTSA, 1200 New Jersey Avenue SE., Washington, DC 20590, and at the National Archives and Records Administration (NARA). For information on the availability of this material at NHTSA, or if you experience difficulty obtaining the standards referenced below, contact NHTSA Office of Technical Information Services, phone number (202) 366-2588. For information on the availability of this material at NARA, call (202) 741-6030, or go to: <http://www.archives.gov/federal-register/cfr/ibr-locations.html>.

(b) American Association of Textile Chemists and Colorists (AATCC), 1 Davis Dr., P.O. Box 12215, Research Triangle Park, NC 27709. Web site: <http://www.aatcc.org>.

(1) AATCC Test Method 30-1981, “Fungicides, Evaluation on Textiles: Mildew and Rot Resistance of Textiles,” into §571.209.

(2) AATCC Gray Scale for Evaluating Change in Color into §§571.209; 571.213.

(c) American National Standards Institute (ANSI), 1899 L St., NW., 11th floor, Washington, DC 20036. Telephone: (202) 293-8020; Fax: (202) 293-9287; Web site: <http://www.ansi.org>. Copies of ANSI/RESNA Standard WC/Vol.1-1998 Section 13 may also be obtained from Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), 1700 North Moore St., Suite 1540, Arlington, VA 22209-1903. Telephone: (703) 524-6686; Web site <http://www.resna.org>.

(1) ANSI Z26.1-1977, “Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways,” approved January 26, 1977, into §571.205(a).

(2) ANSI Z26.1a-1980, “Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways,” approved July 3, 1980, into §571.205(a).

(3) ANSI/SAE Z26.1-1996, “American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways-Safety Standard,” approved August 11, 1997, into §571.205.

(4) ANSI/RESNA Standard WC/Vol. 1-1998, Section 13, “Wheelchairs: Determination of Coefficient of Friction of Test Surfaces,” into §571.403.

(d) ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. Telephone: (610) 832-9500; Fax (610) 832-9555; Web site: <http://www.astm.org>.

(1) 1985 Annual Book of ASTM Standards, Vol. 05.04, “Test Methods for Rating Motor, Diesel, Aviation Fuels, A2. Reference Materials and Blending Accessories, (“ASTM Motor Fuels section”),” A2.3.2, A2.3.3, and A2.7, into §§571.108; 571.205(a).

(2) ASTM B117-64, “Standard Method of Salt Spray (Fog) Testing,” revised 1964, into §571.125.

(3) ASTM B117-73 (Reapproved 1979), “Standard Method of Salt Spray (Fog) Testing,” approved March 29, 1973, into §§571.108; 571.209.

(4) ASTM B117-97, “Standard Practice for Operating Salt Spray (Fog) Apparatus,” approved April 10, 1997, into §571.403.

(5) ASTM B117-03, “Standard Practice for Operating Salt Spray (Fog) Apparatus,” approved October 1, 2003, into §§571.106; 571.111.

(6) ASTM B456-79, “Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium,” approved January 26, 1979, into §571.209.

(7) ASTM B456-95, “Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium,” approved October 10, 1995, into §571.403.

(8) ASTM C150-56, “Standard Specification for Portland Cement,” approved 1956, into §571.108.

(9) ASTM C150-77, “Standard Specification for Portland Cement,” approved February 26, 1977, into §571.108.

(10) ASTM D362-84, “Standard Specification for Industrial Grade Toluene,” approved March 30, 1984, into §§571.108; 571.205(a).

(11) ASTM D445-65, “Standard Method of Test for Viscosity of Transparent and Opaque Liquids (Kinematic and Dynamic Viscosities),” approved August 31, 1965, into §571.116.

(12) ASTM D471-98, “Standard Test Method for Rubber Property-Effect of Liquids,” approved November 10, 1998, into §571.106.

(13) ASTM D484-71, “Standard Specification for Hydrocarbon Drycleaning Solvents,” effective September 15, 1971, into §571.301.

(14) ASTM D756-78, “Standard Practice for Determination of Weight and Shape Changes of Plastics under Accelerated Service Conditions,” approved July 28, 1978, into §571.209.

(15) ASTM D1003-92, “Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics,” approved October 15, 1992, into §571.108.

(16) ASTM D1056-07, “Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber,” approved March 1, 2007, into §571.213.

(17) ASTM D1121-67, “Standard Method of Test for Reserve Alkalinity of Engine Antifreezes and Antirusts,” accepted June 12, 1967, into §571.116.

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(18) ASTM D1123-59, "Standard Method of Test for Water in Concentrated Engine Antifreezes by the Iodine Reagent Method," revised 1959, into §571.116.

(19) ASTM D1193-70, "Standard Specification for Reagent Water," effective October 2, 1970, into §571.116.

(20) ASTM D1415-68, "Standard Method of Test for International Hardness of Vulcanized Natural and Synthetic Rubbers," accepted February 14, 1968, into §571.116.

(21) ASTM D2515-66, "Standard Specification for Kinematic Glass Viscometers," adopted 1966, into §571.116.

(22) ASTM D4329-99, "Standard Practice for Fluorescent UV Exposure of Plastics," approved January 10, 1999, into §571.106.

(23) ASTM D4956-90, "Standard Specification for Retroreflective Sheeting for Traffic Control," approved October 26, 1990, into §571.108.

(24) ASTM E1-68, "Standard Specifications for ASTM Thermometers" (including tentative revisions), accepted September 13, 1968, into §571.116.

(25) ASTM E4-79, "Standard Methods of Load Verification of Testing Machines," approved June 11, 1979, into §571.209.

(26) ASTM E4-03, "Standard Practices for Force Verification of Testing Machines," approved August 10, 2003, into §571.106.

(27) ASTM E8-89, "Standard Test Methods of Tension Testing of Metallic Materials," approved May 15, 1989, into §571.221.

(28) ASTM E77-66, "Standard Method for Inspection, Test, and Standardization of Etched-Stem Liquid-in-Glass Thermometers," revised 1966, into §571.116.

(29) ASTM E274-65T, "Tentative Method of Test for Skid Resistance of Pavements Using a Two-Wheel Trailer," issued 1965, into §§571.208; 571.301.

(30) ASTM E274-70, "Standard Method of Test for Skid Resistance of Paved Surfaces Using a Full-Scale Tire," 114 Privacy Act of 1974: Systems of Records, 65 FR 19476, 19478 (Apr. 11, 2000). revised July 1974, into §§571.105; 571.122a.

(31) ASTM E298-68, "Standard Methods for Assay of Organic Peroxides," effective September 13, 1968, into §571.116.

(32) ASTM E308-66, "Standard Practice for Spectrophotometry and Description of Color in CIE 1931 System," reapproved 1981, into §571.108.

(33) ASTM E1136-93 (Reapproved 2003), "Standard Specification for a Radial Standard Reference Test Tire," approved March 15, 1993, into §§571.105; 571.121; 571.122; 571.126; 571.135; 571.139; 571.500.

(34) ASTM E1337-90 (Reapproved 2008), "Standard Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire," approved June 1, 2008, into §§571.105; 571.121; 571.122; 571.126; 571.135; 571.500.

(35) ASTM F1805-00, "Standard Test Method for Single Wheel Driving Traction in a Straight Line on Snow- and Ice-Covered Surfaces," approved November 10, 2000, into §571.139.

(36) ASTM G23-81, "Standard Practice for Generating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials," approved March 26, 1981, into §571.209.

(37) ASTM G151-97, "Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources," approved July 10, 1997, into §571.106.

(38) ASTM G154-00, "Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials," approved February 10, 2000, into §571.106.

(e) Department of Defense, DODSSP Standardization Document Order Desk, 700 Robbins Ave., Philadelphia, PA 19111-5098. Web site: <http://dodssp.daps.dla.mil/>.

(1) MIL-S-13192, "Military Specification, Shoes, Men's, Dress, Oxford," October 30, 1976, into §571.214.

(2) MIL-S-13192P, "Military Specification, Shoes, Men's, Dress, Oxford," 1988, including Amendment 1, October 14, 1994, into §571.208.

(3) MIL-S-21711E, "Military Specification, Shoes, Women's," 3 December 1982, including Amendment 2, October 14, 1994, into §§571.208; 571.214.

(f) General Services Administration (GSA), Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Telephone: (202) 512-1800; Web site: <http://www.gsa.gov>.

(1) GSA Federal Specification L-S-300, "Sheeting and Tape, Reflective; Nonexposed Lens, Adhesive Backing," September 7, 1965, into §571.108.

(2) [Reserved]

(g) Illuminating Engineering Society of North America (IES), 120 Wall St., 7th Floor, New York, NY 10005-4001. Telephone: (212) 248-5000; Web site: <http://www.iesna.org>.

(1) IES LM 45, "IES Approved Method for Electrical and Photometric Measurements of General Service Incandescent Filament Lamps," approved April 1980, into §571.108.

(2) [Reserved]

(h) International Commission on Illumination (CIE), CIE Central Bureau, Kegelgasse 27, A-1030 Vienna, Austria. <http://www.cie.co.at>.

(1) CIE 1931 Chromaticity Diagram, developed 1931, into §571.108.

(2) [Reserved]

(i) International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland. Telephone: +41 22 749 01 11. Fax: +41 22 733 34 30. Web site: <http://www.iso.org/>.

(1) ISO 7117:1995(E), "Motorcycles-Measurement of maximum speed," Second edition, March 1, 1995, into §571.122.

(2) [Reserved]

(j) National Center for Health Statistics, Centers for Disease Control (CDC), National Division for Health Statistics, Division of Data Services, Hyattsville, MD 20782. Telephone: 1 (800) 232-4636. Web site: <http://www.cdc.gov/nchs>.

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(1) DHEW Publication No. (HRA) 76-1074, "Weight, Height, and Selected Body Dimensions of Adults: United States-1960-1962," first published as Public Health Service Publication No. 1000 Series 11-No. 8, June 1965, into §571.3.

(2) [Reserved]

(k) National Highway Traffic Safety Administration (NHTSA), 1200 New Jersey Ave. SE., Washington, DC 20590. Web site: <http://www.nhtsa.gov>.

(1) Drawing Package, "NHTSA Standard Seat Assembly; FMVSS No. 213, No. NHTSA-213-2003," (consisting of drawings and a bill of materials), June 3, 2003, into §571.213.

(2) Drawing Package, SAS-100-1000, Standard Seat Belt Assembly with Addendum A, Seat Base Weldment (consisting of drawings and a bill of materials), October 23, 1998, into §571.213.

(3) "Parts List; Ejection Mitigation Headform Drawing Package," December 2010, into §571.226.

(4) "Parts List and Drawings; Ejection Mitigation Headform Drawing Package" December 2010, into §571.226.

(1) SAE International, 400 Commonwealth Drive, Warrendale, PA 15096. Telephone: (724) 776-4841; Web site: <http://www.sae.org>.

(1) SAE Recommended Practice J100-1995, "Class 'A' Vehicle Glazing Shade Bands," revised June 1995, into §571.205.

(2) SAE Recommended Practice J211a, "Instrumentation for Impact Tests," revised December 1971, into §571.222.

(3) SAE Recommended Practice J211, "Instrumentation for Impact Tests," revised June 1980, into §§571.213; 571.218.

(4) SAE Recommended Practice J211/1 MAR95, "Instrumentation for Impact Test-Part 1-Electronic Instrumentation," revised March 1995, into §§571.202a; 571.208; 571.403.

(5) SAE Recommended Practice J211-1 DEC2003, "Instrumentation for Impact Test-Part 1-Electronic Instrumentation," revised December 2003, into §§571.206; 571.209.

(6) SAE Recommended Practice J227a, "Electric Vehicle Test Procedure," revised February 1976, into §§571.105; 571.135.

(7) SAE Standard J527a, "Brazed Double Wall Low Carbon Steel Tubing," revised May 1967, into §571.116.

(8) SAE Recommended Practice J567b, "Bulb Sockets," revised April 1964, into §571.108.

(9) SAE Recommended Practice J573d, "Lamp Bulbs and Sealed Units," revised December 1968, into §571.108.

(10) SAE Recommended Practice J575-1983, "Tests for Motor Vehicle Lighting Devices and Components," revised July 1983, into §571.131.

(11) SAE Recommended Practice J578, "Color Specification," revised May 1988, into §571.131.

(12) SAE Recommended Practice J578-1995, "Color Specification," revised June 1995, into §571.403.

(13) SAE Recommended Practice J592 JUN92, "Clearance, Side Marker, and Identification Lamps," revised June 1992, into §571.121.

(14) SAE Recommended Practice J592e-1972, "Clearance, Side Marker, and Identification Lamps," revised July 1972, into §571.121.

(15) SAE Recommended Practice J602-1963, "Headlamp Aiming Device for Mechanically Aimable Sealed Beam Headlamp Units," reaffirmed August 1963, into §571.108.

(16) SAE Recommended Practice J602-1980, "Headlamp Aiming Device for Mechanically Aimable Sealed Beam Headlamp Units," revised October 1980, into §571.108.

(17) SAE Recommended Practice J673a, "Automotive Glazing," revised August 1967, into §571.205(a).

(18) SAE Recommended Practice J673, "Automotive Safety Glasses," revised April 1993, into §571.205.

(19) SAE Recommended Practice J726 SEP79, "Air Cleaner Test Code," revised April 1979, into §571.209.

(20) SAE Recommended Practice J759 JAN95, "Lighting Identification Code," revised January 1995, into §571.121.

(21) SAE Standard J787b, "Motor Vehicle Seat Belt Anchorage," revised September 1966, into §571.3.

(22) SAE Recommended Practice J800c, "Motor Vehicle Seat Belt Assembly Installations," revised November 1973, into §571.209.

(23) SAE Standard J826-1980, "Devices for Use in Defining and Measuring Vehicle Seating Accommodation," revised April 1980, into §§571.208; 571.214.

(24) SAE Standard J826 MAY87, "Devices for Use in Defining and Measuring Vehicle Seating Accommodation," revised May 1987, into §§571.3; 571.210.

(25) SAE Standard J826-1992, "Devices for Use in Defining and Measuring Vehicle Seating Accommodation," revised June 1992, into §571.225.

(26) SAE Standard J826 JUL95, "Devices for Use in Defining and Measuring Vehicle Seating Accommodation," revised July 1995, into §§571.10; 571.111; 571.202; 571.202a; 571.216a.

(27) SAE Recommended Practice J839b, "Passenger Car Side Door Latch Systems," revised May 1965, into §571.201.

(28) SAE Recommended Practice J839-1991, "Passenger Car Side Door Latch Systems," revised June 1991, into §571.206.

(29) SAE Recommended Practice J902, "Passenger Car Windshield Defrosting Systems," revised August 1964, into §571.103.

(30) SAE Recommended Practice J902a, "Passenger Car Windshield Defrosting Systems," revised March 1967 (Editorial change June 1967), into §571.103.

(31) SAE Recommended Practice J903a, "Passenger Car Windshield Wiper Systems," revised May 1966, into §571.104.

(32) SAE Recommended Practice J921, "Instrument Panel Laboratory Impact Test Procedure," approved June 1965, into §571.201.

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(33) SAE Recommended Practice J941, "Passenger Car Driver's Eye Range," approved November 1965, into §571.104.

(34) SAE Recommended Practice J941b, "Motor Vehicle Driver's Eye Range," revised February 1969, into §571.108.

(35) SAE Recommended Practice J942, "Passenger Car Windshield Washer Systems," approved November 1965, into §571.104.

(36) SAE Recommended Practice J944 JUN80, "Steering Control System-Passenger Car-Laboratory Test Procedure," revised June 1980, into §571.203.

(37) SAE Standard J964 OCT84, "Test Procedure for Determining Reflectivity of Rear View Mirrors," reaffirmed October 1984, into §571.111.

(38) SAE Recommended Practice J972, "Moving Rigid Barrier Collision Tests," revised May 2000, into §571.105.

(39) SAE Recommended Practice J977, "Instrumentation for Laboratory Impact Tests," approved November 1966, into §571.201.

(40) SAE Recommended Practice J1100a, "Motor Vehicle Dimensions," revised September 1975, into §571.3.

(41) SAE Recommended Practice J1100 JUN84, "Motor Vehicle Dimensions," revised June 1984, into §§571.3; 571.210.

(42) SAE Recommended Practice J1100-1993, "Motor Vehicle Dimensions," revised June 1993, into §571.225.

(43) SAE Recommended Practice J1100, "Motor Vehicle Dimensions," revised February 2001, into §571.3.

(44) SAE Recommended Practice J1133, "School Bus Stop Arm," revised April 1984, into §571.131.

(45) SAE Standard J1703b, "Motor Vehicle Brake Fluid," revised July 1970, into §571.116.

(46) SAE Standard J1703 NOV83, "Motor Vehicle Brake Fluid," revised November 1983, into §571.116.

(47) SAE RM-66-04, "Compatibility Fluid," Appendix B to SAE Standard J1703 JAN95, "Motor Vehicle Brake Fluid," revised January 1995, into §§571.106; 571.116.

(48) SAE Recommended Practice J2009, "Discharge Forward Lighting Systems," revised February 1993, into §571.108.

(49) SAE Aerospace-Automotive Drawing Standards, issued September 1963, into §§571.104; 571.202.

(m) United Nations Economic Commission for Europe (UNECE), United Nations, Conference Services Division, Distribution and Sales Section, Office C.115-1, Palais des Nations, CH-1211, Geneva 10, Switzerland. Web site: www.unece.org/trans/main/wp29/wp29regs.html.

(1) UNECE Regulation 17 "Uniform Provisions Concerning the Approval of Vehicles with Regard to the Seats, their Anchorages and Any Head Restraints": ECE 17 Rev. 1/Add. 16/Rev. 4 (July 31, 2002), into §571.202.

(2) UNECE Regulation 48 "Uniform Provisions Concerning the Approval of Vehicles With Regard to the Installation of Lighting and Light-Signaling Devices,"

E/ECE/324-E/ECE/TRANS/505, Rev.1/Add.47/Rev.1/Corr.2 (February 26, 1996), into §571.108.

§571.7 Applicability.

(a) **General.** Except as provided in paragraphs (c) and (d) of this section, each standard set forth in subpart B of this part applies according to its terms to all motor vehicles or items of motor vehicle equipment the manufacture of which is completed on or after the effective date of the standard.

(b) [Reserved]

(c) **Military vehicles.** No standard applies to a vehicle or item of equipment manufactured for, and sold directly to, the Armed Forces of the United States in conformity with contractual specifications.

(d) **Export.** No standard applies to a vehicle or item of equipment in the circumstances provided in section 108(b)(5) of the Act (15 U.S.C. 1397 (b)(5)).

(e) **Combining new and used components.** When a new cab is used in the assembly of a truck, the truck will be considered newly manufactured for purposes of paragraph (a) of this section, the application of the requirements of this chapter, and the Act, unless the engine, transmission, and drive axle(s) (as a minimum) of the assembled vehicle are not new, and at least two of these components were taken from the same vehicle.

(f) **Combining new and used components in trailer manufacture.** When new materials are used in the assembly of a trailer, the trailer will be considered newly manufactured for purposes of paragraph (a) of this section, the application of the requirements of this chapter, and the Act, unless, at a minimum, the trailer running gear assembly (axle(s), wheels, braking and suspension) is not new, and was taken from an existing trailer—

(1) Whose identity is continued in the reassembled vehicle with respect to the Vehicle Identification Number; and

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(2) That is owned or leased by the user of the reassembled vehicle.

§571.8 Effective date.

(a) **Firefighting vehicles.** Notwithstanding the effective date provisions of the motor vehicle safety standards in this part, the effective date of any standard or amendment of a standard issued after September 1, 1971, to which firefighting vehicles must conform shall be, with respect to such vehicles, either 2 years after the date on which such standard or amendment is published in the rules and regulations section of the *Federal Register*, or the effective date specified in the notice, whichever is later, except as such standard or amendment may otherwise specifically provide with respect to firefighting vehicles.

(b) **Vehicles built in two or more stages vehicles and altered vehicles.** Unless Congress directs or the agency expressly determines that this paragraph does not apply, the date for manufacturer certification of compliance with any standard, or amendment to a standard, that is issued on or after September 1, 2006 is, insofar as its application to intermediate and final-stage manufacturers and alterers is concerned, one year after the last applicable date for manufacturer certification of compliance. Nothing in this provision shall be construed as prohibiting earlier compliance with the standard or amendment or as precluding NHTSA from extending a compliance effective date for intermediate and final-stage manufacturers and alterers by more than one year.

§571.9 Separability.

If any standard established in this part or its application to any person or circumstance is held invalid, the remainder of the part and the application of that standard to other persons or circumstances is not affected thereby.

§571.10 Designation of Seating Positions.

(a) **Application.** This section applies to passenger cars, trucks, multipurpose passenger vehicles, and buses manufactured on or after September 1, 2010. However, paragraph (b) of this section does not apply to trucks and multipurpose passenger vehicles with a gross vehicle weight rating greater than 10,000 lbs, school buses, police vehicles as defined in S7 of Standard No. 208 (49 CFR 571.208), firefighting vehicles, ambulances, or motor homes. To determine the number of passenger seating positions in school buses, see S4.1 of Standard No. 222 (49 CFR 571.222).

(b) Number of designated seating positions. The formula for calculating the number of designated seating positions (N) for any seat location with a seating surface width greater than 330 mm (13 inches) is as follows:

(b)(1) For seat locations with a seating surface width, as described in paragraph (c), of less than 1400 mm (55.2 inches): $N = \text{The greater of 1 or } \lceil \text{seating surface width (in mm)/350} \rceil$ rounded down to the nearest whole number;

(b)(2) For seat locations with a seating surface width, as described in paragraph (c), greater than or equal to 1400 mm (55.2 inches): $N = \text{No less than } \lceil \text{seating sur-$

face width (in mm)/350 $\rceil$ rounded down to the nearest whole number.

(c) Seating surface measurement.

(1) As used in this section, “seating surface” only includes the seat cushion and soft trim and excludes unpadded trim components such as a decorative seat shield, seat adjusters, or adjuster covers. As used in paragraphs (c)(1)(ii) and (iii) of this section, “outboard” and “inboard” are determined with respect to the measurement zone established in paragraph (c)(1)(i) of this section. As used in this section, “seating surface width” is the maximum horizontal width of a seating surface determined by the following procedure:

(i) Establish a measurement zone bounded by two vertical planes oriented perpendicular to the direction the seat is facing. One is located 150 mm (5.9 inches) behind the front leading surface of the seat and the other is located 250 mm (9.8 inches) behind the front leading surface of the seat. A measurement location within this zone is any vertical plane parallel to the planes establishing the boundary of the zone.

(ii) For each measurement location within the zone, establish vertical reference planes parallel to the direction the seat faces that intersect the most outboard point on each side of the seating surface at that measurement location. If outboard interior trim contacts the top surface of the seat cushion, establish another vertical plane parallel to the direction the seat faces that intersects the most inboard point of contact between outboard interior trim and the top surface of the seat cushion.

(iii) For measurement within the zone, measure horizontally between and perpendicular to the most inboard vertical reference planes established in (ii), as shown in Figure 1 (provided for illustration purposes).

(c)(2) Adjacent seating surfaces are considered to form a single, continuous seating surface whose overall width is measured as specified in (c)(1) of this section, unless

(c)(2)(i) The seating surfaces are separated by:

(c)(2)(i)(A) A fixed trimmed surface whose top surface is unpadded and that has a width not less than 140 mm (5.5 inches), as measured in each transverse vertical plane within that measurement zone, or

(c)(2)(i)(B) A void whose cross section in each transverse vertical plane within that measurement zone is a rectangle that is not less than 140 mm (5.5 inches) wide and not less than 140 mm (5.5 inches) deep. The top edge of the cross section in any such plane is congruent with the transverse horizontal line that intersects the lowest point on the portion of the top profile of the seating surfaces that lie within that plane, or

(c)(2)(ii) Interior trim interrupts the measurement of the nominal hip room between adjacent seating surfaces, measured laterally along the “X” plane through the H-point. For purposes of this paragraph, the H-point is located using the SAE three-dimensional H-point machine per Society of Automotive Engineers (SAE) Surface Vehicle Standard J826, revised July

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1995, “Devices for Use in Defining and Measuring Vehicle Seating Accommodation” (incorporated by reference, see section 571.5) with the legs and leg weights removed, or

(c)(2)(iii) The seating surfaces are adjacent outboard seats, and the lateral distance between any point on the seat cushion of one seat and any point on the seat cushion of the other seat is not less than 140 mm (5.5 inches).

(c)(3) Folding, removable, and adjustable seats are measured in the configuration that results in the single largest maximum seating surface width.

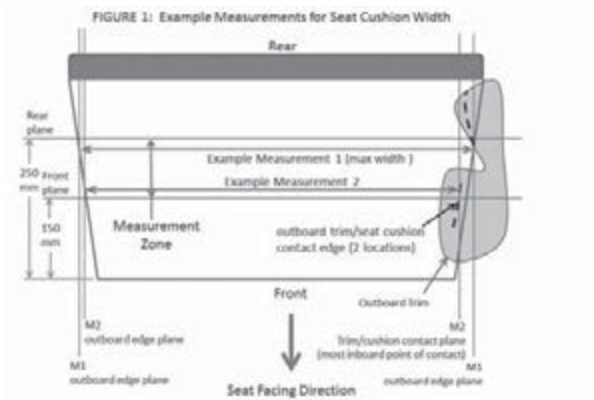


FIGURE 1: Example Measurements for Seat Cushion Width
Plan view of a seat showing several example measurement locations for the determination of seating surface width. Measurement 1 is the seat surface width for this illustration.

Selections from Subpart B— Federal motor vehicle safety standards

§571.101 Standard No. 101; Controls and displays.

S1. Scope. This standard specifies performance requirements for location, identification, color, and illumination of motor vehicle controls, telltales and indicators.

S2. Purpose. The purpose of this standard is to ensure the accessibility, visibility and recognition of motor vehicle controls, telltales and indicators, and to facilitate the proper selection of controls under daylight and nighttime conditions, in order to reduce the safety hazards caused by the diversion of the driver's attention from the driving task, and by mistakes in selecting controls.

S3. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S4. Definitions.

Adjacent, with respect to a control, telltale or indicator, and its identifier means:

(a) The identifier is in close proximity to the control, telltale or indicator; and

(b) No other control, telltale, indicator, identifier or source of illumination appears between the identifier and the telltale, indicator, or control that the identifier identifies.

Common space means an area on which more than one telltale, indicator, identifier, or other message may be displayed, but not simultaneously.

Control means the hand-operated part of a device that enables the driver to change the state or functioning of the vehicle or a vehicle subsystem.

Indicator means a device that shows the magnitude of the physical characteristics that the instrument is designed to sense.

Identifier means a symbol, word, or words used to identify a control, telltale, or indicator.

Multi-function control means a control through which the driver may select, and affect the operation of, more than one vehicle function.

Multi-task display means a display on which more than one message can be shown simultaneously.

Telltale means an optical signal that, when illuminated, indicates the actuation of a device, a correct or improper functioning or condition, or a failure to function.

S5. Requirements. Each passenger car, multipurpose passenger vehicle, truck and bus that is fitted with a control, a telltale or an indicator listed in Table 1 or Table 2 must meet the requirements of this standard for the location, identification, color, and illumination of that control, telltale or indicator. However, the requirements for telltales and indicators do not apply to vehicles with GVWRs of 4,536 kg or greater if these specified vehicles are manufactured before September 1, 2013.

S5.1 Location

S5.1.1 The controls listed in Table 1 and in Table 2 must be located so they are operable by the driver under the conditions of S5.6.2.

S5.1.2 The telltales and indicators listed in Table 1 and Table 2 and their identification must be located so that, when activated, they are visible to a driver under the conditions of S5.6.1 and S5.6.2.

S5.1.3 Except as provided in S5.1.4, the identification for controls, telltales and indicators must be placed on or adjacent to the telltale, indicator or control that it identifies.

S5.1.4 The requirement of S5.1.3 does not apply to a multi-function control, provided the multi-function control is associated with a multi-task display that:

(a) Is visible to the driver under the conditions of S5.6.1 and S5.6.2,

(b) Identifies the multi-function control with which it is associated graphically or using words,

(c) For multi-task displays with layers, identifies on the top-most layer each system for which control is possible from the associated multi-function control, including systems not otherwise regulated by this standard. Subfunctions of the available systems need not be shown on the top-most layer of the multi-task display, and

(d) Identifies the controls of Table 1 and Table 2 with the identification specified in those tables or otherwise required by this standard, whenever those are the active functions of the multi-function control. For lower levels of multi-task displays with layers, identification

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is permitted but not required for systems not otherwise regulated by this standard.

- (e) Does not display telltales listed in Table 1 or Table 2.

S5.2 Identification

S5.2.1 Except for the Low Tire Pressure Telltale, each control, telltale and indicator that is listed in column 1 of Table 1 or Table 2 must be identified by the symbol specified for it in column 2 or the word or abbreviation specified for it in column 3 of Table 1 or Table 2. If a symbol is used, each symbol provided pursuant to this paragraph must be substantially similar in form to the symbol as it appears in Table 1 or Table 2. If a symbol is used, each symbol provided pursuant to this paragraph must have the proportional dimensional characteristics of the symbol as it appears in Table 1 or Table 2. The Low Tire Pressure Telltale (either the display identifying which tire has low pressure or the display which does not identify which tire has low pressure) shall be identified by the appropriate symbol designated in column 4, or both the symbol in column 4 and the words in column 3. No identification is required for any horn (*i.e.*, audible warning signal) that is activated by a lanyard or by the driver pressing on the center of the face plane of the steering wheel hub; or for a turn signal control that is operated in a plane essentially parallel to the face plane of the steering wheel in its normal driving position and which is located on the left side of the steering column so that it is the control on that side of the column nearest to the steering wheel face plane. However, if identification is provided for a horn control in the center of the face plane of the steering wheel hub, the identifier must meet Table 2 requirements for the horn.

S5.2.2 Any symbol, word, or abbreviation not shown in Table 1 or Table 2 may be used to identify a control, a telltale or an indicator that is not listed in those tables.

S5.2.3 Supplementary symbols, words, or abbreviations may be used at the manufacturer's discretion in conjunction with any symbol, word, or abbreviation specified in Table 1 or Table 2.

S5.2.4 [Reserved]

S5.2.5 A single symbol, word, or abbreviation may be used to identify any combination of the control, indicator, and telltale for the same function.

S5.2.6 Except as provided in S5.2.7, all identifications of telltales, indicators and controls listed in Table 1 or Table 2 must appear to the driver to be perceptually upright. A rotating control that has an "off" position shall appear to the driver perceptually upright when the rotating control is in the "off" position.

S5.2.7 The identification of the following items need not appear to the driver to be perceptually upright:

- (a) A horn control;
- (b) Any control, telltale or indicator located on the steering wheel, when the steering wheel is positioned for the motor vehicle to travel in a direction other than straight forward; and
- (c) Any rotating control that does not have an "off" position.

S5.2.8 Each control for an automatic vehicle speed system (cruise control) and each control for heating and air conditioning systems must have identification provided for each function of each such system.

S5.2.9 Each control that regulates a system function over a continuous range must have identification provided for the limits of the adjustment range of that function. If color coding is used to identify the limits of the adjustment range of a temperature function, the hot limit must be identified by the color red and the cold limit by the color blue. If the status or limit of a function is shown by a display not adjacent to the control for that function, both the control (unless it is a multi-function control complying with S5.1.4) and the display must be independently identified as to the function of the control, in compliance with S5.2.1, on or adjacent to the control and on or adjacent to the display.

Example 1. A slide lever controls the temperature of the air in the vehicle heating system over a continuous range, from no heat to maximum heat. Since the control regulates a single function over a quantitative range, only the extreme positions require identification.

Example 2. A switch has three positions, for heat, defrost, and air conditioning. Since each position regulates a different function, each position must be identified.

S5.3 Illumination

S5.3.1 Timing of illumination

(a) Except as provided in S5.3.1(c), the identifications of controls for which the word "Yes" is specified in column 5 of Table 1 must be capable of being illuminated whenever the headlamps are activated. This requirement does not apply to a control located on the floor, floor console, steering wheel, steering column, or in the area of windshield header, or to a control for a heating and air-conditioning system that does not direct air upon the windshield.

(b) Except as provided in S5.3.1(c), the indicators and their identifications for which the word "Yes" is specified in column 5 of Table 1 must be illuminated whenever the vehicle's propulsion system and headlamps are activated.

(c) The indicators, their identifications and the identifications of controls need not be illuminated when the headlamps are being flashed or operated as daytime running lamps.

(d) At the manufacturer's option, any control, indicator, or their identifications may be capable of being illuminated at any time.

(e) A telltale must not emit light except when identifying the malfunction or vehicle condition it is designed to indicate, or during a bulb check.

S5.3.2 Brightness of illumination of controls and indicators

S5.3.2.1 Means must be provided for illuminating the indicators, identifications of indicators and identifications of controls listed in Table 1 to make them visible to the driver under daylight and nighttime driving conditions.

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S5.3.2.2 The means of providing the visibility required by S5.3.2.1:

(a) Must be adjustable to provide at least two levels of brightness;

(b) At a level of brightness other than the highest level, the identification of controls and indicators must be barely discernible to the driver who has adapted to dark ambient roadway condition;

(c) May be operable manually or automatically; and

(d) May have levels of brightness, other than the two required visible levels of brightness, at which those items and identification are not visible.

(1) If the level of brightness is adjusted by automatic means to a point where those items or their identification are not visible to the driver, means shall be provided to enable the driver to restore visibility.

S5.3.3 Brightness of telltale illumination

(a) Means must be provided for illuminating telltales and their identification sufficiently to make them visible to the driver under daylight and nighttime driving conditions.

(b) The means for providing the required visibility may be adjustable manually or automatically, except that the telltales and identification for brakes, high-beams, turn signals, and safety belts may not be adjustable under any driving condition to a level that is invisible.

S5.3.4 Brightness of interior lamps. (a) Any source of illumination within the passenger compartment which is forward of a transverse vertical plane 110 mm rearward of the manikin "H" point with the driver's seat in its rearmost driving position, which is not used for the controls and displays regulated by this standard, which is not a telltale, and which is capable of being illuminated while the vehicle is in motion, shall have either:

(1) Light intensity which is manually or automatically adjustable to provide at least two levels of brightness;

(2) A single intensity that is barely discernible to a driver who has adapted to dark ambient roadway conditions; or

(3) A means of being turned off.

(b) Paragraph (a) of S5.3.4 does not apply to buses that are normally operated with the passenger compartment illuminated.

S5.3.5 The provisions of S5.3.4 do not apply to buses that are normally operated with the passenger compartment illuminated.

S5.4 Color

S5.4.1 The light of each telltale listed in Table 1 must be of the color specified for that telltale in column 6 of that table.

S5.4.2 Any indicator or telltale not listed in Table 1 and any identification of that indicator or telltale must not be a color that masks the driver's ability to recognize any telltale, control, or indicator listed in Table 1.

S5.4.3 Each identifier used for the identification of a telltale, control or indicator must be in a color that stands out clearly against the background. However,

this requirement does not apply to an identifier for a horn control in the center of the face plane of the steering wheel hub. For vehicles with a GVWR of under 4,536 kg (10,000 pounds), the compliance date for this provision is September 1, 2011. For vehicles with a GVWR of 4,536 kg (10,000 pounds) or over, the compliance date for this provision is September 1, 2013.

S5.4.4 The filled-in part of any symbol in Table 1 or Table 2 may be replaced by its outline and the outline of any symbol in Table 1 or Table 2 may be filled in.

S5.5 Common space for displaying multiple messages

S5.5.1 A common space may be used to show messages from any sources, subject to the requirements in S5.5.2 through S5.5.6.

S5.5.2 The telltales for any brake system malfunction required by Table 1 to be red, air bag malfunction, low tire pressure, electronic stability control malfunction (as of September 1, 2011), passenger air bag off, high beam, turn signal, and seat belt must not be shown in the same common space.

S5.5.3 The telltales and indicators that are listed in Table 1 and are shown in the common space must illuminate at the initiation of any underlying condition.

S5.5.4 Except as provided in S5.5.5, when the underlying conditions exist for actuation of two or more telltales, the messages must be either:

(a) Repeated automatically in sequence, or

(b) Indicated by visible means and capable of being selected for viewing by the driver under the conditions of S5.6.2.

S5.5.5 In the case of the telltale for a brake system malfunction, air bag malfunction, side air bag malfunction, low tire pressure, electronic stability control malfunction (as of September 1, 2011), passenger air bag off, high beam, turn signal, or seat belt that is designed to display in a common space, that telltale must displace any other symbol or message in that common space while the underlying condition for the telltale's activation exists.

S5.5.6(a) Except as provided in S5.5.6(b), messages displayed in a common space may be cancelable automatically or by the driver.

(b) Telltales for high beams, turn signal, low tire pressure, and passenger air bag off, and telltales for which the color red is required in Table 1 must not be cancelable while the underlying condition for their activation exists.

S5.6 Conditions

S5.6.1 The driver has adapted to the ambient light roadway conditions.

S5.6.2 The driver is restrained by the seat belts installed in accordance with 49 CFR 571.208 and adjusted in accordance with the vehicle manufacturer's instructions.

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Tables to §571.101

Table 1
Controls, Telltales, and Indicators
With Illumination or Color Requirements¹

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE- VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN- ATION	Column 6 COLOR
Highbeam 2	 3,5	—	Telltale	—	Blue or Green 4
Turn signals 2	 3,6	—	Control Telltale	— —	— Green 4
Hazard warning signal	 3	Hazard —	Control Telltale 7	Yes —	— —
Position, side marker, end-outline marker, identification, or clearance lamps	 3 8	Marker Lamps or MK Lps 8	Control	Yes	—
Windshield wiping system	 3	Wiper or Wipe	Control	Yes	—
Windshield washing system	 3	Washer or Wash	Control	Yes	—
Windshield washing and wiping system combined	 3	Washer-Wiper or Wash-Wipe	Control	Yes	—
Windshield defrosting and defogging system	 3	Defrost, Defog or Def.	Control	Yes	—
Rear window defrosting and defogging system	 3	Rear Defrost, Rear Defog, Rear Def., or R-Def.	Control	Yes	—

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Table 1
Controls, Telltales, and Indicators
With Illumination or Color Requirements¹

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE- VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN- ATION	Column 6 COLOR
Brake system malfunction	—	Brake	Telltale	—	Red ⁴
Antilock brake system malfunction for vehicles subject to FMVSS 105 or 135	—	Antilock, Anti-lock, or ABS ₉	Telltale	—	Yellow
Malfunction in Variable Brake Proportioning System	—	Brake Proportioning ₉	Telltale	—	Yellow
Regenerative brake system malfunction	—	RBS or ABS/RBS ₉	Telltale	—	Yellow
Malfunction in antilock system for vehicles other than trailers subject to FMVSS 121	—	ABS or Antilock ₉	Telltale	—	Yellow
Antilock brake system trailer fault for vehicles subject to FMVSS 121		Trailer ABS or Trailer Antilock	Telltale	—	Yellow
Brake Pressure (for vehicles subject to FMVSS 105 or 135)	—	Brake Pressure ₉	Telltale	—	Red ⁴
Low brake fluid condition (for vehicles subject to FMVSS 105 or 135)	—	Brake Fluid ₉	Telltale	—	Red ⁴
Parking brake applied (for vehicles subject to FMVSS 105 or 135)	—	Park or Parking Brake ₉	Telltale	—	Red ⁴
Brake lining wear-out condition (for vehicles subject to FMVSS 135)	—	Brake Wear ₉	Telltale	—	Red ⁴
Electronic Stability Control System Malfunction (manufacturer may use this telltale in flashing mode to indicate ESC operation. See FMVSS 126.) ₁₀		ESC ₁₁	Telltale	—	Yellow
Electronic Stability Control System "OFF" ₁₀		ESC OFF	Control	Yes	—
			Telltale	—	Yellow

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Table 1
Controls, Telltales, and Indicators
With Illumination or Color Requirements¹

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE- VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN- ATION	Column 6 COLOR
Fuel Level	 or 	Fuel	Telltale	—	—
			Indicator	Yes	—
Engine oil pressure	 ¹²	Oil	Telltale	—	—
			Indicator	Yes	—
Engine coolant temperature	 ¹²	Temp	Telltale	—	—
			Indicator	Yes	—
Electrical charge		Volts or Charge or Amp	Telltale	—	—
			Indicator	Yes	—
Engine stop	—	Engine Stop ¹³	Control	Yes	—
Automatic vehicle speed (cruise control)	—	—	Control	Yes	—
Speedometer	—	MPH, or MPH and km/h ¹⁴	Indicator	Yes	—
Heating and Air conditioning system	—	—	Control	Yes	—
Automatic transmission control position (<i>park</i>) (<i>reverse</i>) (<i>neutral</i>) (<i>drive</i>)	—	P R N D ¹⁵	Indicator	Yes	—
Heating and/or air conditioning fan	 or 	Fan	Control	Yes	—
Low Tire Pressure (including malfunction) (See FMVSS 138)	 ¹⁶	Low Tire ¹⁶	Telltale	—	Yellow

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Table 1
Controls, Telltales, and Indicators
With Illumination or Color Requirements¹

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORDS OR ABBRE- VIATIONS	Column 4 FUNCTION	Column 5 ILLUMIN- ATION	Column 6 COLOR
Low Tire Pressure (including malfunction) that identifies involved tire (See FMVSS 138)	 16	Low Tire 16	Telltale	—	Yellow
Tire Pressure Monitoring System Malfunction (See FMVSS 138) ¹⁷	—	TPMS 16, 18	Telltale	—	Yellow

Notes:

1. An identifier is shown in this table if it is required for a control for which an illumination requirement exists or if it is used for a telltale for which a color requirement exists. If a line appears in column 2 and column 3, the control, telltale or indicator is required to be identified, however the form of the identification is the manufacturer's option. Telltales are not considered to have an illumination requirement, because by definition the telltale must light when the condition for its activation exists.
2. Additional requirements in FMVSS 108.
3. Framed areas of the symbol may be solid; solid areas may be framed.
4. Blue may be blue-green. Red may be red-orange.
5. Symbols employing four lines instead of five may also be used.
6. The pair of arrows is a single symbol. When the controls or telltales for left and right turn operate independently, however, the two arrows may be considered separate symbols and be spaced accordingly.
7. Not required when arrows of turn signal telltales that otherwise operate independently flash simultaneously as hazard warning telltale.
8. Separate identification not required if function is combined with master lighting switch.
9. Refer to FMVSS 105 or FMVSS 135, as appropriate, for additional specific requirements for brake telltale labeling and color. If a single telltale is used to indicate more than one brake system condition, the brake system malfunction identifier must be used.
10. Requirement effective September 1, 2011.
11. This symbol may also be used to indicate the malfunction of related systems/functions, including traction control, trailer stability assist, corner brake control, and other similar functions that use throttle and/or individual wheel torque control to operate and share common components with ESC.
12. Combination of the engine oil pressure symbol and the engine coolant temperature symbol in a single telltale is permitted.
13. Use when engine control is separate from the key locking system.
14. If the speedometer is graduated in both miles per hour and in kilometers per hour, the scales must be identified "MPH" and "km/h", respectively, in any combination of upper- and lowercase letters.
15. The letters 'P', 'R', 'N', and 'D' are considered separate identifiers for the individual gear positions. Their locations within the vehicle, and with respect to each other, are governed by FMVSS 102. The letter 'D' may be replaced by another alphanumeric character or symbol chosen by the manufacturer.
16. Required only for FMVSS 138 compliant vehicles.
17. Alternatively, either low tire pressure telltale may be used to indicate a TPMS malfunction. See FMVSS 138.
18. Required only for vehicles manufactured on or after September 1, 2007.

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Table 2
Identifiers for
Controls, Telltales and Indicators with
No Color or Illumination Requirements

Column 1 ITEM	Column 2 SYMBOL	Column 3 WORD(S) OR ABBREVIATION
Hand Throttle Control	—	Throttle
Engine Start Control	—	Engine Start ₁
Manual Choke Control	—	Choke
Odometer	—	Kilometers or km, if kilometers are shown. Otherwise, no identifier is required. ²
Horn		Horn
Master Lighting Switch		Lights
Headlamps and Taillamps Control	—	— ^{4,5}
Low Brake Air Pressure Telltale (for vehicles subject to FMVSS 121)	—	Brake Air
Seat Belt Unfastened Telltale		Fasten Belts or Fasten Seat Belts

Notes:

1. Use when engine control is separate from the key locking system.
2. Any combination of upper- or lowercase letters may be used.
3. Framed areas may be filled.
4. If a line appears in Column 2 and Column 3, the Control, Telltale or Indicator is required to be identified, however the form of the identification is the manufacturer's option.
5. Separate identification not required if function is combined with Master Lighting Switch

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§571.102 Standard No. 102; Transmission shift position sequence, starter interlock, and transmission braking effect.

S1. Purpose and scope. This standard specifies the requirements for the transmission shift position sequence, a starter interlock, and for a braking effect of automatic transmissions, to reduce the likelihood of shifting errors, to prevent starter engagement by the driver when the transmission is in any drive position, and to provide supplemental braking at speeds below 40 kilometers per hour (25 miles per hour).

S2. Application. This standard applies to passenger cars, multi-purpose passenger vehicles, trucks, and buses.

S3. Requirements.

S3.1 Automatic transmissions.

S3.1.1 Location of transmission shift positions on passenger cars. A neutral position shall be located between forward drive and reverse drive positions.

S3.1.1.1 Transmission shift levers. If a steering-column-mounted transmission shift lever is used, movement from neutral position to forward drive position shall be clockwise. If the transmission shift lever sequence includes a park position, it shall be located at the end, adjacent to the reverse drive position.

S3.1.2 Transmission braking effect. In vehicles having more than one forward transmission gear ratio, one forward drive position shall provide a greater degree of engine braking than the highest speed transmission ratio at vehicle speeds below 40 kilometers per hour (25 miles per hour).

S3.1.3 Starter interlock. Except as provided in S3.1.3.1 through S3.1.3.3, the engine starter shall be inoperative when the transmission shift position is in a forward or reverse drive position.

S3.1.3.1 After the driver has activated the vehicle's propulsion system:

(a) The engine may stop and restart automatically when the transmission shift position is in any forward drive gear;

(b) The engine may not automatically stop when the transmission is in reverse gear; and

(c) The engine may automatically restart in reverse gear only if the vehicle satisfies (1) and (2):

(1) When the engine is automatically stopped in a forward drive shift position and the driver selects Reverse, the engine restarts immediately whenever the service brake is applied.

(2) When the engine is automatically stopped in a forward drive shift position and the driver selects Reverse, the engine does not start automatically if the service brake is not applied.

S3.1.3.2 Notwithstanding S3.1.3.1, the engine may stop and start at any time after the driver has activated the vehicle's propulsion system if the vehicle can meet the requirements specified in paragraphs (a) and (b):

(a) For passenger cars, multi-purpose passenger vehicles, trucks and buses with a GVWR less than or equal to 4,536 kg (10,000 pounds), the vehicle's propulsion system can propel the vehicle in the normal travel mode in all forward and reverse drive gears without the

engine operating. For passenger cars, multipurpose passenger vehicles, trucks and buses with a GVWR greater than 4,536 kg (10,000 pounds), the vehicle's propulsion system can propel the vehicle in the normal travel mode in Reverse and at least one forward drive gear without the engine operating.

(b) If the engine automatically starts while the vehicle is traveling at a steady speed and steady accelerator control setting, the engine does not cause the vehicle to accelerate.

S3.1.3.3 If the transmission shift position is in Park, automatically stopping or restarting the engine shall not take the transmission out of Park.

S3.1.4 Identification of shift positions and of shift position sequence.

S3.1.4.1 Except as specified in S3.1.4.3, if the transmission shift position sequence includes a park position, identification of shift positions, including the positions in relation to each other and the position selected, shall be displayed in view of the driver whenever any of the following conditions exist:

(a) The ignition is in a position where the transmission can be shifted; or

(b) The transmission is not in park.

S3.1.4.2 Except as specified in S3.1.4.3, if the transmission shift position sequence does not include a park position, identification of shift positions, including the positions in relation to each other and the position selected, shall be displayed in view of the driver whenever the ignition is in a position in which the engine is capable of operation.

S3.1.4.3 Such information need not be displayed when the ignition is in a position that is used only to start the vehicle.

S3.1.4.4 All of the information required to be displayed by S3.1.4.1 or S3.1.4.2 shall be displayed in view of the driver in a single location. At the option of the manufacturer, redundant displays providing some or all of the information may be provided.

S3.2 Manual transmissions. Identification of the shift lever pattern of manual transmissions, except three forward speed manual transmissions having the standard "H" pattern, shall be displayed in view of the driver at all times when a driver is present in the driver's seating position.

§571.103 Standard No. 103; Windshield defrosting and defogging systems.

S1. Scope. This standard specifies requirements for windshield defrosting and defogging systems.

S2. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. Definitions. Road load means the power output required to move a given motor vehicle at curb weight plus 180 kilograms on level, clean, dry, smooth portland cement concrete pavement (or other surface with equivalent coefficient of surface friction) at a specified speed through still air at 20 degrees Celsius, and standard barometric pressure (101.3 kilopascals) and includes driveline friction, rolling friction, and air resistance.

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S4. Requirements. (a) Except as provided in paragraph (b) of this section, each passenger car shall meet the requirements specified in S4.1, S4.2, and S4.3, and each multipurpose passenger vehicle, truck, and bus shall meet the requirements specified in S4.1.

(b) Each passenger car, multipurpose passenger vehicle, truck, and bus manufactured for sale in the noncontinental United States may, at the option of the manufacturer, have a windshield defogging system which operates either by applying heat to the windshield or by dehumidifying the air inside the passenger compartment of the vehicle, in lieu of meeting the requirements specified by paragraph (a) of this section.

S4.1 Each vehicle shall have a windshield defrosting and defogging system.

S4.2 Each passenger car windshield defrosting and defogging system shall meet the requirements of section 3 of SAE Recommended Practice J902 (1964) (incorporated by reference, see §571.5) when tested in accordance with S4.3, except that “the critical area” specified in paragraph 3.1 of SAE Recommended Practice J902 (1964) shall be that established as Area C in accordance with Motor Vehicle Safety Standard No. 104, “Windshield Wiping and Washing Systems,” and “the entire windshield” specified in paragraph 3.3 of SAE Recommended Practice J902 (1964) shall be that established as Area A in accordance with §571.104.

S4.3 Demonstration procedure. The passenger car windshield defrosting and defogging system shall be tested in accordance with the portions of paragraphs 4.1 through 4.4.7 of SAE Recommended Practice J902 (1964) or SAE Recommended Practice J902a (1967) (both incorporated by reference, see §571.5) applicable to that system, except that—

(a) During the first 5 minutes of the test:

(1) For a passenger car equipped with a heating system other than a heat exchanger type that uses the engine’s coolant as a means to supply the heat to the heat exchanger, the warm-up procedure is that specified by the vehicle’s manufacturer for cold weather starting, except that connection to a power or heat source external to the vehicle is not permitted.

(2) For all other passenger cars, the warm-up procedure may be that recommended by the vehicle’s manufacturer for cold weather starting.

(b) During the last 35 minutes of the test period (or the entire test period if the 5-minute warm-up procedure specified in paragraph (a) of this section is not used),

(1) For a passenger car equipped with a heating system other than a heat exchanger type that uses the engine’s coolant as a means to supply the heat to the heat exchanger, the procedure shall be that specified by the vehicle’s manufacturer for cold weather starting, except that connection to a power or heat source external to the vehicle is not permitted.

(2) For all other passenger cars, either—

(i) The engine speed shall not exceed 1,500 r.p.m. in neutral gear; or

(ii) The engine speed and load shall not exceed the speed and load at 40 kilometers per hour in the manufacturer’s recommended gear with road load;

(c) A room air change of 90 times per hour is not required;

(d) The windshield wipers may be used during the test if they are operated without manual assist;

(e) One or two windows may be open a total of 25 millimeters;

(f) The defroster blower may be turned on at any time; and

(g) The wind velocity is at any level from 0 to 3 kilometers per hour.

(h) The test chamber temperature and the wind velocity shall be measured, after the engine has been started, at the forwardmost point of the vehicle or a point 914 millimeters from the base of the windshield, whichever is farther forward, at a level halfway between the top and bottom of the windshield on the vehicle centerline.

§571.104 Standard No. 104; Windshield wiping and washing systems.

S1. Scope. This standard specifies requirements for windshield wiping and washing systems.

S2. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. Definitions. The term seating reference point is substituted for the terms manikin H point, manikin H point with seat in rearmost position and H point wherever any of these terms appear in any SAE Standard or SAE Recommended Practice referred to in this standard.

Daylight opening means the maximum unobstructed opening through the glazing surface, as defined in paragraph 2.3.12 of section E, “Ground Vehicle Practice,” of SAE Aerospace-Automotive Drawing Standards (1963) (incorporated by reference, see §571.5).

Glazing surface reference line means the line resulting from the intersection of the glazing surface and a horizontal plane 635 millimeters above the seating reference point, as shown in Figure 1 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5).

Overall width means the maximum overall body width dimension “W116”, as defined in section E, “Ground Vehicle Practice,” of SAE Aerospace-Automotive Drawing Standards (1963) (incorporated by reference, see §571.5).

Plan view reference line means—

(a) For vehicles with bench-type seats, a line parallel to the vehicle longitudinal centerline outboard of the steering wheel centerline 0.15 times the difference between one-half of the shoulder room dimension and the steering wheel centerline-to-car-centerline dimension as shown in Figure 2 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5); or

(b) For vehicles with individual-type seats, either—

(i) A line parallel to the vehicle longitudinal centerline which passes through the center of the driver’s designated seating position; or

(ii) A line parallel to the vehicle longitudinal centerline located so that the geometric center of the 95 percent eye range contour is positioned on the longitudinal centerline of the driver’s designated seating position.

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Shoulder room dimension means the front shoulder room dimension “W3” as defined in section E, “Ground Vehicle Practice,” of SAE Aerospace-Automotive Drawing Standards (1963) (incorporated by reference, see §571.5).

95 percent eye range contour means the 95th percentile tangential cutoff specified in SAE Recommended Practice J941 (1965) (incorporated by reference, see §571.5).

S4. Requirements.

S4.1 Windshield wiping system. Each vehicle shall have a power-driven windshield wiping system that meets the requirements of S4.1.1.

S4.1.1 Frequency.

S4.1.1.1 Each windshield wiping system shall have at least two frequencies or speeds.

S4.1.1.2 One frequency or speed shall be at least 45 cycles per minute regardless of engine load and engine speed.

S4.1.1.3 Regardless of engine speed and engine load, the highest and one lower frequency or speed shall differ by at least 15 cycles per minute. Such lower frequency or speed shall be at least 20 cycles per minute regardless of engine speed and engine load.

S4.1.1.4 Compliance with subparagraphs S4.1.1.2 and S4.1.1.3 may be demonstrated by testing under the conditions specified in sections 4.1.1 and 4.1.2 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5).

S4.1.2 Wiped area. When tested wet in accordance with SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5), each passenger car windshield wiping system shall wipe the percentage of Areas A, B, and C of the windshield (established in accordance with S4.1.2.1) that (1) is specified in column 2 of the applicable table following subparagraph S4.1.2.1 and (2) is within the area bounded by a perimeter line on the glazing surface 25 millimeters from the edge of the daylight opening.

S4.1.2.1 A, B, and C shall be established as shown in Figures 1 and 2 of SAE Recommended Practice J903a (1966) (incorporated by reference, see §571.5) using the angles specified in Columns 3 through 6 of Table I, II, III, or IV, as applicable.

S4.2 Windshield washing system.

S4.2.1 Each passenger car shall have a windshield washing system that meets the requirements of SAE Recommended Practice J942 (1965) (incorporated by reference, see §571.5), except that the reference to “the effective wipe pattern defined in SAE J903, paragraph 3.1.2” in paragraph 3.1 of SAE Recommended Practice J942 (1965) shall be deleted and “the areas established in accordance with subparagraph S4.1.2.1 of Motor Vehicle Safety Standard No. 104” shall be inserted in lieu thereof.

S4.2.2 Each multipurpose passenger vehicle, truck, and bus shall have a windshield washing system that meets the requirements of SAE Recommended Practice J942 (1965) (incorporated by reference, see §571.5), except that the reference to “the effective wipe pattern defined in SAE J903, paragraph 3.1.2” in paragraph 3.1 of SAE

Recommended Practice J942 (1965) shall be deleted and “the pattern designed by the manufacturer for the windshield wiping system on the exterior surface of the windshield glazing” shall be inserted in lieu thereof.

TABLE I—PASSENGER CARS OF LESS THAN 60 INCHES IN OVERALL WIDTH

COLUMN 1—AREA	COLUMN 2—MINIMUM PERCENT TO BE WIPED	ANGLES IN DEGREES			
		COLUMN 3—LEFT	COLUMN 4—RIGHT	COLUMN 5—UP	COLUMN 6—DOWN
A.....	80	16	49	7	5
B.....	94	13	46	4	3
C.....	99	7	15	3	1

TABLE II—PASSENGER CARS OF 60 OR MORE BUT LESS THAN 64 INCHES IN OVERALL WIDTH

COLUMN 1—AREA	COLUMN 2—MINIMUM PERCENT TO BE WIPED	ANGLES IN DEGREES			
		COLUMN 3—LEFT	COLUMN 4—RIGHT	COLUMN 5—UP	COLUMN 6—DOWN
A.....	80	17	51	8	5
B.....	94	13	49	4	3
C.....	99	7	15	3	1

TABLE III—PASSENGER CARS OF 64 OR MORE BUT LESS THAN 68 INCHES IN OVERALL WIDTH

COLUMN 1—AREA	COLUMN 2—MINIMUM PERCENT TO BE WIPED	ANGLES IN DEGREES			
		COLUMN 3—LEFT	COLUMN 4—RIGHT	COLUMN 5—UP	COLUMN 6—DOWN
A.....	80	17	53	9	5
B.....	94	14	51	5	3
C.....	99	8	15	4	1

TABLE IV—PASSENGER CARS OF 68 OR MORE INCHES IN OVERALL WIDTH

COLUMN 1—AREA	COLUMN 2—MINIMUM PERCENT TO BE WIPED	ANGLES IN DEGREES			
		COLUMN 3—LEFT	COLUMN 4—RIGHT	COLUMN 5—UP	COLUMN 6—DOWN
A.....	80	18	56	10	5
B.....	94	14	53	5	3
C.....	99	10	15	5	1

§571.105 Standard No. 105; Hydraulic and electric brake systems.

S1. Scope. This standard specifies requirements for hydraulic and electric service brake systems, and associated parking brake systems.

S2. Purpose. The purpose of this standard is to insure safe braking performance under normal and emergency conditions.

S3. Application. This standard applies to multipurpose passenger vehicles, trucks, and buses with a

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GVWR greater than 3,500 kilograms (7,716 pounds) that are equipped with hydraulic or electric brake systems.

S4. Definitions.

Antilock brake system or ABS means a portion of a service brake system that automatically controls the degree of rotational wheel slip during braking by:

- (1) Sensing the rate of angular rotation of the wheels;
- (2) Transmitting signals regarding the rate of wheel angular rotation to one or more controlling devices which interpret those signals and generate responsive controlling output signals; and

- (3) Transmitting those controlling signals to one or more modulators which adjust brake actuating forces in response to those signals.

Backup system means a portion of a service brake system, such as a pump, that automatically supplies energy, in the event of a primary brake power source failure.

Brake power assist unit means a device installed in a hydraulic brake system that reduces the operator effort required to actuate the system, and that if inoperative does not prevent the operator from braking the vehicle by a continued application of muscular force on the service brake control.

Brake power unit means a device installed in a brake system that provides the energy required to actuate the brakes, either directly or indirectly through an auxiliary device, with the operator action consisting only of modulating the energy application level.

Directly Controlled Wheel means a wheel for which the degree of rotational wheel slip is sensed, either at that wheel or on the axle shaft for that wheel and corresponding signals are transmitted to one or more modulators that adjust the brake actuating forces at that wheel. Each modulator may also adjust the brake actuating forces at other wheels that are on the same axle or in the same axle set in response to the same signal or signals.

Electric vehicle or EV means a motor vehicle that is powered by an electric motor drawing current from rechargeable storage batteries, fuel cells, or other portable sources of electrical current, and which may include a non-electrical source of power designed to charge batteries and components thereof.

Electrically-actuated service brakes means service brakes that utilize electrical energy to actuate the foundation brakes.

Full brake application means a brake application in which the force on the brake pedal reaches 150 pounds within 0.3 seconds from the point of application of force to the brake control.

Hydraulic brake system means a system that uses hydraulic fluid as a medium for transmitting force from a service brake control to the service brake, and that may incorporate a brake power assist unit, or a brake power unit.

Indirectly Controlled Wheel means a wheel at which the degree of rotational wheel slip is not sensed, but at which the modulator of an antilock braking system adjusts its brake actuating forces in response to signals from one or more sensed wheels.

Initial brake temperature means the average temperature of the service brakes on the hottest axle of the vehicle 0.2 mi before any brake application.

Lightly loaded vehicle weight means:

- (a) For vehicles with a GVWR of 10,000 lbs. or less, unloaded vehicle weight plus 400 lbs. (including driver and instrumentation);

- (b) For vehicles with a GVWR greater than 10,000 lbs., unloaded vehicle weight plus 500 lbs. (including driver and instrumentation).

Maximum drive-through speed means the highest possible constant speed at which the vehicle can be driven through 200 feet of a 500-foot radius curve arc without leaving the 12-foot lane.

Parking mechanism means a component or subsystem of the drive train that locks the drive train when the transmission control is placed in a parking or other gear position and the ignition key is removed.

Peak friction coefficient or PFC means the ratio of the maximum value of braking test wheel longitudinal force to the simultaneous vertical force occurring prior to wheel lockup, as the braking torque is progressively increased.

Pressure component means a brake system component that contains the brake system fluid and controls or senses the fluid pressure.

Regenerative braking system or RBS means an electrical energy system that is installed in an EV for recovering or dissipating kinetic energy, and which uses the propulsion motor(s) as a retarder for partial braking of the EV while returning electrical energy to the propulsion batteries or dissipating electrical energy.

Skid number means the frictional resistance of a pavement measured in accordance with ASTM E274-70 (incorporated by reference, see §571.5) at 40 mph, omitting water delivery as specified in paragraphs 7.1 and 7.2 of that method.

Snub means the braking deceleration of a vehicle from a higher reference speed to a lower reference speed that is greater than zero.

Spike stop means a stop resulting from the application of 200 lbs of force on the service brake control in 0.08 s.

Split service brake system means a brake system consisting of two or more subsystems actuated by a single control, designed so that a single failure in any subsystem (such as a leakage-type failure of a pressure component of a hydraulic subsystem except structural failure of a housing that is common to two or more subsystems, or an electrical failure in an electric subsystem) does not impair the operation of any other subsystem.

Stopping distance means the distance traveled by a vehicle from the point of application of force to the brake control to the point at which the vehicle reaches a full stop.

Tandem axle means a group of two or more axles placed in close arrangement one behind the other with the center lines of adjacent axles not more than 72 inches apart.

Variable proportioning brake system means a system that automatically adjusts the braking force at the axles to compensate for vehicle static axle loading

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and/or dynamic weight transfer between axles during deceleration.

Wheel lockup means 100 percent wheel slip.

S5. Requirements.

S5.1 Service brake systems. Each vehicle must be equipped with a service brake system acting on all wheels. Wear of the service brake must be compensated for by means of a system of automatic adjustment. Each passenger car and each multipurpose passenger vehicle, truck, and bus with a GVWR of 10,000 pounds or less must be capable of meeting the requirements of S5.1.1 through S5.1.6 under the conditions prescribed in S6, when tested according to the procedures and in the sequence set forth in S7. Each school bus with a GVWR greater than 10,000 pounds must be capable of meeting the requirements of S5.1.1 through S5.1.5, and S5.1.7 under the conditions specified in S6, when tested according to the procedures and in the sequence set forth in S7. Each multipurpose passenger vehicle, truck and bus (other than a school bus) with a GVWR greater than 10,000 pounds must be capable of meeting the requirements of S5.1.1, S5.1.2, S5.1.3, and S5.1.7 under the conditions specified in S6, when tested according to the procedures and in the sequence set forth in S7. Except as noted in S5.1.1.2 and S5.1.1.4, if a vehicle is incapable of attaining a speed specified in S5.1.1, S5.1.2, S5.1.3, or S5.1.6, its service brakes must be capable of stopping the vehicle from the multiple of 5 mph that is 4 to 8 mph less than the speed attainable in 2 miles, within distances that do not exceed the corresponding distances specified in Table II. If a vehicle is incapable of attaining a speed specified in S5.1.4 in the time or distance interval set forth, it must be tested at the highest speed attainable in the time or distance interval specified.

S5.1.1 Stopping distance.

(a) The service brakes shall be capable of stopping each vehicle with a GVWR of less than 8,000 pounds, and each school bus with a GVWR between 8,000 pounds and 10,000 pounds in four effectiveness tests within the distances and from the speeds specified in S5.1.1.1, S5.1.1.2, S5.1.1.3, and S5.1.1.4.

(b) The service brakes shall be capable of stopping each vehicle with a GVWR of between 8,000 pounds and 10,000 pounds, other than a school bus, in three effectiveness tests within the distances and from the speeds specified in S5.1.1.1, S5.1.1.2, and S5.1.1.4.

(c) The service brakes shall be capable of stopping each vehicle with a GVWR greater than 10,000 pounds in two effectiveness tests within the distances and from the speeds specified in S5.1.1.2 and S5.1.1.3. Each school bus with a GVWR greater than 10,000 pounds manufactured after January 12, 1996 and before March 1, 1999 and which is equipped with an antilock brake system may comply with paragraph S5.1.1.2 and S5.1.1.3 rather than the first effectiveness test, as specified in S5.1.1.1. Each school bus with a GVWR greater than 10,000 pounds manufactured on or after March 1, 1999 shall be capable of meeting the requirements of S5.1.1 through S5.1.5, under the conditions prescribed in S6, when tested according to the procedures and in the sequence set forth in S7.

S5.1.1.1 In the first (preburnished) effectiveness test, the vehicle shall be capable of stopping from 30 mph and 60 mph within the corresponding distances specified in Column I of Table II.

S5.1.1.2 In the second effectiveness test, each vehicle with a GVWR of 10,000 pounds or less and each school bus with a GVWR greater than 10,000 pounds shall be capable of stopping from 30 mph and 60 mph, and each vehicle with a GVWR greater than 10,000 pounds (other than a school bus) shall be capable of stopping from 60 mph, within the corresponding distances specified in Column II of Table II. If the speed attainable in 2 miles is not less than 84 mph, a passenger car or other vehicle with a GVWR of 10,000 pounds or less shall also be capable of stopping from 80 mph within the corresponding distances specified in Column II of Table II.

S5.1.1.3 In the third effectiveness test the vehicle shall be capable of stopping at lightly loaded vehicle weight from 60 mph within the corresponding distance specified in Column III of Table II.

S5.1.1.4 In the fourth effectiveness test, a vehicle with a GVWR of 10,000 pounds or less shall be capable of stopping from 30 and 60 mph within the corresponding distances specified in Column I of Table II. If the speed attainable in 2 miles is not less than 84 mph, a passenger car, or other vehicle with a GVWR of 10,000 lbs., or less, shall also be capable of stopping from 80 mph within the corresponding distance specified in Column I of Table II.

If the speed attainable in 2 miles is not less than 99 mph, a passenger car shall, in addition, be capable of stopping from the applicable speed indicated below, within the corresponding distance specified in Column I of Table II.

Speed attainable in 2 miles (mph)	Required to stop from (mph)
Not less than 99 but less than 104	95
104 or more	100

For an EV, the speed attainable in 2 miles is determined with the propulsion batteries at a state of charge of not less than 95 percent at the beginning of the run.

S5.1.2 Partial failure.

S5.1.2.1 In vehicles manufactured with a split service brake system, in the event of a rupture or leakage type of failure in a single subsystem, other than a structural failure of a housing that is common to two or more subsystems, the remaining portion(s) of the service brake system shall continue to operate and shall be capable of stopping a vehicle from 60 mph within the corresponding distance specified in Column IV of Table II.

S5.1.2.2 In vehicles not manufactured with a split service brake system, in the event of any one rupture or leakage type of failure in any component of the service brake system the vehicle shall, by operation of the service brake control, be capable of stopping 10 times consecutively from 60 mph within the corresponding distance specified in Column IV of Table II.

S5.1.2.3 For a vehicle manufactured with a service brake system in which the brake signal is transmitted

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electrically between the brake pedal and some or all of the foundation brakes, regardless of the means of actuation of the foundation brakes, the vehicle shall be capable of stopping from 60 mph within the corresponding distance specified in Column IV of Table II with any single failure in any circuit that electrically transmits the brake signal, and with all other systems intact.

S5.1.2.4 For an EV manufactured with a service brake system that incorporates RBS, the vehicle shall be capable of stopping from 60 mph within the corresponding distance specified in Column IV of Table II with any single failure in the RBS, and with all other systems intact.

S5.1.3 Inoperative brake power assist unit or brake power unit. A vehicle equipped with one or more brake power assist units shall meet the requirements of either S5.1.3.1, S5.1.3.2, or S5.1.3.4 (chosen at the option of the manufacturer), and a vehicle equipped with one or more brake power units shall meet the requirements of either S5.1.3.1, S5.1.3.3, or S5.1.3.4 (chosen at the option of the manufacturer).

S5.1.3.1 The service brakes on a vehicle equipped with one or more brake power assist units or brake power units, with one such unit inoperative and depleted of all reserve capability, shall be capable of stopping a vehicle from 60 mph within the corresponding distance specified in Column IV of Table II.

S5.1.3.2 **Brake power assist units.** The service brakes on a vehicle equipped with one or more brake power assist units, with one such unit inoperative, shall be capable of stopping a vehicle from 60 mph:

(a) In six consecutive stops at an average deceleration for each stop that is not lower than that specified in column I of table III, when the inoperative unit is not initially depleted of all reserve capability; and

(b) In a final stop, at an average deceleration that is not lower than 7 FPSPS for passenger cars (equivalent stopping distance 554 feet) or 6 FPSPS for vehicles other than passenger cars (equivalent stopping distance 646 feet), as applicable, when the inoperative unit is depleted of all reserve capacity.

S5.1.3.3 **Brake power units.** The service brakes of a vehicle equipped with one or more brake power units with an accumulator-type reserve system, with any one failure in any one unit shall be capable of stopping the vehicle from 60 mph—

(a) In 10 consecutive stops at an average deceleration for each stop that is not lower than that specified in Column II of Table III, when the unit is not initially depleted of all reserve capability; and

(b) In a final stop, at an average deceleration that is not lower than 7 FPSPS for passenger cars (equivalent stopping distance 554 feet) or 6 FPSPS for vehicles other than passenger cars (equivalent stopping distance 646 feet), as applicable, when the inoperative unit is depleted of all reserve capacity.

S5.1.3.4 **Brake power assist and brake power units.** The service brakes of a vehicle equipped with one or more brake power assist units or brake power units with a backup system, with one brake power assist unit or brake power unit inoperative and depleted of all

reserve capability and with only the backup system operating in the failed subsystem, shall be capable of stopping the vehicle from 60 mph in 15 consecutive stops at an average deceleration for each stop that is not lower than 12 fpsps (equivalent stopping distance 323 feet).

S5.1.3.5 **Electric brakes.** Each vehicle with electrically-actuated service brakes (brake power unit) shall comply with the requirements of S5.1.3.1 with any single electrical failure in the electrically-actuated service brakes and all other systems intact.

S5.1.4 **Fade and recovery.** The service brakes shall be capable of stopping each vehicle in two fade and recovery tests as specified below.

S5.1.4.1 The control force used for the baseline check stops or snubs shall be not less than 10 pounds, nor more than 60 pounds, except that the control force for a vehicle with a GVWR of 10,000 pounds or more may be between 10 pounds and 90 pounds.

S5.1.4.2(a) Each vehicle with GVWR of 10,000 lbs or less shall be capable of making 5 fade stops (10 fade stops on the second test) from 60 mph at a deceleration not lower than 15 fpsps for each stop, followed by 5 fade stops at the maximum deceleration attainable from 5 to 15 fpsps.

(b) Each vehicle with a GVWR greater than 10,000 pounds shall be capable of making 10 fade snubs (20 fade snubs on the second test) from 40 mph to 20 mph at 10 fpsps for each snub.

S5.1.4.3(a) Each vehicle with a GVWR of 10,000 pounds or less shall be capable of making five recovery stops from 30 mph at 10 fpsps for each stop, with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery stops of 150 pounds, and for the fifth stop, of 20 pounds more than the average control force for the baseline check; and

(2) A minimum of—

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the baseline check times 0.60, whichever is lower (but in no case lower than 5 pounds).

(b) Each vehicle with a GVWR of more than 10,000 pounds shall be capable of making five recovery snubs from 40 mph to 20 mph at 10 fpsps for each snub, with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery snubs of 150 pounds, and for the fifth snub, of 20 pounds more than the average control force for the baseline check (but in no case more than 100 pounds); and

(2) A minimum of—

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the baseline check times 0.60, whichever is lower (but in no case lower than 5 pounds).

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S5.1.5 Water recovery. The service brakes shall be capable of stopping each vehicle in a water recovery test, as specified below.

S5.1.5.1 The control force used for the baseline check stops or snubs shall be not less than 10 pounds, nor more than 60 pounds, except that the control force for a vehicle with a GVWR of 10,000 pounds or more may be between 10 and 90 pounds.

S5.1.5.2 (a) After being driven for 2 minutes at a speed of 5 mph in any combination of forward and reverse directions through a trough having a water dept of 6 inches, each vehicle with a GVWR of 10,000 pounds or less shall be capable of making five recovery stops from 30 mph at ten fpsps for each stop with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery stops of 150 pounds, and for the fifth stop, of 45 pounds more than the average control force for the baseline check (but in no case more than 90 pounds, except that the maximum control force for the fifth stop in the case of a vehicle manufactured before September 1, 1976, shall be not more than plus 60 pounds of the average control force for the baseline check (but in no case more than 110 pounds).

(2) A minimum of-

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the

baseline check times 0.60, whichever is lower (but in no case lower than 5 pounds).

(b) After being driven for 2 minutes at a speed of 5 mph in any combination of forward and reverse directions through a trough having a water depth of 6 inches, each vehicle with a GVWR of more than 10,000 pounds shall be capable of making five recovery stops from 30 mph at 10 fpsps for each stop with a control force application that falls within the following maximum and minimum limits:

(1) A maximum for the first four recovery stops of 150 pounds, and for the fifth stop, of 60 pounds more than the average control force for the baseline

check (but in no case more than 110 pounds); and

(2) A minimum of-

(A) The average control force for the baseline check minus 10 pounds, or

(B) The average control force for the

baseline check times 0.60, whichever is lower (but in no case lower than 5 pounds).

S5.1.6 Spike stops. Each vehicle with a GVWR of 10,000 lbs. or less shall be capable of making 10 spike stops from 30 mph, followed by 6 effectiveness (check) stops from 60 mph, at least one of which shall be within a corresponding stopping distance specified in column I of table II.

S5.1.7 Stability and control during braking. When stopped four consecutive times under the conditions specified in S6, each vehicle with a GVWR greater than 10,000 pounds manufactured on or after July 1, 2005 and each vehicle with a GVWR greater than 10,000 pounds manufactured in two or more stages on or after July 1, 2006

shall stop from 30 mph or 75 percent of the maximum drive-through speed, whichever is less, at least three times within the 12-foot lane, without any part of the vehicle leaving the roadway. Stop the vehicle with the vehicle at its lightly loaded vehicle weight, or at the manufacturer's option, at its lightly loaded vehicle weight plus not more than an additional 1000 pounds for a roll bar structure on the vehicle.

S5.2 Parking Brake System. Each vehicle shall be manufactured with a parking brake system of a friction type with a solely mechanical means to retain engagement, which shall under the conditions of S6, when tested according to the procedures specified in S7, meet the requirements specified in S5.2.1, S5.2.2, or S5.2.3 as appropriate, with the system engaged-

(a) In the case of a vehicle with a GVWR of 4,536 kilograms (10,000 pounds) or less, with a force applied to the control not to exceed 125 pounds for a foot-operated system and 90 pounds for a hand-operated system; and

(b) In the case of a vehicle with a GVWR greater than 4,536 kilograms (10,000 pounds), with a force applied to the control not to exceed 150 pounds for a foot-operated system and 125 pounds for a hand-operated system.

S5.2.1. Except as provided in §5.2.2, the parking brake system on a passenger car and on a school bus with a GVWR of 10,000 pounds or less shall be capable of holding the vehicle stationary (to the limit of traction on the braked wheels) for 5 minutes in both a forward and reverse direction on a 30 percent grade.

S5.2.2 A vehicle of a type described in S5.2.1 at the option of the manufacturer may meet the requirements of S5.2.2.1, S5.2.2.2, and S5.2.2.3 instead of the requirements of S5.2.1 if:

(a) The vehicle has a transmission or transmission control which incorporates a parking mechanism, and

(b) The parking mechanism must be engaged before the ignition key can be removed.

S5.2.2.1 The vehicle's parking brake and parking mechanism, when both are engaged, shall be capable of holding the vehicle stationary (to the limit of traction of the braked wheels) for 5 minutes, in both forward and reverse directions, on a 30 percent grade.

S5.2.2.2 The vehicle's parking brake, with the parking mechanism not engaged, shall be capable of holding the vehicle stationary for 5 minutes, in both forward and reverse directions, on a 20 percent grade.

S5.2.2.3 With the parking mechanism engaged and the parking brake not engaged, the parking mechanism shall not disengage or fracture in a manner permitting vehicle movement, when the vehicle is impacted at each end, on a level surface, by a barrier moving at 2½ mph.

S5.2.3 (a) The parking brake system on a multipurpose passenger vehicle, truck or bus (other than a school bus) with a GVWR of 4,536 kilograms (10,000 pounds) or less shall be capable of holding the vehicle stationary for 5 minutes, in both forward and reverse directions, on a 20 percent grade.

(b) The parking brake system on a multipurpose passenger vehicle, truck, or bus (including a school bus) with a GVWR greater than 4,536 kilograms (10,000 pounds) shall be capable of holding the vehicle stationary for 5

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minutes, in both forward and reverse directions, on a 20 percent grade.

S5.3 Brake system indicator lamp. Each vehicle shall have a brake system indicator lamp or lamps, mounted in front of and in clear view of the driver, which meet the requirements of S5.3.1 through S5.3.5. A vehicle with a GVWR of 10,000 pounds or less may have a single common indicator lamp. A vehicle with a GVWR of greater than 10,000 pounds may have an indicator lamp which is common for gross loss of pressure, drop in the level of brake fluid, or application of the parking brake, but shall have a separate indicator lamp for antilock brake system malfunction. However, the options provided in S5.3.1(a) shall not apply to a vehicle manufactured without a split service brake system; such a vehicle shall, to meet the requirements of S5.3.1(a), be equipped with a malfunction indicator that activates under the conditions specified in S5.3.1(a)(4). This warning indicator shall, instead of meeting the requirements of S5.3.2 through S5.3.5, activate (while the vehicle remains capable of meeting the requirements of S5.1.2.2 and the ignition switch is in the “on” position) a continuous or intermittent audible signal and a flashing warning light, displaying the words “STOP-BRAKE FAILURE” in block capital letters not less than one-quarter of an inch in height.

S5.3.1 An indicator lamp shall be activated when the ignition (start) switch is in the “on” (“run”) position and whenever any of the conditions (a) or (b), (c), (d), (e), (f), and (g) occur:

(a) A gross loss of pressure (such as caused by rupture of a brake line but not by a structural failure of a housing that is common to two or more subsystems) due to one of the following conditions (chosen at the option of the manufacturer):

(1) Before or upon application of a differential pressure of not more than 225 lb/in² between the active and failed brake system measured at a master cylinder outlet or a slave cylinder outlet.

(2) Before or upon application of 50 pounds of control force upon a fully manual service brake.

(3) Before or upon application of 25 pounds of control force upon a service brake with a brake power assist unit.

(4) When the supply pressure in a brake power unit drops to a level not less than one-half of the normal system pressure.

(b) A drop in the level of brake fluid in any master cylinder reservoir compartment to less than the recommended safe level specified by the manufacturer or to one-fourth of the fluid capacity of that reservoir compartment, whichever is greater.

(c) A malfunction that affects the generation or transmission of response or control signals in an antilock brake system, or a total functional electrical failure in a variable proportioning brake system.

(d) Application of the parking brake.

(e) For a vehicle with electrically-actuated service brakes, failure of the source of electric power to the brakes, or diminution of state of charge of the batteries to less

than a level specified by the manufacturer for the purpose of warning a driver of degraded brake performance.

(f) For a vehicle with electric transmission of the service brake control signal, failure of a brake control circuit.

(g) For an EV with RBS that is part of the service brake system, failure of the RBS.

S5.3.2 (a) Except as provided in paragraph (b) of this section, all indicator lamps shall be activated as a check of lamp function either when the ignition (start) switch is turned to the “on” (run) position when the engine is not running, or when the ignition (start) switch is in a position between “on” (run) and “start” that is designated by the manufacturer as a check position.

(b) The indicator lamps need not be activated when a starter interlock is in operation.

S5.3.3 (a) Each indicator lamp activated due to a condition specified in S5.3.1 shall remain activated as long as the malfunction exists, whenever the ignition (start) switch is in the “on” (run) position, whether or not the engine is running.

(b) For vehicles manufactured on and after September 1, 1999 with GVWRs greater than 10,000 lbs, each message about the existence of a malfunction, as described in S5.3.1(c), shall be stored in the antilock brake system after the ignition switch is turned to the “off” position and the indicator lamp shall

be automatically reactivated when the ignition switch is again turned to the “on” position. The indicator lamp shall also be activated as a check of lamp function whenever the ignition is turned to the “on” (run) position. The indicator lamp shall be deactivated at the end of the check of lamp function unless there is a malfunction or a message about a malfunction that existed when the key switch was last turned to the “off” position.

S5.3.4 When an indicator lamp is activated it may be steady burning or flashing.

S5.3.5 (a) Each indicator lamp shall display word, words or abbreviation, in accordance with the requirements of Standard No. 101 (49 CFR 571.101) and/or this section, which shall have letters not less than 1/8-inch high and be legible to the driver in daylight when lighted. Words in addition to those required by Standard No. 101 and/or this section and symbols may be provided for purposes of clarity.

(b) If a single common indicator is used, the lamp shall display the word “Brake”. The letters and background of a single common indicator shall be of contrasting colors, one of which is red.

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(c)(1) If separate indicators are used for one or more of the conditions described in S5.3.1(a) through S5.3.1(g) of this standard, the indicator display shall include the word “Brake” and appropriate additional labeling, except as provided in (c)(1) (A) through (D) of this paragraph.

(A) If a separate indicator lamp is provided for gross loss of pressure, the words “Brake Pressure” shall be used for S5.3.1(a).

(B) If a separate indicator lamp is provided for low brake fluid, the words “Brake Fluid” shall be used for S5.3.1(b), except for vehicles using hydraulic system mineral oil.

(C) If a separate indicator lamp is provided for an anti-lock system, the single word “Antilock” or “Anti-lock”, or the abbreviation “ABS”, may be used for S5.3.1(c).

(D) If a separate indicator lamp is provided for application of the parking brake, the single word “Park” may be used for S5.3.1(d).

(E) If a separate indicator is used for the regenerative brake system, the symbol “RBS” may be used. RBS failure may also be indicated by a lamp displaying the symbol “ABS/RBS.”

(2) Except for a separate indicator lamp for an anti-lock system, a regenerative system, or an indicator for both anti-lock and regenerative system, the letters and background of each separate indicator lamp shall be of contrasting colors, one of which is red. The letters and background of a separate lamp for an anti-lock system, a regenerative system, or a lamp displaying both an anti-lock and a regenerative system shall be of contrasting colors, one of which is yellow.

S5.4 Reservoirs.

S5.4.1 Master cylinder reservoirs. A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment.

S5.4.2 Reservoir capacity. Reservoirs, whether for master cylinders or other type systems, shall have a total minimum capacity equivalent to the fluid displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoirs move from a new lining, fully retracted position (as adjusted initially to the manufacturer’s recommended setting) to a fully worn, fully applied position, as determined in accordance with S7.18(c) of this standard. Reservoirs shall have completely separate compartments for each subsystem except that in reservoir systems utilizing a portion of the reservoir for a common supply to two or more subsystems, individual partial compartments shall each have a minimum volume of fluid equal to at least the volume displaced by the master cylinder piston servicing the subsystem, during a full stroke of the piston. Each brake power unit reservoir servicing only the brake system shall have a minimum capacity equivalent to the fluid displacement required to charge the system piston(s) or accumulator(s) to normal operating pressure plus the displacement resulting when all the wheel cylinders or caliper pistons serviced by the reservoir or accumulator(s) move from a new lining fully retracted position (as adjusted initially

to the manufacturer’s recommended setting) to a fully worn, fully applied position.

S5.4.3 Reservoir labeling—Each vehicle equipped with hydraulic brakes shall have a brake fluid warning statement that reads as follows, in letters at least one-eighth of an inch high: “WARNING, Clean filler cap before removing. Use only ___ fluid from a sealed container.” (Inserting the recommended type of brake fluid as specified in 49 CFR 571.116, e.g., “DOT 3”). The lettering shall be—

(a) Permanently affixed, engraved, or embossed;

(b) Located so as to be visible by direct view, either on or within 4 inches of the brake fluid reservoir filler plug or cap; and

(c) Of a color that contrasts with its background, if it is not engraved or embossed.

S5.5 Antilock and variable proportioning brake systems.

S5.5.1 Each vehicle with a GVWR greater than 10,000 pounds, except for any vehicle with a speed attainable in 2 miles of not more than 33 mph, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle. On each vehicle with a GVWR greater than 10,000 pounds but not greater than 19,500 pounds and motor homes with a GVWR greater than 10,000 pounds but not greater than 22,500 pounds manufactured before March 1, 2001, the antilock brake system may also directly control the wheels of the rear drive axle by means of a single sensor in the driveline. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

S5.5.2 In the event of any failure (structural or functional) in an antilock or variable proportioning brake system, the vehicle shall be capable of meeting the stopping distance requirements specified in S5.1.2 for service brake system partial failure. For an EV that is equipped with both ABS and RBS that is part of the service brake system, the ABS must control the RBS.

S5.6 Brake system integrity. Each vehicle shall be capable of completing all performance requirements of S5 without—

(a) Detachment or fracture of any component of the braking system, such as brake springs and brake shoe or disc pad facing, other than minor cracks that do not impair attachment of the friction facing. All mechanical components of the braking system shall be intact and functional. Friction facing tearout (complete detachment of lining) shall not exceed 10 percent of the lining on any single frictional element.

(b) Any visible brake fluid or lubricant on the friction surface of the brake, or leakage at the master cylinder or brake power unit reservoir cover, seal and filler openings.

S6 Test conditions. The performance requirements of S5 shall be met under the following conditions. Where a range of conditions is specified, the vehicle shall be capable of meeting the requirements at all points within the range. Compliance of vehicles manufactured in two or more stages may, at the option of the final-stage manufacturer, be demonstrated to comply with this standard

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by adherence to the instructions of the incomplete manufacturer provided with the vehicle in accordance with § 568.4(a)(7)(ii) and §568.5 of title 49 of the Code of Federal Regulations.

S6.1 Vehicle weight.

S6.1.1 Other than tests specified at lightly loaded vehicle weight in S7.5(a), S7.7, S7.8, and S7.9, the vehicle is loaded to its GVWR such that the weight on each axle as measured at the tire-ground interface is in proportion to its GAWR, except that each fuel tank is filled to any level from 100 percent of capacity (corresponding to full GVWR) to 75 percent. However, if the weight on any axle of a vehicle at lightly loaded vehicle weight exceeds the axle's proportional share of the gross vehicle weight rating, the load required to reach GVWR is placed so that the weight on that axle remains the same as a lightly loaded vehicle weight.

S6.1.2 For applicable tests specified in S7.5(a), S7.7, S7.8, and S7.9, vehicle weight is lightly loaded vehicle weight, with the added weight, except for the roll bar structure allowed for trucks and buses with a GVWR greater than 10,000 pounds, distributed in the front passenger seat area in passenger cars, multipurpose passenger vehicles, and trucks, and in the area adjacent to the driver's seat in buses.

S6.2 Electric vehicles and electric brakes.

S6.2.1 The state of charge of the propulsion batteries is determined in accordance with SAE Recommended Practice J227a (1976) (incorporated by reference, see §571.5). The applicable sections of SAE J227a (1976) are 3.2.1 through 3.2.4, 3.3.1 through 3.3.2.2, 3.4.1 and 3.4.2, 4.2.1, 5.2, 5.2.1, and 5.3.

S6.2.2 At the beginning of the first effectiveness test specified in S7.3, and at the beginning of each burnishing procedure, each EV's propulsion battery is at the maximum state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. If a battery is replaced rather than recharged, the replacement battery is to be charged and measured for state of charge in accordance with these procedures. During each burnish procedure, each propulsion battery is restored to the recommended state of charge or a state of charge of not less than 95 percent after each increment of 40 burnish stops until each burnish procedure is complete. The batteries may be charged at a more frequent interval if, during a particular 40-stop increment, the EV is incapable of achieving the initial burnish test speed. During each burnish procedure, the propulsion batteries may be charged by an external means or replaced by batteries that are charged to the state of charge recommended by the manufacturer or a state of charge of not less than 95 percent. For EVs having a manual control for setting the level of regenerative braking, the manual control, at the beginning of each burnish procedure, is set to provide maximum regenerative braking throughout the burnish.

S6.2.3 At the beginning of each performance test in the test sequence (S7.3, S7.5, S7.7 through S7.11, and S7.13 through S7.19 of this standard), unless otherwise specified, each propulsion battery of an EV is at the maxi-

mum state of charge recommended by the manufacturer, as stated in the vehicle operator's manual or on a label that is permanently attached to the vehicle, or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. If batteries are replaced rather than recharged, each replacement battery shall be charged and measured for state of charge in accordance with these procedures. No further charging of any propulsion battery occurs during any of the performance tests in the test sequence of this standard. If the propulsion batteries are depleted during a test sequence such that the vehicle reaches automatic shutdown, will not accelerate, or the low state of charge warning lamp is illuminated, the vehicle is to be accelerated to brake test speed by auxiliary means.

S6.2.4(a) For an EV equipped with RBS, the RBS is considered to be part of the service brake system if it is automatically controlled by an application of the service brake control, if there is no means provided for the driver to disconnect or otherwise deactivate it, and if it is activated in all transmission positions, including neutral. The RBS is operational during all burnishes and all tests, except for the test of a failed RBS.

(b) For an EV equipped with an RBS that is not part of the service brake system, the RBS is operational and set to produce the maximum regenerative braking effect during the burnishes, and is disabled during the test procedures. If the vehicle is equipped with a neutral gear that automatically disables the RBS, the test procedures which are designated to be conducted in gear may be conducted in neutral.

S6.2.5 For tests conducted "in neutral," the operator of an EV with no "neutral" position (or other means such as a clutch for disconnecting the drive train from the propulsion motor(s)) does not apply any electromotive force to the propulsion motor(s). Any electromotive force that is applied to the propulsion motor(s) automatically remains in effect unless otherwise specified by the test procedure.

S6.2.6 A vehicle equipped with electrically-actuated service brakes also performs the following test series. Conduct 10 stopping tests from a speed of 100 kph or the maximum vehicle speed, whichever is less. At least two of the 10 stopping distances must be less than or equal to 70 meters. The vehicle is loaded to GVWR for these tests and the transmission is in the neutral position when the service brake control is actuated and throughout the remainder of the test. The battery or batteries providing power to those electrically-actuated brakes, at the beginning of each test, shall be in a depleted state of charge for conditions (a), (b), or (c) of this paragraph as appropriate. An auxiliary means may be used to accelerate an EV to test speed.

(a) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries, and with automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at not more than five percent above the EV actual automatic shut-down critical value. The critical value is determined by measuring the state-of-charge of each propulsion battery at the instant that automatic shut-down occurs and averaging the states-of-charge recorded.

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(b) For an EV equipped with electrically-actuated service brakes deriving power from the propulsion batteries, and with no automatic shut-down capability of the propulsion motor(s), the propulsion batteries are at an average of not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.3.1(e) of this standard, is illuminated.

(c) For a vehicle which has an auxiliary battery (or batteries) that provides electrical energy to operate the electrically-actuated service brakes, the auxiliary battery(batteries) is (are) at (at an average of) not more than five percent above the actual state of charge at which the brake failure warning signal, required by S5.3.1(e) of this standard, is illuminated.

S6.3 Tire inflation pressure. Tire inflation pressure is the pressure recommended by the vehicle manufacturer for the GVWR of the vehicle.

S6.4 Transmission selector control. For S7.3, S7.5, S7.8, S7.15, S7.17, S7.11.1.2, S7.11.2.2, S7.11.3.2, and as required for S7.13, the transmission selector control is in neutral for all decelerations. For all other tests during all decelerations, the transmission selector is in the control position, other than overdrive, recommended by the manufacturer for driving on a level surface at the applicable test speed. To avoid engine stall during tests required to be run in gear a manual transmission may be shifted to neutral (or the clutch disengaged) when the vehicle speed decreases to 20 mph.

S6.5 Engine. Engine idle speed and ignition timing settings are according to the manufacturer's recommendations. If the vehicle is equipped with an adjustable engine speed governor, it is adjusted according to the manufacturer's recommendation.

S6.6 Vehicle openings. All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) are closed except as required for instrumentation purposes.

S6.7 Ambient temperature. The ambient temperature is any temperature between 32°F. and 100°F.

S6.8 Wind velocity. The wind velocity is zero.

S6.9 Road surface.

S6.9.1 For vehicles with a GVWR of 10,000 pounds or less, road tests are conducted on a 12-foot-wide, level roadway, having a skid number of 81. Burnish stops are conducted on any surface. The parking brake test surface is clean, dry, smooth, Portland cement concrete.

S6.9.2(a) For vehicles with a GVWR greater than 10,000 pounds, road tests (excluding stability and control during braking tests) are conducted on a 12-foot-wide, level roadway, having a peak friction coefficient of 0.9 when measured using an ASTM E1136-93 (Reapproved 2003) (incorporated by reference, see §571.5), standard reference test tire, in accordance with ASTM E1337-90 (Reapproved 2008) (incorporated by reference, see §571.5), at a speed of 40 mph, without water delivery. Burnish stops are conducted on any surface. The parking brake test surface is clean, dry, smooth, Portland cement concrete.

S6.9.2(b) For vehicles with a GVWR greater than 10,000 pounds, stability and control during braking tests are conducted on a 500-foot-radius curved roadway with a

wet level surface having a peak friction coefficient of 0.5 when measured on a straight or curved section of the curved roadway using an ASTM E1136-93 (Reapproved 2003) standard reference tire, in accordance with ASTM E1337-90 (Reapproved 2008) at a speed of 40 mph, with water delivery.

S6.10 Vehicle position and wheel lockup restrictions. The vehicle is aligned in the center of the roadway at the start of each brake application. Stops, other than spike stops, are made without any part of the vehicle leaving the roadway.

S6.10.1 For vehicles with a GVWR of 10,000 pounds or less, stops are made with wheel lockup permitted only as follows:

(a) At vehicle speeds above 10 mph, there may be controlled wheel lockup on an antilock-equipped axle, and lockup of not more than one wheel per vehicle, uncontrolled by an antilock system. (Dual wheels on one side of an axle are considered a single wheel.)

(b) At vehicle speeds of 10 mph or less, any wheel may lock up for any duration.

(c) Unlimited wheel lockup is allowed during spike stops (but not spike check stops), partial failure stops, and inoperative brake power or power assist unit stops.

S6.10.2 For vehicles with a GVWR greater than 10,000 pounds, stops are made with wheel lockup permitted only as follows:

(a) At vehicle speeds above 20 mph, any wheel on a nonsteerable axle other than the two rearmost nonliftable, nonsteerable axles may lock up for any duration. The wheels on the two rear-most nonliftable, nonsteerable axles may lock up according to (b).

(b) At vehicle speeds above 20 mph, one wheel on any axle or two wheels on any tandem may lock up for any duration.

(c) At vehicle speeds above 20 mph, any wheel not permitted to lock in (a) or (b) may lock up repeatedly, with each lockup occurring for a duration of one second or less.

(d) At vehicle speeds of 20 mph or less, any wheel may lock up for any duration.

(e) Unlimited wheel lockup is allowed during partial failure stops, and inoperative brake power or power assist stops.

S6.11 Thermocouples. The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in figure 1. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the metal rubbing surface of a drum or rotor. For centergrooved shoes or pads, thermocouples are installed within one-eighth of an inch to one-quarter inch of the groove and as close to the center as possible.

S6.12 Initial brake temperature. Unless otherwise specified the brake temperature is 150 °F. to 200 °F.

S6.13 Control forces. Unless otherwise specified, the force applied to a brake control is not less than 15 lb and not more than 150 lb.

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S6.14 Special drive conditions. A vehicle with a GVWR greater than 10,000 pounds equipped with an interlocking axle system or a front wheel drive system that is engaged and disengaged by the driver is tested with the system disengaged.

S6.15 Selection of compliance options. Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S7. Test procedure and sequence. Each vehicle shall be capable of meeting all the applicable requirements of S5 when tested according to the procedures and sequence set forth below, without replacing any brake system part or making any adjustments to the brake system other than as permitted in the burnish and reburnish procedures and in S7.9 and S7.10. (For vehicles only having to meet the requirements of S5.1.1, S5.1.2, S5.1.3, and S5.1.7 in section S5.1, the applicable test procedures and sequence are S7.1, S7.2, S7.4, S7.5(b), S7.5(a), S7.8, S7.9, S7.10, and S7.18. However, at the option of the manufacturer, the following test procedure and sequence may be conducted: S7.1, S7.2, S7.3, S7.4, S7.5(b), S7.6, S7.7, S7.5(a), S7.8, S7.9, S7.10, and S7.18. The choice of this option must not be construed as adding to the requirements specified in S5.1.2 and S5.1.3.) Automatic adjusters must remain activated at all times. A vehicle shall be deemed to comply with the stopping distance requirements of S5.1 if at least one of the stops at each speed and load specified in each of S7.3, S7.5(b), S7.8, S7.9, S7.10, S7.15 and S7.17 (check stops) is made within a stopping distance that does not exceed the corresponding distance specified in Table II. When the transmission selector control is required to be in neutral for a deceleration, a stop or snub must be obtained by the following procedures:

- (a) Exceed the test speed by 4 to 8 mph;
- (b) Close the throttle and coast in gear to approximately 2 mph above the test speed;
- (c) Shift to neutral; and
- (d) When the test speed is reached, apply the service brakes.

S7.1 **Brake warming.** If the initial brake temperature for the first stop in a test procedure (other than S7.7 and S7.16) has not been reached, heat the brakes to the initial brake temperature by making not more than 10 snubs from not more than 40 to 10 mph, at a deceleration not greater than 10 fpsps.

S7.2 **Pretest instrumentation check.** Conduct a general check of instrumentation by making not more than 10 stops from a speed of not more than 30 mph, or 10 snubs from a speed of not more than 40 to 10 mph, at a deceleration of not more than 10 fpsps. If instrument repair, replacement, or adjustment is necessary, make not more than 10 additional stops or snubs after such repair, replacement, or adjustment.

S7.3 **Service brake system-first (preburnish) effectiveness test.** Make six stops from 30 mph. Then make six stops from 60 mph.

S7.4 **Service brake system-burnish procedure.**

S7.4.1 **Vehicles with GVWR of 10,000 lb or less.**

S7.4.1.1 **Burnish.** Burnish the brakes by making 200 stops from 40 mph at 12 fpsps (the 150 lb control force limit does not apply here). The interval from the start of one service brake application to the start of the next shall be either the time necessary to reduce the initial brake temperature to between 230 °F. and 270 °F., or the distance of 1 mile, whichever occurs first. Accelerate to 40 mph after each stop and maintain that speed until making the next stop.

S7.4.1.2 **Brake adjustment-post burnish.** After burnishing, adjust the brakes in accordance with the manufacturer's published recommendations.

S7.4.2 **Vehicles with GVWR greater than 10,000 pounds.**

S7.4.2.1 **Burnish.** Vehicles are burnished according to the following procedures. Make 500 snubs between 40 mph and 20 mph at a deceleration rate of 10 f.p.s.p.s. Except where an adjustment is specified, after each brake application accelerate to 40 mph and maintain that speed until making the next brake application at a point 1 mile from the initial point of the previous brake application. If the vehicle cannot attain a speed of 40 mph in 1 mph, continue to accelerate until the vehicle reaches 40 mph or until the vehicle has traveled 1.5 miles from the initial point of the previous brake application, whichever occurs first. The brakes shall be adjusted three times during the burnish procedure, in accordance with the manufacturer's recommendations, after 125, 250, and 375 snubs.

S7.4.2.2 **Brake adjustment-post burnish.** After burnishing, adjust the brakes in accordance with the manufacturer's published recommendations.

S7.5(a) Stability and control during braking (vehicles with a GVWR greater than 10,000 pounds). Make four stops in the lightly-loaded weight condition specified in S5.1.7. Use a full brake application for the duration of the stop, with the clutch pedal depressed or the transmission selector control in the neutral position, for the duration of each stop.

(b) Service brake system-second effectiveness test. For vehicles with a GVWR of 10,000 pounds or less, or any school bus, make six stops from 30 mph. Then, for any vehicle, make six stops from 60 mph. Then, for a vehicle with a GVWR of 10,000 pounds or less, make

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four stops from 80 mph if the speed attainable in 2 miles is not less than 84 mph.

S7.6 First reburnish. Repeat S7.4, except make 35 burnish stops or snubs. In the case of vehicles burnished in accordance with S7.4.2.1(a) of this section, reburnish the vehicle by making 35 snubs from 60 to 20 mph, but if the hottest brake temperature reaches $500^{\circ}\text{F} \pm 50^{\circ}\text{F}$, make the remainder of the brake applications from the highest snub condition listed in Table IV that will maintain the hottest brake temperature at $500^{\circ}\text{F} \pm 50^{\circ}\text{F}$. If at a snub condition of 40 to 20 mph, the temperature of the hottest brake exceeds 550°F , make the remainder of the 35 brake applications from that snub condition without regard to brake temperature.

S7.7 Parking brake test. The parking brake tests for any vehicle on different grades, in different directions, and for different loads may be conducted in any order. The force required for actuation of a hand-operated brake system shall be measured at the center of the hand grip area or at a distance of $1\frac{1}{2}$ inches from the end of the actuation lever, as illustrated in Figure II.

S7.7.1 Test procedure for requirements of S5.2.1 and 55.2.3.

S7.7.1.1 Condition the parking brake friction elements so that the temperature at the beginning of the test is at any level not more than 150°F . (when the temperature of components on both ends of an axle are averaged).

S7.7.1.2 Drive the vehicle, loaded to GVWR, onto the specified grade with the longitudinal axis of the vehicle in the direction of the slope of the grade, stop the vehicle and hold it stationary by application of the service brake control, and place the transmission in neutral.

S7.7.1.3 With the vehicle held stationary by means of the service brake control, apply the parking brake by a single application of the force specified in (a), (b), or (c) of this paragraph, except that a series of applications to achieve the specified force may be made in the case of a parking brake system design that does not allow the application of the specified force in a single application:

(a) In the case of a passenger car or other vehicle with a GVWR of 10,000 lbs. or less, not more than 125 pounds for a foot-operated system, and not more than 90 pounds for a hand-operated system; and

(b) In the case of a vehicle with a GVWR greater than 4,536 kilograms (10,000 pounds) not more than 150 pounds for a foot-operated system, and not more than 125 pounds for a hand-operated system.

(c) For a vehicle using an electrically-activated parking brake, apply the parking brake by activating the parking brake control.

S7.7.1.4 Following the application of the parking brake in accordance with S7.7.1.3, release all force on the service brake control and commence the measurement of time if the vehicle remains stationary. If the vehicle does not remain stationary, reapplication of the service brake to hold the vehicle stationary, with reapplication of a force to the parking brake control at the level specified in S7.7.1.3 (a) or (b) as appropriate for the vehicle being tested (without release of the ratcheting or

other holding mechanism of the parking brake) may be used twice to attain a stationary position.

S7.7.1.5 Following observation of the vehicle in a stationary condition for the specified time in one direction, repeat the same test procedure with the vehicle orientation in the opposite direction on the specified grade.

S7.7.1.6 Check the operation of the parking brake application indicator required by S5.3.1(d).

S7.7.2 Test procedure for requirements of S5.2.2

(a) Check that transmission must be placed in park position to release key;

(b) Test as in S7.7.1, except in addition place the transmission control to engage the parking mechanism; and

(c) Test as in S7.7.1 except on a 20 percent grade, with the parking mechanism not engaged.

S7.7.3 Lightly loaded vehicle. Repeat S7.7.1 or S7.7.2 as applicable except with the vehicle at lightly loaded vehicles weight or at manufacturer's option, for a vehicle with GVWR greater than 10,000 pounds, at lightly loaded vehicle weight plus not more than an additional 1,000 pounds for a roll bar structure on the vehicle.

S7.7.4 Non-service brake type parking brake systems. For vehicles with parking brake systems not utilizing the service brake friction elements, burnish the friction elements of such systems prior to parking brake tests according to the manufacturer's published recommendations as furnished to the purchaser. If no recommendations are furnished, run the vehicle in an unburnished condition.

S7.8 Service brake system test—lightly loaded vehicle (third effectiveness) test. Make six stops from 60 mph with vehicle at lightly vehicle weight, or at the manufacturer's option for a vehicle with GVWR greater than 10,000 pounds, at lightly loaded vehicle weight plus not more than an additional 1,000 pounds for a roll bar structure on the vehicle. (This test is not applicable to a vehicle which has a GVWR of not less than 7,716 pounds and not greater than 10,000 pounds and is not a school bus.)

S7.9 Service brake system test—partial failure.

S7.9.1 With the vehicle at lightly loaded vehicle weight or at the manufacturer's option for a vehicle with a GVWR greater than 10,000 pounds, at lightly loaded vehicle weight plus not more than an additional 1,000 pounds for a roll bar structure on the vehicle, alter the service brake system to produce any one rupture or leakage type of failure, other than a structural failure of a housing that is common to two or more subsystems. Determine the control force, pressure level, or fluid level (as appropriate for the indicator being tested) necessary to activate the brake system indicator lamp. Make four stops if the vehicle is equipped with a split service brake system, or 10 stops if the vehicle is not so equipped, each from 60 mph, by a continuous application of the service brake control. Restore the service brake system to normal at completion of this test.

S7.9.2 Repeat S7.9.1 for each of the other subsystems.

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S7.9.3 Repeat S7.9.1 and S7.9.2 with vehicle at GVWR. Restore the service brake system to normal at completion of this test.

S7.9.4 (For vehicles with antilock and/or variable proportioning brake systems). With vehicle at GVWR, disconnect functional power source, or otherwise render antilock system inoperative. Disconnect variable proportioning brake system. Make four stops, each from 60 mph. If more than one antilock or variable proportioning brake subsystem is provided, disconnect or render one subsystem inoperative and run as above. Restore system to normal at completion of this test. Repeat for each subsystem provided.

Determine whether the brake system indicator lamp is activated when the electrical power source to the antilock or variable proportioning unit is disconnected.

S7.9.5 For a vehicle in which the brake signal is transmitted electrically between the brake pedal and some or all of the foundation brakes, regardless of the means of actuation of the foundation brakes, the tests in S7.9.1 through S7.9.3 of this standard are conducted by inducing any single failure in any circuit that electrically transmits the brake signal, and all other systems intact. Determine whether the brake system indicator lamp is activated when the failure is induced.

S7.9.6 For an EV with RBS that is part of the service brake system, the tests specified in S7.9.1 through S7.9.3 are conducted with the RBS disconnected and all other systems intact. Determine whether the brake system indicator lamp is activated when the RBS is disconnected.

S7.10 Service brake system—inoperative brake power unit or brake power assist unit test. (For vehicles equipped with brake power unit or brake power assist unit.)

S7.10.1 Regular procedure. (This test need not be run if the option in S7.10.2 is selected.) On vehicles with brake power assist units, render the brake power assist unit inoperative, or one of the brake power assist unit subsystems if two or more subsystems are provided, by disconnecting the relevant power supply. Exhaust any residual brake power reserve capability of the disconnected system. On vehicles with brake power units, disconnect the primary source of power. Make four stops, each from 60 mph by a continuous application of the service brake control. Restore the system to normal at completion of this test. For vehicles equipped with more than one brake power unit or brake power assist unit, conduct tests of each in turn.

S7.10.2 Optional Procedures. On vehicles with brake power assist units, the unit is charged to maximum prior to start of test. (Engine may be run up in speed, then throttle closed quickly to attain maximum charge on vacuum assist units.) Brake power units shall also be charged to maximum accumulator pressure prior to start of test. No recharging is allowed after start of test.

(a) (For vehicles with brake power assist units.) Disconnect the primary source of power. Make six stops each from 60 mph, to achieve the average deceleration for each stop as specified in table III. Apply the brake

control as quickly as possible. Maintain control force until vehicle has stopped.

At the completion of the stops specified above, deplete the system of any residual brake power reserve capability. Make one stop from 60 mph at an average deceleration of not lower than 7 fpsps for passenger cars (equivalent stopping distance 554 feet), or 6 fpsps for vehicles other than passenger cars (equivalent stopping distance 646 feet) and determine whether the control force exceeds 150 pounds.

(b) (For vehicles with brake power units with accumulator type systems.) Test as in S7.10.2(a), except make 10 stops instead of 6 and, at the completion of the 10 stops, deplete the failed element of the brake power unit of any residual brake power reserve capability before making the final stop.

(c) (For vehicles with brake power assist or brake power units with backup systems.) If the brake power or brake power assist unit operates in conjunction with a backup system and the backup system is activated automatically in the event of a primary power failure, the backup system is operative during this test. Disconnect the primary source of power of one subsystem. Make 15 stops, each from 60 mph, with the backup system activated for the failed subsystem, to achieve an average deceleration of 12 fpsps for each stop.

(d) Restore systems to normal at completion of these tests. For vehicles equipped with more than one brakepower assist or brakepower unit, conduct tests of each in turn.

S7.10.3 Electric brakes.

(a) For vehicles with electrically-actuated service brakes, the tests in S7.10.1 or S7.10.2 are conducted with any single electrical failure in the electric brake system instead of the brake power or brake power assist systems, and all other systems intact.

(b) For EVs with RBS that is part of the service brake system, the tests in S7.10.1 or S7.10.2 are conducted with the RBS discontinued and all other systems intact.

S7.11 Service brake system—first fade and recovery test.

S7.11.1 Baseline check stops or snubs.

S7.11.1.1 Vehicles with GVWR of 10,000 lb or less. Make three stops from 30 mph at 10 fpsps for each stop. Control force readings may be terminated when vehicle speed falls to 5 mph. Average the maximum brake control force required for the three stops.

S7.11.1.2 Vehicles with GVWR greater than 10,000 pounds. With transmission in neutral (or declutched), make three snubs from 40 to 20 mph at 10 fpsps for each snub. Average the maximum brake control force required for the three snubs.

S7.11.2 Fade stops or snubs.

S7.11.2.1 Vehicles with GVWR of 10,000 pounds or less. Make 5 stops from 60 mph at 15 fpsps followed by 5 stops at the maximum attainable deceleration between 5 and 15 fpsps for each stop. Establish an initial brake temperature before the first brake application of 130° to 150°F. Initial brake temperatures before brake applications for subsequent stops are those occurring at

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the distance intervals. Attain the required deceleration within 1 second and, as a minimum, maintain it for the remainder of the stopping time. Control force readings may be terminated when vehicle speed falls to 5 mph. Leave an interval of 0.4 mi between the start of brake applications. Accelerate immediately to the initial test speed after each stop. Drive 1 mi at 30 mph after the last fade stop, and immediately follow the recovery procedure specified in S7.11.3.1.

S7.11.2.2 Vehicles with GVWR greater than 10,000 lb. With transmission in neutral (or declutched) make 10 snubs from 40 to 20 mph at 10 fpsps for each snub. Establish an initial brake temperature before the first brake application of 130 °F. to 150 °F. Initial brake temperatures before brake application for subsequent snubs are those occurring in the time intervals specified below. Attain the required deceleration within 1 s and maintain it for the remainder of the snubbing time. Leave an interval of 30 s between snubs (start of brake application to start of brake application). Accelerate immediately to the initial test speed after each snub. Drive for 1.5 mi at 40 mph after the last snub and immediately follow the recovery procedure specified in S7.11.3.2.

S7.11.3 Recovery stops or snubs.

S7.11.3.1 Vehicles with GVWR of 10,000 lb or less. Make five stops from 30 mph at 10 fpsps for each stop. Control force readings may be terminated when vehicle speed falls to 5 mph. Allow a braking distance interval of 1 mi. Immediately after each stop accelerate at maximum rate to 30 mph and maintain that speed until making the next stop. Record the maximum control force for each stop.

S7.11.3.2 Vehicles with GVWR greater than 10,000 lb. With transmission in neutral (or declutched) make five snubs from 40 to 20 mph at 10 fpsps for each snub. After each snub, accelerate at maximum rate to 40 mph and maintain that speed until making the next brake application at a point 1.5 mi from the point of the previous brake application. Record the maximum control force for each snub.

S7.12 Service brake system-second re-burnish. Repeat S7.6.

S7.13 Service brake system-second fade and recovery test. Repeat S7.11 except in S7.11.2 run 15 fade stops or 20 snubs instead of 10.

S7.14 Third reburnish. Repeat S7.6.

S7.15 Service brake system-fourth effectiveness test. Repeat S7.5. Then (for passenger cars) make four stops from either 95 mph if the speed attainable in 2 mi is 99 to (but not including) 104 mph, or 100 mph if the speed attainable in 2 mi is 104 mph or greater.

S7.16 Service brake system-water recovery test.

S7.16.1 Baseline check stop. Make three stops from 30 mph at 10 fpsps for each stop. Control force readings may be terminated when vehicle speed falls to 5 mph. Average the maximum brake control force required for the three stops.

S7.16.2 Wet brake recovery stops. With the brakes fully released at all times, drive the vehicle for 2 min at a speed of 5 mph in any combination of forward and reverse directions, through a trough having a water depth

of 6 in. After leaving the trough, immediately accelerate at a maximum rate to 30 mph without a brake application. Immediately upon reaching that speed make five stops, each from 30 mph at 10 fpsps for each stop. After each stop (except the last), accelerate the vehicle immediately at a maximum rate to a speed of 30 mph and begin the next stop.

S7.17 Spike stops. Make 10 successive spike stops from 30 mph with the transmission in neutral, with no reverse stops. Make spike stops by applying a control force of 200 lb while recording control force versus time. Maintain control force until vehicle has stopped. At completion of 10 spike stops, make six effectiveness stops from 60 mph.

S7.18 Final inspection. Inspect—

(a) The service brake system for detachment or fracture of any components, such as brake springs and brake shoes or disc pad facing.

(b) The friction surface of the brake, the master cylinder or brake power unit reservoir cover and seal and filler openings, for leakage of brake fluid or lubricant.

(c) The master cylinder or brake power unit reservoir for compliance with the volume and labeling requirements of S5.4.2 and S5.4.3. In determining the fully applied worn condition assume that the lining is worn to: (1) Rivet or bolt heads on riveted or bolted linings, or (2) within one thirty-seconds of an inch of shoe or pad mounting surface on bonded linings, or (3) the limit recommended by the manufacturer, whichever is larger relative to the total possible shoe or pad movement. Drums or rotors are assumed to be at nominal design drum diameter or rotor thickness. Linings are assumed adjusted for normal operating clearance in the released position.

(d) The brake system indicator light(s), for compliance with operation in various key positions, lens color, labeling, and location, in accordance with S5.3.

S7.19 Moving barrier test. (Only for vehicles that have been tested according to S7.7.2.) Load the vehicle to GVWR, release parking brake, and place the transmission selector control to engage the parking mechanism. With a moving barrier as described in paragraph 4.3 of SAE Recommended Practice J972 (2000) (incorporated by reference, see §571.5), impact the vehicle from the front at 2½ mph. Keep the longitudinal axis of the barrier parallel with the longitudinal axis of the vehicle. Repeat the test, impacting the vehicle from the rear.

NOTE: The vehicle used for this test need not be the same vehicle that has been used for the braking tests.

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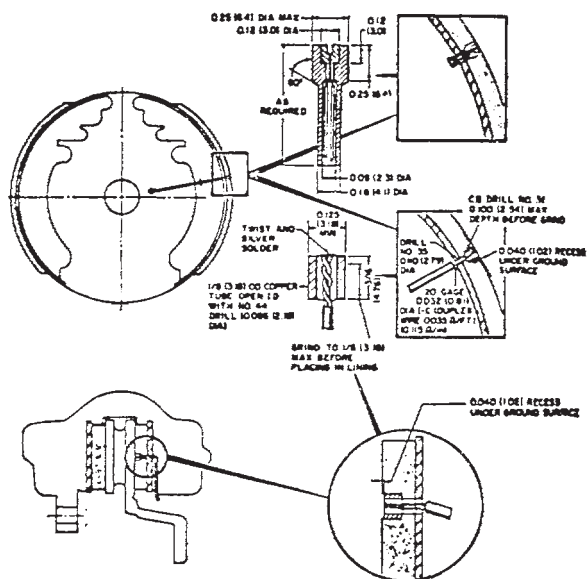
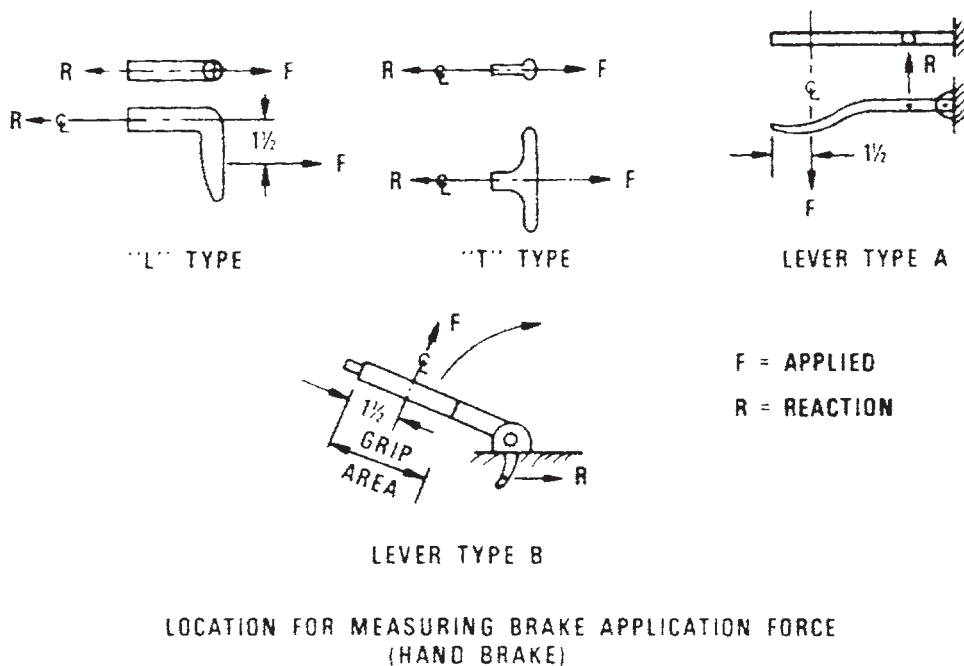


Figure 1 - Typical plug thermo couple installations

NOTE: The second thermocouple shall be installed at .080 inch depth within 1 inch circumferentially of the thermocouple installed at .040 inch depth.



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TABLE I—BRAKE TEST PROCEDURE SEQUENCE AND REQUIREMENTS

No.—Sequence	Test load		Test procedure	Requirements
	Light	GVWR		
1 Instrumentation check			S7.2	
2 First (preburnish) effectiveness test		X	S7.3	S5.1.1.1
3 Burnish procedure		X	S7.4	
4 Second effectiveness test		X	S7.5(b)	S5.1.1.2
5 First reburnish		X	S7.6	
6 Parking brake	X	X	S7.7	S5.2
7 Stability and control during braking (braking-in-a-curve test)	X		S7.5(a)	S5.1.7
8 Third effectiveness (lightly loaded vehicle)	X		S7.8	S5.1.1.3
9 Partial failure	X	X	S7.9	S5.1.2
10 Inoperative brake power and power assist units		X	S7.10	S5.1.3
11 First fade and recovery		X	S7.11	S5.1.4
12 Second reburnish		X	S7.12	
13 Second fade and recovery		X	S7.13	S5.1.4
14 Third reburnish		X	S7.14	
15 Fourth effectiveness		X	S7.15	S5.1.1.4
16 Water recovery		X	S7.16	S5.1.5
17 Spike stops		X	S7.17	S5.1.6
18 Final inspection			S7.18	S5.6
19 Moving barrier test		X	S7.19	S5.2.2.3

TABLE II—STOPPING DISTANCES

Vehicle Test Speed (miles per hour)	Stopping Distance in feet for tests indicated															
	I—1st (preburnished) & 4th effectiveness; spike effectiveness check				II—2d effectiveness				III—3d (lightly loaded vehicles) effectiveness					IV—Inoperative brake power and power assist unit; partial failure		
	(a)	(b)	(c)	(d)	(a)	(b) & (c)	(d)	(e)	(a)	(b)	(c)	(d)	(e)	(a)	(b) & (c)	(d) & (e)
30	¹ 57	^{1,2} 65	^{1,2} 69 (1st) ^{1,2} 65 (4th and spike) ¹ 72	88	¹ 54	¹ 57	78	^{1,2} 70	51	57	65	84	70	114	130	170
35	74	83	91	132	70	74	106	96	67	74	83	114	96	155	176	225
40	96	108	119	173	91	96	138	124	87	96	108	149	124	202	229	288
45	121	137	150	218	115	121	175	158	110	121	137	189	158	257	291	358
50	150	169	185	264	142	150	216	195	135	150	169	233	195	317	359	435
55	181	204	224	326	172	181	261	236	163	181	204	281	236	383	433	530
60	¹ 216	¹ 242	¹ 267	388	¹ 204	¹ 216	¹ 310	¹ 280	¹ 194	¹ 216	¹ 242	¹ 335	¹ 280	¹ 456	¹ 517	¹ 613
80	¹ 405	¹ 459	¹ 510	NA	¹ 383	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
95	¹ 607	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
100	¹ 673	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

¹Distance for specified tests.²Applicable to school buses only. NA=Not applicable. Note: (a) Passenger cars; (b) vehicles other than passenger cars with GVWR of less than 8,000 lbs; (c) vehicles with GVWR of not less than 8,000 lbs and not more than 10,000 lbs; (d) vehicles other than buses, with GVWR greater than 10,000 lbs; (e) buses, including school buses, with GVWR greater than 10,000 lbs.

TABLE III—INOPERATIVE BRAKE POWER ASSIST AND BRAKE POWER UNITS

Stop No.	Average deceleration, F				Equivalent stopping distance, feet			
	Column 1—brake power assist		Column 2—brake power unit		Column 3—brake power assist		Column 4—brake power unit	
	(a)	(b) and (c)	(a)	(b) and (c)	(a)	(b) and (c)	(a)	(b) and (c)
1	16.0	14.0	16.0	13.0	242	277	242	298
2	12.0	12.0	13.0	11.0	323	323	298	352
3	10.0	10.0	12.0	10.0	388	388	323	388
4	9.0	8.5	11.0	9.5	431	456	352	409
5	8.0	7.5	10.0	9.0	484	517	388	431
6	7.5	6.7	9.5	8.5	517	580	409	456
7	¹ 7.0	¹ 6.0	9.0	8.0	554	646	431	484
8	NA	NA	8.5	7.5	NA	NA	456	517

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TABLE III—INOPERATIVE BRAKE POWER ASSIST AND BRAKE POWER UNITS, Continued

Stop No.	Average deceleration, F				Equivalent stopping distance, feet			
	Column 1—brake power assist		Column 2—brake power unit		Column 3—brake power assist		Column 4—brake power unit	
	(a)	(b) and (c)	(a)	(b) and (c)	(a)	(b) and (c)	(a)	(b) and (c)
9.....	NA	NA	8.0	7.0	NA	NA	484	554
10.....	NA	NA	7.5	6.5	NA	NA	517	596
11.....	NA	NA	¹ 7.0	¹ 6.0	NA	NA	554	646

¹Depleted. (a) Passenger cars; (b) vehicles other than passenger cars with GVWR of 10,000 lbs or less; (c) vehicles with GVWR greater than 10,000 lbs; NA=Not applicable.

§571.106 Standard No. 106; Brake hoses.

S1. Scope. This standard specifies labeling and performance requirements for motor vehicle brake hose, brake hose assemblies, and brake hose end fittings.

S2. Purpose. The purpose of this standard is to reduce deaths and injuries occurring as a result of brake system failure from pressure or vacuum loss due to hose or hose assembly rupture.

S3. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, buses, trailers, and motorcycles, and to hydraulic, air, and vacuum brake hose, brake hose assemblies, and brake hose end fittings for use in those vehicles.

S4. Definitions.

Armor means protective material installed on a brake hose to increase the resistance of the hose or hose assembly to abrasion or impact damage.

Brake hose means a flexible conduit, other than a vacuum tubing connector, manufactured for use in a brake system to transmit or contain the fluid pressure or vacuum used to apply force to a vehicle's brakes. For hose, a dimensional description such as "¼-inch hose" refers to the nominal inside diameter. For tubing, a dimensional description such as "¼-in tubing" refers to the nominal outside diameter.

Brake hose assembly means a brake hose, with or without armor, equipped with end fittings for use in a brake system, but does not include an air or vacuum assembly prepared by the owner or operator of a used vehicle, by his employee, or by a repair facility, for installation in that used vehicle.

Brake hose end fitting means a coupler, other than a clamp, designed for attachment to the end of a brake hose.

Free length means the linear measurement of hose exposed between the end fittings of a hose assembly in a straight position.

Permanently attached end fitting means an end fitting that is attached by deformation of the fitting about the hose by crimping or swaging, or an end fitting that is attached by use of a sacrificial sleeve or ferrule that requires replacement each time a hose assembly is rebuilt.

Preformed means a brake hose that is manufactured with permanent bends and is shaped to fit a specific vehicle without further bending.

Rupture means any failure that results in separation of a brake hose from its end fitting or in leakage.

Vacuum tubing connector means a flexible conduit of vacuum that (i) connects metal tubing to metal tubing in a brake system, (ii) is attached without end fittings, and (iii) when installed, has an unsupported length less than the total length of those portions that cover the metal tubing.

S5. Requirements—hydraulic brake hose, brake hose assemblies, and brake hose end fittings.

S5.1 Construction. (a) Each hydraulic brake hose assembly shall have permanently attached brake hose end fittings which are attached by deformation of the fitting about the hose by crimping or swaging.

(b) Each hydraulic brake hose assembly that is equipped with a permanent supplemental support integrally attached to the assembly and is manufactured as a replacement for use on a vehicle not equipped, as an integral part of the vehicle's original design, with a means of attaching the support to the vehicle shall be equipped with a bracket that is integrally attached to the supplemental support and that adapts the vehicle to properly accept this type of brake hose assembly.

S5.2 Labeling.

S5.2.1 Each hydraulic brake hose, except hose sold as part of a motor vehicle, shall have at least two clearly identifiable stripes of at least one-sixteenth of an inch in width, placed on opposite sides of the brake hose parallel to its longitudinal axis. One stripe may be interrupted by the information required by S5.2.2, and the other stripe may be interrupted by additional information at the manufacturer's option. However, hydraulic brake hose manufactured for use only in an assembly whose end fittings prevent its installation in a twisted orientation in either side of the vehicle, need not meet the requirements of S5.2.1.

S5.2.2 Each hydraulic brake hose shall be labeled, or cut from bulk hose that is labeled, at intervals of not more than 6 inches, measured from the end of one leg-end to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on hose that is sold as part of a brake hose assembly or a motor vehicle.

(a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

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(b) A designation that identifies the manufacturer of the hose, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS-222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The marking may consist of a designation other than block capital letters required by S5.2.2.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

(d) The nominal inside diameter of the hose expressed in inches or fractions of inches, or in millimeters followed by the abbreviation "mm."

(e) Either "HR" to indicate that the hose is regular expansion hydraulic hose or "HL" to indicate that the hose is low expansion hydraulic hose.

S5.2.3 Package labeling for brake hose assemblies designed to be used with a supplemental support

(a) Each hydraulic brake hose assembly that is equipped with a permanent supplemental support integrally attached to the assembly and is manufactured as a replacement assembly for a vehicle equipped, as an integral part of the vehicle's original design, with a means of attaching the support to the vehicle shall be sold in a package that is marked or labeled as follows: "FOR USE ON [*insert Manufacturer, Model Name*] ONLY";

(b) Each hydraulic brake hose assembly that is equipped with a permanent supplemental support integrally attached to the assembly and is manufactured as a replacement for use on a vehicle not equipped, as an integral part of the vehicle's original design, with a means of attaching the support to the vehicle shall comply with paragraphs (a)(1) and (2) of this section:

(1) Be sold in a package that is marked or labeled as follows: "FOR USE ONLY WITH A SUPPLEMENTAL SUPPORT."

(2) Be accompanied by clear, detailed instructions explaining the proper installation of the brake hose and the supplemental support bracket to the vehicle and the consequences of not attaching the supplemental support bracket to the vehicle. The instructions shall be printed on or included in the package specified in paragraph (a)(1) of this section.

S5.2.4 Each hydraulic brake hose assembly, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake hose assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S5.2.4.1.

The band may at the manufacturer's option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped in block capital letters, numerals or symbols at least one-eighth of an inch high with the following information:

(a) The symbol DOT constituting certification by the hose assembler that the hose assembly conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS-222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

S5.2.4.1 At least one end fitting of a hydraulic brake hose assembly shall be etched, stamped or embossed with a designation at least one-sixteenth of an inch high that identifies the manufacturer of the hose assembly and is filed in accordance with S5.2.4(b).

S5.3 Test requirements. A hydraulic brake hose assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S6. However, a particular hose assembly or appropriate part thereof need not meet further requirements after having been subjected to and having met the constriction requirement (S5.3.1) and any one of the requirements specified in S5.3.2 through S5.3.13.

S5.3.1 Constriction. Except for that part of an end fitting which does not contain hose, every inside diameter of any section of a hydraulic brake hose assembly shall be not less than 64 percent of the nominal inside diameter of the brake hose (S6.12).

S5.3.2 Expansion and burst strength. The maximum expansion of a hydraulic brake hose assembly at 1,000 psi, 1,500 psi and 2,900 psi shall not exceed the values specified in Table I (S6.1), except that a brake hose larger than $\frac{3}{16}$ inch or 5 mm is not subject to the 2,900 psi expansion test requirements. The hydraulic brake hose assembly shall then withstand water pressure of 4,000 psi for 2 minutes without rupture, and then shall not rupture at less than 7,000 psi for a $\frac{1}{8}$ inch, 3 mm, or smaller diameter hose, or at less than 5,000 psi for a hose with a diameter larger than $\frac{1}{8}$ inch or 3 mm (S6.2).

TABLE I.—MAXIMUM EXPANSION OF FREE LENGTH BRAKE HOSE, CC/FT

Hydraulic brake hose, inside diameter	Test pressure					
	1,000 psi		1,500 psi		2,900 psi	
	Regular expansion hose	Low expansion hose	Low expansion hose	Regular expansion hose	Regular expansion hose	Low expansion hose
$\frac{1}{8}$ inch, or 3mm, or less . . .	0.66	0.33	0.79	0.42	1.21	0.61
$>\frac{1}{8}$ inch or 3mm, to $\frac{3}{16}$ inch, or 5 mm.	0.86	0.55	1.02	0.72	1.67	0.91
$>\frac{3}{16}$ inch, or 5	1.04	0.82	1.30	1.17	*	*

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S5.3.3 Whip resistance. A hydraulic brake hose assembly shall not rupture when run continuously on a flexing machine for 35 hours (S6.3).

S5.3.4 Tensile strength. A hydraulic brake hose assembly shall withstand a pull of 325 pounds without separation of the hose from its end fittings during a slow pull test, and shall withstand a pull of 370 pounds without separation of the hose from its end fittings during a fast pull test (S6.4).

S5.3.5 Water absorption and burst strength. A hydraulic brake hose assembly, after immersion in water for 70 hours (S6.5), shall withstand water pressure of 4,000 psi for 2 minutes, and then shall not rupture at less than 5,000 psi (S6.2).

S5.3.6 Water absorption and tensile strength. A hydraulic brake hose assembly, after immersion in water for 70 hours (S6.5), shall withstand a pull of 325 pounds without separation of the hose from its end fittings during a slow pull test, and shall withstand a pull of 370 pounds without separation of the hose from its end fittings during a fast pull test (S6.4).

S5.3.7 Water absorption and whip resistance. A hydraulic brake hose assembly, after immersion in water for 70 hours (S6.5), shall not rupture when run continuously on a flexing machine for 35 hours (S6.3).

S5.3.8 Low-temperature resistance. A hydraulic brake hose conditioned at a temperature between minus 49 degrees Fahrenheit (minus 45 degrees Celsius) and minus 54 degrees Fahrenheit (minus 48 degrees Celsius) for 70 hours shall not show cracks visible without magnification when bent around a cylinder as specified in S6.6 (S6.6).

S5.3.9 Brake fluid compatibility, constriction, and burst strength. Except for brake hose assemblies designed for use with mineral or petroleum-based brake fluids, a hydraulic brake hose assembly shall meet the constriction requirement of S5.3.1 after having been subjected to a temperature of 248 degrees Fahrenheit (120 degrees Celsius) for 70 hours while filled with SAE RM-66-04 "Compatibility Fluid," as described in Appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see §571.5). It shall then withstand water pressure of 4,000 psi for 2 minutes and thereafter shall not rupture at less than 5,000 psi (S6.2 except all sizes of hose are tested at 5,000 psi).

S5.3.10 Ozone resistance. A hydraulic brake hose shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours at 104° F. (S6.8).

S5.3.11 Dynamic Ozone Test. A hydraulic brake hose shall not show cracks visible without magnification after having been subjected to a 48-hour dynamic ozone test (S6.9).

S5.3.12 High temperature impulse test. A brake hose assembly tested under the conditions in S6.10:

- (a) Shall withstand pressure cycling for 150 cycles, at 295 degrees Fahrenheit (146 degrees Celsius) without leakage;
- (b) Shall not rupture during a 2- minute, 4,000 psi pressure hold test, and;
- (c) Shall not burst at a pressure less than 5,000 psi.

S5.3.13 End fitting corrosion resistance. After 24 hours of exposure to salt spray, a hydraulic brake hose end fitting shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information has caused displacement of the protective coating (S6.11).

S6. Test procedures—Hydraulic brake hose, brake hose assemblies, and brake hose end fittings.

S6.1. Expansion test.

S6.1.1 Apparatus. Utilize a test apparatus (as shown in Figure 1) which consists of:

- (a) Source for required fluid pressure;
- (b) Test fluid of water without any additives and free of gases;
- (c) Reservoir for test fluid;
- (d) Pressure gauges;
- (e) Brake hose end fittings in which to mount the hose vertically; and
- (f) Graduate burette with 0.05 cc increments.

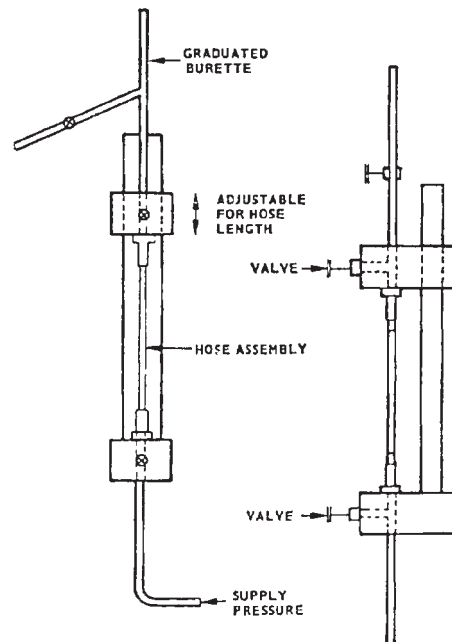


Fig. 1. Expansion Test Apparatus

S6.1.2 Preparation.

- (a) Measure the free length of the hose assembly.
- (b) Mount the hose so that it is in a vertical straight position without tension when pressure is applied.
- (c) fill the hose with test fluid and bleed all gases from the system.
- (d) Close the valve to the burette and apply 1,500 psi for 10 seconds; then release pressure.

S6.1.3 Calculation of expansion at 1,000, 1,500 psi, and 2,900 psi.

- (a) Adjust the fluid level in the burette to zero.
- (b) Close the valve to the burette, apply pressure at the rate of 15,000 psi per minute, and seal 1,000 psi in

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the hose (1,500 psi in the second series, and 2,900 psi in the third series).

(c) After 3 seconds open the valve to the burette for 10 seconds and allow the fluid in the expanded hose to rise into the burette.

(d) Repeat the procedure in steps (b) and (c) twice. Measure the amount of test fluid which has accumulated in the burette as a result of the three applications of pressure.

(e) Calculate the volumetric expansion per foot by dividing the total accumulated test fluid by 3 and further dividing by the free length of the hose in feet.

S6.2 Burst strength test.

(a) Connect the brake hose to a pressure system and fill it completely with water, allowing all gases to escape.

(b) Apply water pressure of 4,000 psi at a rate of 15,000 psi per minute.

(c) After 2 minutes at 4,000 psi, increase the pressure at the rate of 15,000 psi per minute until the pressure exceeds 5,000 psi for a brake hose larger than $\frac{1}{8}$ inch or 3 mm diameter, or until the pressure exceeds 7,000 psi for a brake hose of $\frac{1}{8}$ inch, 3 mm, or smaller diameter.

S6.3 Whip resistance test.

S6.3.1 Apparatus. Utilize test apparatus that is dynamically balanced and includes:

(a) A movable header consisting of a horizontal bar equipped with capped end fittings and mounted through bearings at each end to points 4 inches from the center of two vertically rotating disks whose edges are in the same vertical plane;

(b) An adjustable stationary header parallel to the movable header in the same horizontal plane as the centers of the disks, and fitted with open end fittings;

(c) An elapsed time indicator; and

(d) A source of water pressure connected to the open end fittings.

S6.3.2 Preparation.

(a) Except for the supplemental support specified in S6.3.2(d), remove all external appendages including, but not limited to, hose armor, chafing collars, mounting brackets, date band and spring guards.

(b) Measure the hose free length.

(c) Mount the hose in the whip test machine, introducing slack as specified in Table II for the size hose tested, measuring the projected length parallel to the axis of the rotating disks. The manufacturer may, at his option, adapt the fitting attachment points to permit mounting hose assemblies equipped with angled or other special fittings in the same orientation as hose assemblies equipped with straight fittings.

(d) In the case of a brake hose assembly equipped with a permanent supplemental support integrally attached to the assembly, the assembly may be mounted using the supplemental support and associated means of simulating its attachment to the vehicle. Mount the supplemental support in the same vertical and horizontal planes as the stationary header end of the whip test fixture described in S6.3.1(b). Mount or attach the supplemental support so that it is positioned in accordance with the

recommendation of the assembly manufacturer for attaching the supplemental support on a vehicle.

TABLE II—HOSE LENGTHS

Free length between end fittings, inches	Slack, inches	
	$\frac{1}{8}$ inch or 3 mm hose or less	More than $\frac{1}{8}$ inch or 3 mm hose
8 to 15- $\frac{1}{2}$, inclusive	1.750	.....
10 to 15- $\frac{1}{2}$, inclusive .....	.....	1,000
Over 15- $\frac{1}{2}$ to 19 inclusive.....	1.250	.....
Over 19 to 24, inclusive	0.750	.....

S6.3.3 Operation.

(a) Apply 235 psi water pressure and bleed all gases from the system.

(b) Drive the movable head at 800 rpm.

S6.4 Tensile strength test. Utilize a tension testing machine conforming to the requirements of ASTM E4-03 (incorporated by reference, see §571.5) and provided with a recording device to measure the force applied.

S6.4.1 Preparation. Mount the hose assembly to ensure straight, evenly distributed machine pull.

S6.4.2 Operation. (a) Conduct the slow pull test by applying tension at a rate of 1 inch per minute travel of the moving head until separation occurs.

(b) Conduct the fast pull test by applying tension at a rate of 2 inches per minute travel of the moving head until separation occurs.

S6.5 Water absorption sequence tests. (a) Prepare three brake hose assemblies and measure the free length of the hose assemblies.

(b) Immerse the brake hose assemblies in distilled water at 185 degrees Fahrenheit (85 degrees Celsius) for 70 hours. Remove the brake hose assemblies from the water and condition in air at room temperature for 30 minutes.

(c) Conduct the tests in S6.2, S6.3, and S6.4, using a different hose for each sequence.

S6.6 Low temperature resistance test.

S6.6.1 Preparation.

(a) Remove hose armor, if any, and condition the hose in a straight position in air at a temperature between minus 49 degrees Fahrenheit and minus 54 degrees Fahrenheit (minus 45 degrees Celsius and minus 48 degrees Celsius) for 70 hours.

(b) Condition a cylinder in air at a temperature between minus 49 degrees Fahrenheit and minus 54 degrees Fahrenheit (minus 45 degrees Celsius and minus 48 degrees Celsius) for 70 hours, using a cylinder of 2 $\frac{1}{2}$ inches in diameter for tests of hose less than $\frac{1}{8}$ inch or 3 mm, 3 inches in diameter for tests of $\frac{1}{8}$ inch or 3 mm hose, 3 $\frac{1}{2}$ inches in diameter for tests of $\frac{3}{16}$ to $\frac{1}{4}$ inch hose or 4 mm to 6 mm hose, and 4 inches in diameter for tests of hose greater than $\frac{1}{4}$ inch or 6 mm in diameter.

S6.6.2 Flexibility testing. Bend the conditioned hose 180 degrees around the conditioned cylinder at a steady rate in a period of 3 to 5 seconds. Examine without magnification for cracks.

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S6.7 Brake fluid compatibility test.

S6.7.1 Preparation.

(a) Attach a hose assembly below a 1-pint reservoir filled with 100 ml. of SAE RM-66-04 Compatibility Fluid as shown in Figure 2.

(b) Fill the hose assembly with brake fluid, seal the lower end, and place the test assembly in an oven in a vertical position.

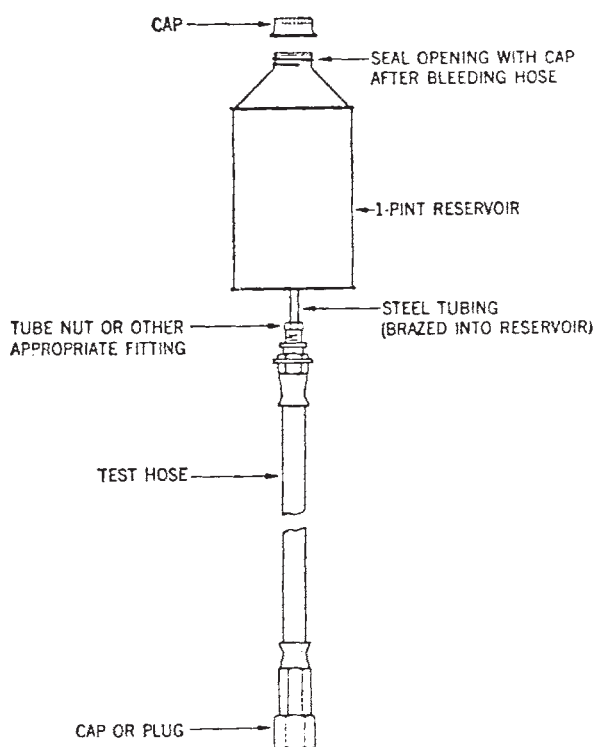


Fig. 2. Brake Fluid Compatibility Apparatus

S6.7.2 Oven treatment. (a) Condition the hose assembly at 200° F. for 70 hours.

(b) Cool the hose assembly at room temperature for 30 minutes.

(c) Drain the brake hose assembly, immediately determine that every inside diameter of any section of the hose assembly, except for that part of an end fitting which does not contain hose, is not less than 64 percent of the nominal inside diameter of the hose, and conduct the test specified in S6.2.

S6.8 Ozone resistance test. Utilize a cylinder with a diameter eight times the nominal outside diameter of the brake hose excluding armor.

S6.8.1 Preparation. After removing any armor, bind a hydraulic brake hose 360 around the cylinder. In the case of hose shorter than the circumference of the cylinder, bend the hose so that as much of its length as possible is in contact.

S6.8.2 Exposure to ozone.

(a) Condition the hose on the cylinder in air at room temperature for 24 hours.

(b) Immediately thereafter, condition the hose on the cylinder for 70 hours in an exposure chamber having an ambient air temperature of 104 degrees Fahrenheit (40 degrees Celsius) during the test and containing air mixed with ozone in the proportion of 100 parts of ozone per 100 million parts of air by volume.

(c) Examine the hose for cracks under 7-power magnification, ignoring areas immediately adjacent to or within the area covered by binding.

S6.9 Dynamic Ozone Test.

S6.9.1 Apparatus. Utilize a test apparatus shown in Figure 3 which is constructed so that:

(a) It has a fixed pin with a vertical orientation over which one end of the brake hose is installed.

(b) It has a movable pin that is oriented 30 degrees from vertical, with the top of the movable pin angled towards the fixed pin. The moveable pin maintains its orientation to the fixed pin throughout its travel in the horizontal plane. The other end of the brake hose is installed on the movable pin.

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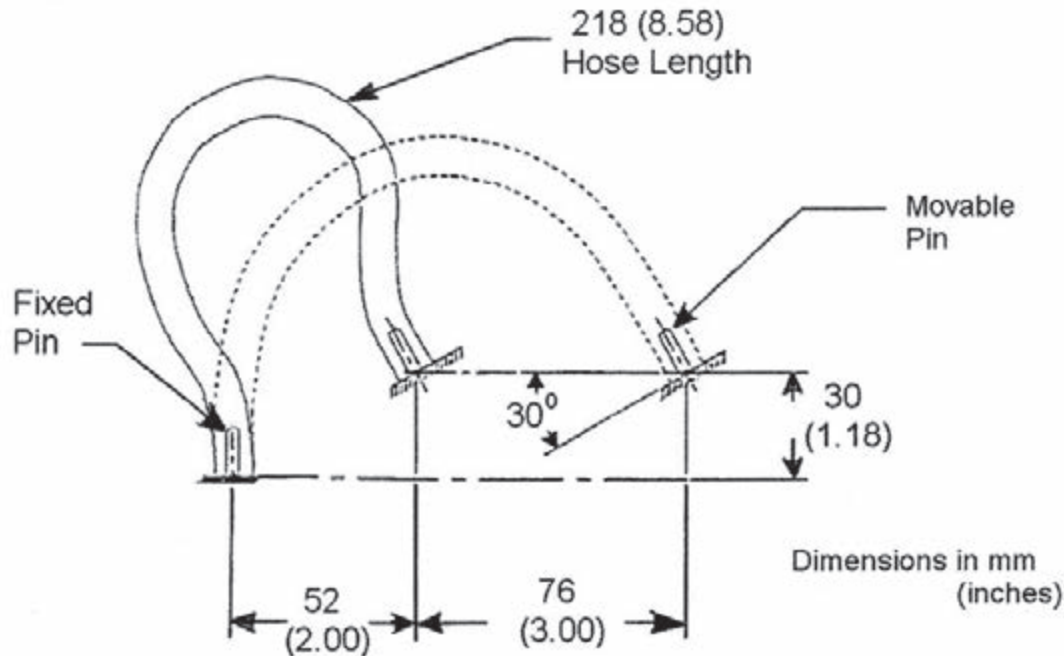


Figure 3. Dynamic Ozone Test Apparatus

S6.9.2 Preparation. (a) Precondition the hose assembly by laying it on a flat surface in an unstressed condition, at room temperature, for 24 hours.

(b) Cut the brake hose assembly to a length of 8.6 inches (218 mm), such that no end fittings remain on the cut hose.

(c) Mount the brake hose onto the test fixture by fully inserting the fixture pins into each end of the hose. Secure the hose to the fixture pins using a band clamp at each end of the hose.

(d) Place the test fixture into an ozone chamber

(e) Stabilize the atmosphere in the ozone chamber so that the ambient temperature is 104°F (40 degrees Celsius) and the air mixture contains air mixed with ozone in the proportion of 100 parts of ozone per 100 million parts of air by volume. This atmosphere is to remain stable throughout the remainder of the test.

(f) Begin cycling the movable pin at a rate of 0.3 Hz. Continue the cycling for 48 hours.

(g) At the completion of 48 hours of cycling, remove the test fixture from the ozone chamber. Without removing the hose from the test fixture, visually examine the hose for cracks without magnification, ignoring areas immediately adjacent to or within the area covered by the band clamps. Examine the hose with the movable pin at any point along its travel.

S6.10 High temperature impulse test.

S6.10.1 Apparatus. (a) A pressure cycling machine to which one end of the brake hose assembly can be attached, with the entire hose assembly installed vertically inside of a circulating air oven. The machine shall be capable of increasing the pressure in the hose from zero psi to 1600

psi, and decreasing the pressure in the hose from 1600 psi to zero psi, within 2 seconds.

(b) A circulating air oven that can reach a temperature of 295 degrees Fahrenheit (146 degrees Celsius) within 30 minutes, and that can maintain a constant 295 degrees F (146 degrees Celsius) thereafter, with the brake hose assembly inside of the oven and attached to the pressure cycling machine.

(c) A burst test apparatus to conduct testing specified in S6.2

S6.10.2 Preparation. (a) Connect one end of the hose assembly to the pressure cycling machine and plug the other end of the hose. Fill the pressure cycling machine and hose assembly with SAE RM-66-04 "Compatibility Fluid," as described in Appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see §571.5) and bleed all gases from the system.

(b) Place the brake hose assembly inside of the circulating air oven in a vertical position. Increase the oven temperature to 295 degrees F (146 degrees Celsius) and maintain this temperature throughout the pressure cycling test.

(c) During each pressure cycle, the pressure in the hose is increased from zero psi to 1600 psi and held constant for 1 minute, then the pressure is decreased from 1600 psi to zero psi and held constant for 1 minute. Perform 150 pressure cycles on the brake hose assembly.

(d) Remove the brake hose assembly from the oven, disconnect it from the pressure cycling machine, and drain the fluid from the hose. Cool the brake hose assembly at room temperature for 45 minutes.

(e) Wipe the brake hose using acetone to remove residual Compatibility Fluid. Conduct the burst strength

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test in S6.2, except all sizes of hose are tested at 5,000 psi.

S6.11 End fitting corrosion test. Utilize the apparatus described in ASTM B117-03 (incorporated by reference, see §571.5).

S6.11.1 Construction. *Construct the salt spray chamber so that:*

- (a) The construction material does not affect the corrosiveness of the fog.
- (b) The hose assembly is supported or suspended 30 degrees from the vertical and parallel to the principal direction of the horizontal flow of fog through the chamber.
- (c) The hose assembly does not contact any metallic material or any material capable of acting as a wick
- (d) Condensation which falls from the assembly does not return to the solution reservoir for respraying.
- (e) Condensation from any source does not fall on the brake hose assemblies or the solution collectors.
- (f) Spray from the nozzles is not directed onto the hose assembly.

S6.11.2 Preparation. (a) Plug each end of the hose assembly.

(b) Mix a salt solution five parts by weight of sodium chloride to 95 parts of distilled water, using sodium chloride substantially free of nickel and copper, and containing on a dry basis not more than 0.1 percent of sodium iodide and not more than 0.3 percent total impurities. Ensure that the solution is free of suspended solids before the solution is atomized.

(c) After atomization at 95 degrees Fahrenheit (35 degrees Celsius), ensure that the collected solution is in the PH range of 6.5 to 7.2. Make the PH measurements at 77 degrees Fahrenheit (28 degrees Celsius).

(d) Maintain a compressed air supply to the nozzle or nozzles free of oil and dirt and between 10 and 25 psi.

S6.11.3 Operation. Subject the brake hose assembly to the salt spray continuously for 24 hours.

(a) Regulate the mixture so that each collector will collect from 1 to 2 milliliters of solution per hour for each 80 square centimeters of horizontal collecting area.

(b) Maintain exposure zone temperature at 95 degrees Fahrenheit (35 degrees Celsius).

(c) Upon completion, remove the salt deposit from the surface of the hose by washing gently or dipping in clean running water not warmer than 100 degrees Fahrenheit (38 degrees Celsius) and then drying immediately.

S6.12 Constriction test. Brake hose constriction test requirements shall be met using at least one of the methods specified in S6.12.1, S6.12.2, or S6.12.3.

S6.12.1 Plug gauge. (a) Utilize a plug gauge as shown in Figure 4. Diameter "A" is equal to 64 percent of the nominal inside diameter of the hydraulic brake hose being tested.

(b) Brake hose assemblies that are to be used for additional testing have constriction testing only at each end fitting. Other brake hose assemblies may be cut into 3-inch lengths to permit constriction testing of the entire assembly. Hose assemblies with end fittings that do not

permit entry of the gauge (*e.g.*, restrictive orifice or banjo fitting) are cut 3 inches from the point at which the hose terminates in the end fitting and then tested from the cut end.

(c) Hold the brake hose in a straight position and vertical orientation.

(d) Place the spherical end of the plug gauge just inside the hose or end fitting. If the spherical end will not enter the hose or end fitting using no more force than gravity acting on the plug gauge, this constitutes failure of the constriction test.

(e) Release the plug gauge. Within 3 seconds, the plug gauge shall fall under the force of gravity alone up to the handle of the gauge. If the plug gauge does not fully enter the hose up to the handle of the gauge within three seconds, this constitutes failure of the constriction test.

S6.12.2 Extended plug gauge. (a) The test in 6.12.1 may be conducted with an extended plug gauge to enable testing of the entire brake hose from one end fitting, without cutting the brake hose. The extended plug gauge weight and spherical diameter specifications are as shown in Figure 4, but the handle portion of the gauge may be deleted and the gauge length may be greater than 3 inches.

(b) The required performance of the extended plug gauge in S6.12.1(e) is that after the plug gauge is released, the extended plug gauge shall fall under the

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force of gravity alone at an average rate of 1 inch per second until the spherical diameter of the extended gauge passes through all portions of the brake hose assembly containing hose. If the extended plug gauge

does not pass through all portions of the brake hose assembly containing hose at an average rate of 1 inch per second, this constitutes failure of the constriction test.

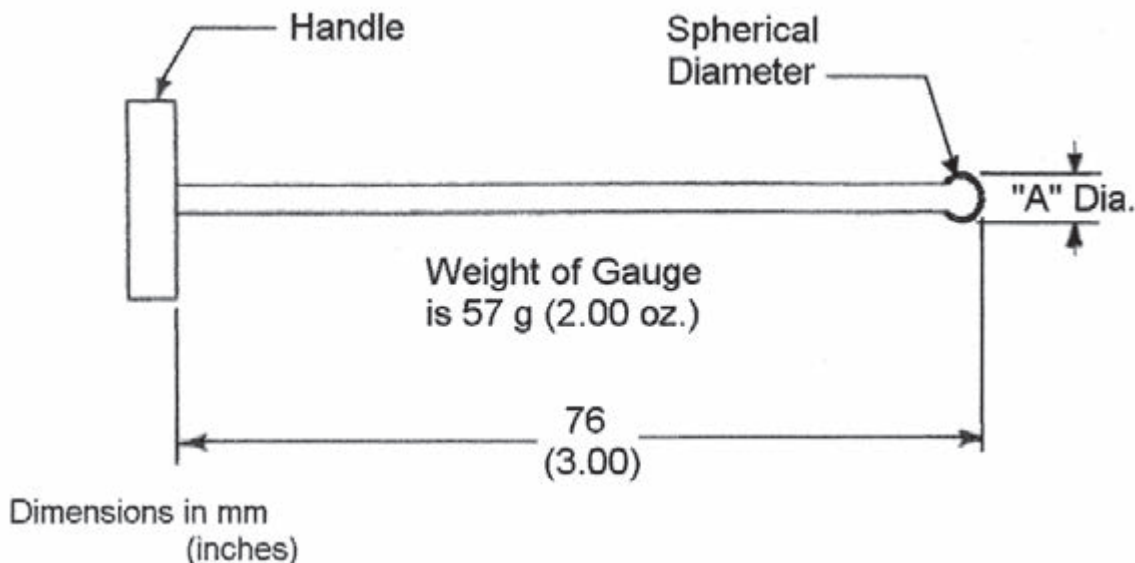


Figure 4. Constriction Test Plug Gauge

S6.12.3 Drop ball test. (a) Utilize a rigid spherical ball with a diameter equal to 64 percent of the nominal inside diameter of the hydraulic brake hose being tested. The weight of the spherical ball shall not exceed 2 ounces (57 grams).

(b) Hold the brake hose in a straight position and vertical orientation.

(c) Hold the ball just above the end fitting.

(d) Release the ball. The ball shall fall under the force of gravity alone completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second. Failure of the ball to pass completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second, constitutes failure of the constriction test.

S7. Requirements—Air brake hose, brake hose assemblies, and brake hose end fittings.

S7.1 Construction. Each air brake hose assembly shall be equipped with permanently attached brake hose end fittings or reusable brake hose end fittings. Each air brake hose constructed of synthetic or natural elastomeric rubber shall conform to the dimensional requirements specified in Table III, except for brake hose manufactured in metric sizes.

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TABLE III.—AIR BRAKE HOSE DIMENSIONS—INSIDE DIAMETER (ID) AND OUTSIDE DIAMETER (OD) DIMENSIONS IN INCHES (MILLIMETERS)

	Type A—Hose Size—Nominal Inside Diameter					
	1/4	5/16	3/8	7/16	1/2 SP ⁽¹⁾	5/8
Min. I.D.	0.227 (5.8)	0.289 (7.3)	0.352 (8.9)	0.407 (10.3)	0.469 (11.9)	0.594 (15.1)
Max. I.D.	0.273 (6.9)	0.335 (8.5)	0.398 (10.1)	0.469 (11.9)	0.531 (13.5)	0.656 (16.7)
Min. O.D.	0.594 (15.1)	0.656 (16.7)	0.719 (18.3)	0.781 (19.8)	0.844 (21.4)	1.031 (26.2)
Max. O.D.	0.656 (16.7)	0.719 (18.3)	0.781 (19.8)	0.843 (21.4)	0.906 (23.0)	1.094 (27.8)
	Type AI ⁽²⁾ —Hose Size—Nominal Inside Diameter					
	3/16	1/4	5/16	13/32	1/2	5/8
Min. I.D.	0.188 (4.8)	0.250 (6.4)	0.312 (7.9)	0.406 (10.3)	0.500 (12.7)	0.625 (15.9)
Max. I.D.	0.214 (5.4)	0.281 (7.1)	0.343 (8.7)	0.437 (11.1)	0.539 (13.7)	0.667 (16.9)
Min. O.D.	0.472 (12.0)	0.535 (13.6)	0.598 (15.1)	0.714 (18.1)	0.808 (20.5)	0.933 (23.7)
Max. O.D.	0.510 (13.0)	0.573 (14.6)	0.636 (16.2)	0.760 (19.3)	0.854 (21.7)	0.979 (24.9)
	Type AII ⁽²⁾ —Hose Size—Nominal Inside Diameter					
	3/16	1/4	5/16	13/32	1/2	5/8
Min. I.D.	0.188 (4.8)	0.250 (6.4)	0.312 (7.9)	0.406 (10.3)	0.500 (12.7)	0.625 (15.9)
Max. I.D.	0.214 (5.4)	0.281 (7.1)	0.343 (8.7)	0.437 (11.1)	0.539 (13.7)	0.667 (16.9)
Min. O.D.	0.500 (12.7)	0.562 (14.3)	0.656 (16.7)	0.742 (18.8)	0.898 (22.8)	1.054 (26.8)
Max. O.D.	0.539 (13.7)	0.602 (15.3)	0.695 (17.7)	0.789 (20.1)	0.945 (24.0)	1.101 (27.9)

⁽¹⁾ Notes: Type A, sizes 3/8, 7/16, and 1/2 Special can be assembled with reusable end fittings. All sizes can be assembled using permanently-attached (crimped) end fittings.

⁽²⁾ Types AI and AII, all sizes, can be assembled with reusable or permanently-attached (crimped) end fittings.

S7.2 Labeling

S7.2.1 Hose. Each air brake hose shall be labeled, or cut from bulk hose that is labeled, at intervals of not more than 6 inches, measured from the end of one leg-end to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on hose that is sold as part of a brake hose assembly or a motor vehicle.

(a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS-222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

(d) The nominal inside diameter of the hose expressed in inches or fractions of inches or in millimeters. The abbreviation “mm” shall follow hose sizes that are expressed in millimeters. (Examples: 3/8, 1/2 (1/2SP in the case of 1/2 inch special air brake hose), 4mm, 6mm.)

(e) The type designation corresponding to the brake hose dimensions in Table III. Type A shall be labeled with the letter “A”, Type AI shall be labeled with the letters “AI”, and type AII shall be labeled with the letters “AII”. Metric air brake hose shall be labeled with the letter “A.”

S7.2.2 End fittings. Except for an end fitting that is attached by deformation of the fitting about a hose by crimping or swaging, at least one component of each air brake hose fitting shall be etched, embossed, or stamped

in block capital letters and numerals at least one-sixteenth of an inch high with the following information:

(a) The symbol DOT, constituting a certification by the manufacturer of that component that the component conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of that component of the fitting, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS-222, National Highway Traffic Safety Administration, 400 Seventh St. S.W., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The letter “A” shall indicate intended use in air brake systems. In the case of an end fitting intended for use in a reusable assembly with brake hose subject to Table III, “AI” or “AII” shall indicate use with Type I or Type II hose, respectively.

(d) The nominal inside diameter of the hose to which the fitting is properly attached expressed in inches or fractions of inches or in millimeters. (See examples in S7.2.1 (d).) The abbreviation “mm” shall follow hose sizes that are expressed in millimeters.

S7.2.3 Assemblies. Each air brake hose assembly made with end fittings that are attached by crimping or swaging, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake hose assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S7.2.3.1. The band may at the manufacturer’s option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped in block capital letters, numerals or symbols at least one-eighth of an inch high, with the following information:

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(a) The symbol DOT, constituting certification by the hose assembler that the hose assembly conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics Division, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

S7.2.3.1 At least one end fitting of an air brake hose assembly made with end fittings that are attached by crimping or swaging shall be etched, stamped or embossed with a designation at least one-sixteenth of an inch high that identifies the manufacturer of the hose assembly and is filed in accordance with S7.2.3(b).

S7.3 Test requirements. Each air brake hose assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S8. However, a particular hose assembly or appropriate part thereof need not

meet further requirements after having met the constriction requirement (S7.3.1) and then having been subjected to any one of the requirements specified in S7.3.2 through S7.3.13.

S7.3.1 Constriction. Every inside diameter of any section of an air brake hose assembly shall not be less than 66 percent of the nominal inside diameter of the brake hose. (S8.14)

S7.3.2 High temperature resistance. An air brake hose shall not show external or internal cracks, charring, or disintegration visible without magnification when straightened after being bent for 70 hours at 212 degrees Fahrenheit (100 degrees Celsius) over a small test cylinder having the radius specified in Table IV for the size of hose tested. (S8.1)

S7.3.3 Low temperature resistance. The inside and outside surfaces of an air brake hose shall not show cracks as a result of conditioning at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 70 hours when bent around a large test cylinder having the radius specified in Table IV for the size of hose tested (S8.2).

TABLE IV—AIR BRAKE HOSE DIAMETERS AND TEST CYLINDER RADII

Nominal hose inside diameter, inches ¹	3/16	1/4	5/16	3/8	13/32	7/16, 1/2	5/8
Nominal hose inside diameter, millimeters ¹	4, 5	6	8	.....	10	12	16
Small test cylinder, radius in inches (millimeters) ²	1 (25)	1½ (38)	1¾ (45)	1¾ (45)	17/8 (48)	2 (51)	2½ (64)
Large test cylinder, radius in inches (millimeters) ³	2 (51)	2½ (64)	3 (76)	3½ (89)	3½ (89)	4 (102)	4½ (114)

Notes:

¹ These sizes are listed to provide test cylinder radii for brake hoses manufactured in these sizes. They do not represent conversions.

² Small test cylinders are used for the high temperature resistance test.

³ Large test cylinders are used for the low temperature resistance, ozone resistance, and adhesion of wire-reinforced hose tests.

S7.3.4 Oil resistance. After immersion in ASTM No. 3 oil for 70 hours at 212°F. the volume of a specimen prepared from the inner tube and cover of an air brake hose shall not increase more than 100 percent (S8.3).

S7.3.5 Ozone resistance. An air brake hose assembly shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours at 104 degrees Fahrenheit (40 degrees Celsius) when bent around a test cylinder of the radius specified in Table IV for the size of hose tested (S8.4).

S7.3.6 Length change. An air brake hose shall not contract in length more than 7 percent nor elongate more than 5 percent when subjected to air pressure of 200 psi (S8.5).

S7.3.7 Adhesion. (a) Except for hose reinforced by wire, an air brake hose shall withstand a tensile force of 8 pounds per inch of length before separation of adjacent layers (S8.6).

(b) An air brake hose reinforced by wire shall permit a steel ball to roll freely along the entire length of the inside of the hose when the hose is subjected to a vacuum of 25 inches of Hg and bent around a test cylinder (S8.13).

S7.3.8 Flex strength and air pressure. An air brake hose assembly of the length specified in the table accompanying Figure 5, when subjected to a flex test and internal pressure cycling, shall be capable of having its internal pressure increased from zero to 140 psi within 2 minutes with pressurized air supplied through an orifice (S8.7).

S7.3.9 Corrosion resistance and burst strength. An air brake hose assembly exposed to salt spray shall not rupture when exposed to hydrostatic pressure of 900 psi (S8.8).

S7.3.10 Tensile strength. An air brake hose assembly designed for use between a frame and axle or between a towed and towing vehicle shall withstand, without separation of the hose from its end fittings, a pull of 250 pounds if it is ¼ inch, 6 mm, or less in nominal inside diameter, or a pull of 325 pounds if it is larger than ¼ inch or 6 mm in nominal inside diameter. An air brake hose assembly designed for use in any other application shall withstand, without separation of the hose from its end fittings, a pull of 50 pounds if it is ¼ inch, 6 mm, or less in nominal inside diameter, 150 pounds if it is larger than ¼ inch or 6 mm and equal to or smaller than ½ inch or 12 mm in nominal inside diameter, or

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325 pounds if it is larger than ½ inch or 12 mm in nominal inside diameter (S8.9).

S7.3.11 Water absorption and tensile strength. After immersion in distilled water for 70 hours, an air brake hose assembly designed for use between a frame and axle or between a towed and a towing vehicle shall withstand, without separation of the hose from its end fittings, a pull of 250 pounds if it is ¼ inch or less or 6 mm or less in nominal inside diameter, or a pull of 325 pounds if it is larger than ¼ inch or 6 mm in nominal inside diameter. After immersion in distilled water for 70 hours, an air brake hose assembly designed for use in any other application shall withstand, without separation of the hose from its end fittings, a pull of 50 pounds if it is ¼ inch or 6 mm or less in nominal inside diameter, 150 pounds if it is larger than ¼ inch or 6 mm and equal to or smaller than ½ inch or 12 mm in nominal inside diameter, or 325 pounds if it is larger than ½ inch or 12 mm in nominal inside diameter. (S8.10)

S7.3.12 Zinc chloride resistance. The outer cover of an air brake hose shall not show cracks visible under 7-power magnification after immersion in a 50 percent zinc chloride aqueous solution for 200 hours (S8.11).

S7.3.13 End fitting corrosion resistance. After 24 hours of exposure to salt spray, air brake hose end fittings shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information causes a displacement of the protective coating.

S8. Test procedures—Air brake hose, brake hose assemblies, and brake hose end fittings.

S8.1 High temperature resistance test.

(a) Utilize a small test cylinder with a radius specified in Table IV for the size of hose tested.

(b) Bind the hose around the cylinder and condition it in an air oven for 70 hours at 212 degrees Fahrenheit (100 degrees Celsius).

(c) Cool the hose to room temperature, remove it from the cylinder and straighten it.

(d) Without magnification, examine the hose externally and cut the hose lengthwise and examine the inner tube.

S8.2 Low temperature resistance test.

(a) Utilize a large test cylinder with a radius specified in Table IV for the size of hose tested.

(b) Condition the cylinder and the brake hose, in a straight position, in a cold box at minus 40° F. for 70 hours.

(c) With the hose and cylinder at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), bend the hose 180 degrees around the cylinder at a steady rate in a period of 3 to 5 seconds. Remove the hose from the test cylinder and visibly examine the exterior of the hose for cracks without magnification.

(d) Allow the hose to warm at room temperature for 2 hours. All reusable end fittings are removed from the hose. All permanently-attached end fittings are cut away from the hose. Cut through one wall of the hose longitudinally along its entire length. Unfold the hose to permit examination of the interior surface. Visibly

examine the interior of the hose for cracks without magnification.

S8.3 Oil resistance test. Utilize three test specimens and average the results.

S8.3.1 Preparation. Fashion a test specimen by cutting a rectangular block 2 inches long and not less than one-third of an inch in width, having a thickness of not more than one-sixteenth inch, from the brake hose and buff the specimen on both faces to ensure smooth surfaces.

S8.3.2 Measurement.

(a) Weigh each specimen to the nearest milligram in air (W_1) and in distilled water (W_2) at room temperature. If wetting is necessary to remove air bubbles, dip the specimen in acetone and thoroughly rinse it with distilled water.

(b) Immerse each specimen in ASTM IRM 903 oil for 70 hours at 212 degrees Fahrenheit (100 degrees Celsius) and then cool in ASTM IRM 903 oil at room temperature for 30 to 60 minutes.

(c) Dip the specimen quickly in acetone and blot it lightly with filter paper.

(d) Weigh each specimen in a tared weighing bottle (W_3) and in distilled water (W_4) within five minutes of removal from the cooling liquid.

(e) Calculate the percentage increase in volume follows:

$$\text{Percent of increase} = [(W_3 - W_4) - (W_1 - W_2)] / (W_1 - W_2) \times 100$$

S8.4 Ozone resistance test. Conduct the test specified in S6.8, using air brake hose, except use the large test cylinder specified in Table IV for the size of hose tested.

S8.5 Length change test.

(a) Position a test hose in a straight, horizontal position, and apply air pressure of 10 psi thereto.

(b) Measure the hose to determine original free length.

(c) Without releasing the 10 psi, raise the air pressure to the test hose to 200 psi.

(d) Measure the hose under 200 psi to determine final free length. An elongation or contraction is an increase or decrease, respectively, in the final free length from the original free length of the hose.

S8.6 Adhesion test for air brake hose not reinforced by wire.

S8.6.1 Apparatus. A tension testing machine that is power-driven and that applies a constant rate of extension is used for measuring the force required to separate the layers of the test specimen. The apparatus is constructed so that:

(a) The recording head includes a freely rotating form with an outside diameter substantially the same as the inside diameter of the hose specimen to be placed on it.

(b) The freely rotating form is mounted so that its axis of rotation is in the plane of the ply being separated from the specimen and so that the applied force is perpendicular to the tangent of the specimen circumference at the line of separation.

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(c) The rate of travel of the power-actuated grip is a uniform one inch per minute and the capacity of the machine is such that maximum applied tension during the test is not more than 85 percent nor less than 15 percent of the machine's rated capacity.

(d) The machine produces a chart with separation as one coordinate and applied tension as the other.

S8.6.2 Preparation.

(a) Cut a test specimen of 1 inch or more in length from the hose to be tested and cut the layer to be tested of that test specimen longitudinally along its entire length to the level of contact with the adjacent layer.

(b) Peel the layer to be tested from the adjacent layer to create a flap large enough to permit attachment of the power-actuated clamp of the apparatus.

(c) Mount the test specimen on the freely rotating form with the separated layer attached to the power-actuated clamp.

S8.6.3 [Reserved]

S8.6.4 Calculations.

(a) The adhesion value shall be the minimum force recorded on the chart excluding that portion of the chart which corresponds to the initial and final 20 percent portion along the displacement axis.

(b) Express the force in pounds per inch of length.

S8.7 Flex strength and air pressure test.

S8.7.1 Apparatus. A flex testing machine with a fixed hose assembly attachment point and a movable hose assembly attachment point, which meets the dimensional requirements of Figure 5 for the size of hose being tested. The attachment points connect to the end fittings on the hose assembly without leakage and, after the hose assembly has been installed for the flex test, are restrained from rotation. The movable end has a linear travel of 6 inches and a cycle rate of 100 cycles per minute. The machine is capable of increasing the air pressure in the hose assembly from zero to 150 psi within 2 seconds, and decreasing the air pressure in the hose assembly from 150 to zero psi within 2 seconds.

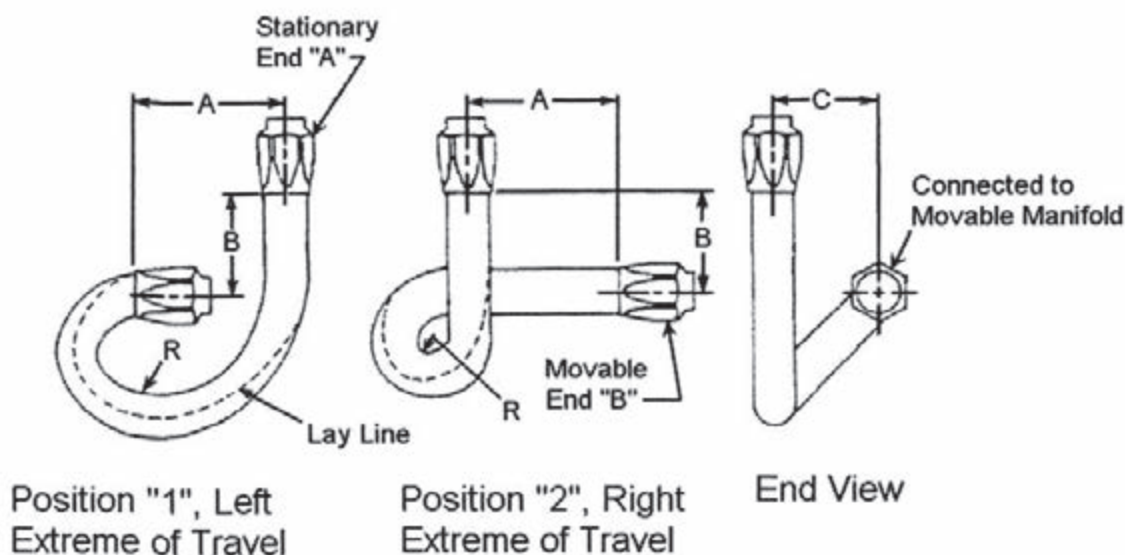


Figure 5. Flex Test Apparatus

TABLE ACCOMPANYING FIGURE 5.—DIMENSIONS IN INCHES (MILLIMETERS)

Free hose length	Nominal hose inside diameter	Dimensions							
		Position "1"				Position "2"			
		A	B	C	R ⁽¹⁾	A	B	C	R ⁽¹⁾
10.00 (254) ..	3/16, 1/4	3.00 (76)	2.75 (70)	3.75 (95)	1.40 (34)	3.00 (76)	2.75 (70)	3.75 (95)	1.20 (30)
11.00 (279) ..	5/16, 3/8, 13/32 ...	3.00 (76)	3.50 (89)	4.50 (114)	1.70 (43)	3.00 (76)	3.50 (89)	4.50 (114)	1.30 (33)
14.00 (355) ..	7/16, 1/2, 5/8	3.00 (76)	4.00 (102)	5.00 (127)	2.20 (56)	3.00 (76)	4.00 (102)	5.00 (127)	1.80 (46)

Note (1): This is an approximate average radius.

S8.7.2 Preparation. (a) Lay the hose material on a flat surface in an unstressed condition. Apply a perma-

nent marking line along the centerline of the hose on the uppermost surface.

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(b) Prepare the hose assembly with a free length as shown in the table accompanying Figure 5. The end fittings shall be attached according to the end fitting manufacturer's instructions.

(c) Plug the ends of the hose assembly and conduct the salt spray test in S6.11 using an air brake hose assembly. Remove the plugs from the end fittings.

(d) Within 168 hours of completion of the salt spray test, expose the hose assembly to an air temperature of 212 degrees Fahrenheit (100 degrees Celsius) for 70 hours, with the hose in a straight position. Remove the hose and cool it at room temperature for 2 hours. Within 166 hours, subject the hose to the flexure test in S8.7.2(e).

(e) Install the hose assembly on the flex testing machine as follows. With the movable hose attachment point at the mid point of its travel, attach one end of the hose to the movable attachment point with the marked line on the hose in the uppermost position. Attach the other end of the hose to the fixed attachment point allowing the hose to follow its natural curvature.

(f) Cycle the air pressure in the hose by increasing the pressure in the hose from zero psi to 150 psi and holding constant for one minute, then decreasing the pressure from 150 psi to zero psi and holding constant for one minute. Continue the pressure cycling for the duration of the flex testing. Begin the flex testing by cycling the movable attachment point through 6 inches of travel at a rate of 100 cycles per minute. Stop the flex testing and pressure cycling after one million flex cycles have been completed.

(g) Install an orifice with a hole diameter of 0.0625 inches and a thickness of 0.032 inches in the air pressure supply line to the hose assembly. Provide a gauge or other means to measure air pressure in the hose assembly. Regulate the supply air pressure to the orifice to 150 psi.

(h) Apply 150 psi air pressure to the orifice. After 2 minutes have elapsed, measure the air pressure in the brake hose assembly, while pressurized air continues to be supplied through the orifice.

S8.8 Corrosion resistance and burst strength test.

(a) Conduct the test specified in S6.11 using an air brake hose assembly. Remove the plugs from the ends of the hose assembly.

(b) Fill the hose assembly with water, allowing all gases to escape. Apply water pressure at a uniform rate of increase of approximately 1,000 psi per minute until the hose ruptures.

S8.9 Tensile strength test. Utilize a tension testing machine conforming to the requirements of ASTM E4-03 (incorporated by reference, see §571.5) and provided with a recording device to measure the force applied.

(a) Attach an air brake hose assembly to the testing machine to permit straight, even, machine pull on the hose. Use adapters to mount hose assemblies equipped with angled end fittings so that the hose is in a straight position when installed on the machine.

(b) Apply tension at a rate of 1 inch per minute travel of the moving head until separation occurs.

S8.10 Water Absorption and tensile strength test. Immerse an air brake hose assembly in distilled water at room temperature for 70 hours. Thirty minutes after removal from the water, conduct the test specified in S8.9.

S8.11 Zinc chloride resistance test. Immerse an air brake hose in a 50 percent zinc chloride aqueous solution at room temperature for 200 hours. Remove it from the solution and examine it under 7-power magnification for cracks.

S8.12 End fitting corrosion resistance test. Conduct the test specified in S6.11 using an air brake hose assembly.

S8.13 Adhesion test for air brake hose reinforced by wire. (a) Place a steel ball with a diameter equal to 73 percent of the nominal inside diameter of the hose being tested inside of the hose. Plug one end of the hose. Attach the other end of the hose to a source of vacuum.

(b) Subject the hose to a vacuum of 25 inches of Hg for five minutes. With the vacuum still applied to the hose, bend the hose 180 degrees around a large test cylinder with a radius specified in Table IV for the size of hose tested. At the location of this bend, bend the hose 180 degrees around the test cylinder in the opposite direction.

(c) With the vacuum still applied to the hose, return the hose to a straight position. Attempt to roll the ball inside the hose using gravity from one end of the hose to the other end.

S8.14 Constriction test. Perform the constriction test in S6.12 using an air brake hose, except that the spherical diameter "A" of the plug gauge in Figure 4, or the diameter of the rigid spherical ball in S6.12.3(a), shall be 66 percent of the nominal inside diameter of the air brake hose being tested.

S9. Requirements—vacuum brake hose, brake hose assemblies, and brake hose end fittings.

S9.1 Labeling.

S9.1.1 Hose. Each vacuum brake hose shall be labeled, or cut from bulk hose that is labeled, at intervals of not more than 6 inches, measured from the end of one legend to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on hose that is sold as part of a brake hose assembly or a motor vehicle.

(a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics Division, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

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(d) The nominal inside diameter of the hose expressed in inches or fractions of inches or in millimeters, or the nominal outside diameter of plastic tubing expressed in inches or fractions of inches or in millimeters followed by the letters OD. The abbreviation “mm” shall follow hose sizes that are expressed in millimeters. (Example of inside diameter: $\frac{7}{32}$, $\frac{1}{4}$, 4 mm. Example of outside diameter: $\frac{1}{4}$ OD, 12 mm OD.)

(e) The letters “VL” or “VH” shall indicate that the component is a light-duty vacuum brake hose or heavy-duty vacuum brake hose, respectively.

S9.1.2 End fittings. Except for an end fitting that is attached by heat shrinking or by interference fit with plastic vacuum hose or that is attached by deformation of the fitting about a hose by crimping or swaging, at least one component of each vacuum brake hose fitting shall be etched, embossed, or stamped in block capital letters and numerals at least one-sixteenth of an inch high with the following information:

(a) The symbol DOT, constituting a certification by the manufacturer of that component that the component conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of that component of the fitting, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics Division, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

(c) The letters “VL” or “VH” shall indicate that the end fitting is intended for use in a light-duty or heavy-duty vacuum brake system, respectively.

(d) The nominal inside diameter of the hose to which the fitting is properly attached expressed in inches or fractions of inches or in millimeters, or the outside diameter of the plastic tubing to which the fitting is properly attached expressed in inches or fraction of inches or in millimeters followed by the letter OD (See examples in S9.1.1(d)). The abbreviation “mm” shall follow hose sizes that are expressed in millimeters.

S9.1.3 Assemblies. Each vacuum brake hose assembly made with end fittings that are attached by crimping or swaging and each plastic tube assembly made with end fittings that are attached by heat shrinking or dimensional interference fit, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake hose assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S9.1.3.1. The band may at the manufacturer’s option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped, in block capital letters, numerals or symbols at least one-eighth of an inch high, with the following information:

(a) The symbol DOT, constituting certification by the hose assembler that the hose assembly conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Crash Avoidance Standards, Vehicle Dynamics

Division, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590. The designation may consist of block capital letters, numerals or a symbol.

S9.1.3.1 At least one end fitting of a vacuum brake hose assembly made with end fittings that are attached by crimping or swaging, or of a plastic tubing assembly made with end fittings that are attached by heat shrinking or dimensional interference fit shall be etched, stamped or embossed with a designation at least one-sixteenth of an inch high that identifies the manufacturer of the hose assembly and is filed in accordance with S9.1.3(b).

S9.2 Test requirements. Each vacuum brake hose assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S10. However, a particular hose assembly or appropriate part thereof need not meet further requirements after having met the constriction requirement (S9.2.1) and then having been subjected to any one of the requirements specified in S9.2.2 through S9.2.10.

S9.2.1 Constriction. Except for that part of an end fitting which does not contain hose, every inside diameter of any section of a vacuum brake hose assembly shall not be less than 75 percent of the nominal inside diameter of the hose if for heavy duty, or 70 percent of the nominal inside diameter of the hose if for light duty (S10.10).

S9.2.2 High temperature resistance. A vacuum brake hose tested under the conditions specified in S10.1:

(a) Shall not have collapse of the outside diameter exceeding 10 percent of the initial outside diameter for a heavy-duty vacuum brake hose, or exceeding 15 percent of the initial outside diameter for a light-duty vacuum brake hose;

(b) Shall not show external cracks, charring, or disintegration visible without magnification, and;

(c) Shall not leak when subjected to a hydrostatic pressure test.

S9.2.3 Low temperature resistance. A vacuum brake hose tested under the conditions specified in S10.2 shall:

(a) Not show cracks visible without magnification after conditioning at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 70 hours when bent around a cylinder having the radius specified in Table V for the size hose tested; and

(b) Not leak when subjected to a hydrostatic pressure test (S10.1(e)).

S9.2.4 Ozone resistance. A vacuum brake hose shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours (S10.3).

S9.2.5 Burst strength. A vacuum brake hose shall not rupture under hydrostatic pressure of 350 psi (S10.4).

S9.2.6 Vacuum. The collapse of the outside diameter of a vacuum brake hose under internal vacuum of 26 inches of Hg. for five minutes shall not exceed one-sixteenth of an inch (S10.5).

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S9.2.7 Bend. The collapse of the outside diameter of a vacuum brake hose, other than a preformed vacuum brake hose, at the middle point of the test length when

bent until the ends touch shall not exceed the values given in Table V for the size of hose tested (S10.6).

TABLE V—VACUUM BRAKE HOSE TEST REQUIREMENTS

Hose inside diameter*		High temperature resistance		Low temperature resistance		Bend		Deformation—collapsed inside diameter (dimension D), inches
Inches	Millimeters	Hose length, inches	Radius of cylinder, inches	Hose length, inches	Radius of cylinder, inches	Hose length, inches	Maximum collapse of outside inches	
7/32	5	8	1-1/2	17-1/2	3	7	11/64	3/64
1/4	6	9	1-1/2	17-1/2	3	8	3/32	1/16
9/32	.....	9	1-3/4	19	3-1/2	9	12/64	4/64
11/32	8	9	1-3/4	19	3-1/2	11	13/64	5/64
3/8	10	10	1-3/4	19	3-1/2	12	5/32	3/32
7/16	.....	11	2	20-1/2	4	14	17/64	5/64
15/32	.....	11	2	20-1/2	4	14	17/64	5/64
1/2	12	11	2	20-1/2	4	16	7/32	1/8
5/8	16	12	2-1/4	22	4-1/2	22	7/32	5/32
3/4	.....	14	2-1/2	24	5	28	7/32	3/16
1	.....	16	3-1/4	28-1/2	6-1/2	36	9/32	1/4

*These sizes are listed to provide test values for brake hoses manufactured in these sizes. They do not represent conversions.

S9.2.8 Swell and adhesion. Following exposure to Reference Fuel B (as described in ASTM D471-98 (incorporated by reference, see §571.5), every inside diameter of any section of a vacuum brake hose shall not be less than 75 percent of the nominal inside diameter of the hose if for heavy duty, or 70 percent of the nominal inside diameter of the hose if for light duty. The vacuum brake hose shall show no leakage in a vacuum test of 26 inches of Hg for 10 minutes. A vacuum hose that is constructed of two or more layers shall withstand a force of 6 pounds per inch of length before separation of adjacent layers. (S10.7).

S9.2.9 Deformation. A vacuum brake hose shall return to 90 percent of its original outside diameter within 60 seconds after five applications of force as specified in S10.8, except that a wire reinforced hose need only return to 85 percent of its original outside diameter. In the case of a heavy duty hose, the first application of force shall not exceed a peak value of 70 pounds, and the fifth application of force shall reach a peak value of at least 40 pounds. In the case of light duty hose the first application of force shall not exceed a peak value of 50 pounds, and the fifth application of force shall reach a peak value of at least 20 pounds (S10.9).

S9.2.10 End fitting corrosion resistance. After 24 hours of exposure to salt spray, vacuum brake hose end fittings shall show no base metal corrosion of the end fitting surface except where crimping or the application of labeling information has caused displacement of the protective coating. (S10.10).

S10. Test procedures—Vacuum brake hose, brake hose assemblies, and brake hose end fittings.

S10.1 High temperature resistance test. (a) Measure the initial outside diameter of the hose.

(b) Subject the hose to an internal vacuum of 26 inches of Hg at an ambient temperature of 257 degrees Fahrenheit (125 degrees Celsius) for a period of 96 hours.

Remove the hose to room temperature and atmospheric pressure.

(c) Within 5 minutes of completion of the conditioning in S10.1(b), measure the outside diameter at the point of greatest collapse and calculate the percentage collapse based on the initial outside diameter.

(d) Cool the hose at room temperature for 5 hours. Bend the hose around a mandrel with a diameter equal to five times the initial outside diameter of the hose. Examine the exterior of the hose for cracks, charring, or disintegration visible without magnification. Remove the hose from the mandrel.

(e) Fill the hose assembly with water, allowing all gases to escape. Apply water pressure in the hose of 175 psi within 10 seconds. Maintain an internal hydrostatic pressure of 175 psi for one minute and examine the hose for visible leakage.

S10.2 Low temperature resistance test. (a) Conduct the test specified in S8.2(a) through (c) using vacuum brake hose with the cylinder radius specified in Table V for the size of hose tested.

(b) Remove the hose from the test cylinder, warm the hose at room temperature for 5 hours, and conduct the hydrostatic pressure test in S10.1(e).

S10.3 Ozone resistance test. Conduct the test specified in S6.8 using vacuum brake hose.

S10.4 Burst strength test. Conduct the test specified in S8.8 using vacuum brake hose.

S10.5 Vacuum test. Utilize a 12-inch vacuum brake hose assembly sealed at one end.

(a) Measure the hose outside diameter.

(b) Attach the hose to a source of vacuum and subject it to a vacuum of 26 inches of Hg for 5 minutes.

(c) Measure the hose to determine the minimum outside diameter while the hose is still subject to vacuum.

S10.6 Bend test.

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(a) Bend a vacuum brake hose, of the length prescribed in Table V, in the direction of its normal curvature until the ends just touch as shown in Figure 6.

(b) Measure the outside diameter of the specimen at point A before and after bending.

(c) The difference between the two measurements is the collapse of the hose outside diameter on bending.

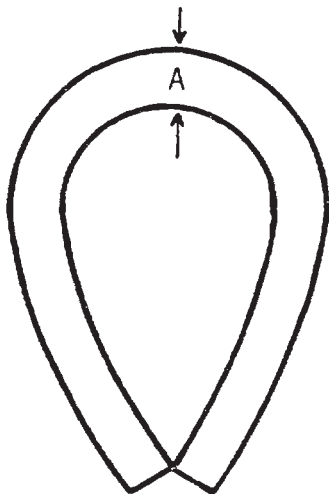


Fig. 6—Bend Test of Vacuum Brake Hose.

S10.7 Swell and adhesion test. (a) Fill a specimen of vacuum brake hose 12 inches long with ASTM Reference Fuel B as described in ASTM D471-98 (incorporated by reference, see §571.5).

(b) Maintain reference fuel in the hose under atmospheric pressure at room temperature for 48 hours.

(c) Remove fuel and conduct the constriction test in S10.10.

(d) Attach the hose to a source of vacuum and subject it to a vacuum of 26 inches of Hg for 10 minutes. Remove the hose from the vacuum source.

(e) For a vacuum brake hose constructed of two or more layers, conduct the test specified in S8.6 using the vacuum brake hose.

S10.8 [Reserved]

S10.9 Deformation test. Table VI specifies the test specimen dimensions.

S10.9.1 Apparatus. Utilize a compression device, equipped to measure force of at least 100 pounds, and feeler gages of sufficient length to be passed completely through the test specimen.

S10.9.2 Operation.

(a) Position the test specimen longitudinally in the compression device with the fabric laps not in the line of the applied pressure.

TABLE VI—DIMENSIONS OF TEST SPECIMEN AND FEELER GAGE FOR DEFORMATION TEST

Hose inside diameter*		Specimen dimensions (see Fig. 7)		Feeler gage dimensions	
in.	mm	Depth (inch)	Length (inch)	Width (inch)	Thickness (inch)
7/32	5	3/64	1	1/8	3/64
1/4	6	1/16	1	1/8	1/16
9/32	.....	1/16	1	1/8	1/16
11/32	8	5/64	1	3/16	5/64
3/8	10	3/32	1	3/16	3/32
7/16	.....	5/64	1	1/4	5/64
15/32	.....	5/64	1	1/4	5/64
1/2	12	1/8	1	1/4	1/8
5/8	16	5/32	1	1/4	5/32
3/4	.....	3/16	1	1/4	3/16
1	.....	1/4	1	1/4	1/4

*These sizes are listed to provide test values for brake hoses manufactured in these sizes. They do not represent conversions.

(b) Apply gradually increasing force to the test specimen to compress its inside diameter to that specified in Table VI (dimension D of Figure 7) for the size of hose tested.

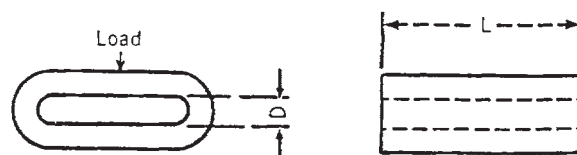


Fig. 7. Deformed Specimen of Vacuum Brake Hose

(c) After 5 seconds release the force and record the peak load applied.

(d) Repeat the procedure four times permitting a 10-second recovery period between load applications.

S10.10 End fitting corrosion resistance test. Conduct the test specified in S6.11 using a vacuum brake hose assembly.

S10.11 Constriction test. Perform the constriction test in S6.12 using a vacuum brake hose, except that the spherical diameter "A" of the plug gauge in Figure 4, or the diameter of the rigid spherical ball in S6.12.3(a), shall be 75 percent of the nominal inside diameter of the vacuum brake hose if it is heavy duty, or 70 percent of the nominal inside diameter of the vacuum brake hose if it is light duty.

S11. Requirements—Plastic air brake tubing, plastic air brake tubing assemblies, and plastic air brake tubing end fittings.

S11.1 Construction. Each plastic air brake tubing assembly shall be equipped with permanently attached end fittings or reusable end fittings. Plastic air brake tubing shall conform to the dimensional requirements specified in Table VII. (S12.1)

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TABLE VII.—PLASTIC AIR BRAKE TUBING DIMENSIONS

Nominal tubing outside diameter	Maximum outside diameter		Minimum outside diameter		Nominal inside diameter		Nominal wall thickness		Wall thickness tolerance	
	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches
1/8 inch.....	3.25	0.128	3010	0.122	2.01	0.079	0.58	0.023	0.08	0.003
5/32 inch.....	4.04	0.159	3.89	0.153	2.34	0.092	0.81	0.032	0.08	0.003
3/16 inch.....	4.83	0.190	4.67	0.184	2.97	0.117	0.89	0.035	0.08	0.003
1/4 inch.....	6.43	0.253	6.27	0.247	4.32	0.170	1.02	0.040	0.08	0.003
5/16 inch.....	8.03	0.316	7.82	0.308	5.89	0.232	1.02	0.040	0.10	0.004
3/8 inch.....	9.63	0.379	9.42	0.371	6.38	0.251	1.57	0.062	0.10	0.004
1/2 inch.....	12.83	0.505	12.57	0.495	9.55	0.376	1.57	0.062	0.10	0.004
5/8 inch.....	16.00	0.630	15.75	0.620	11.20	0.441	2.34	0.092	0.13	0.005
3/4 inch.....	19.18	0.755	18.92	0.745	14.38	0.566	2.34	0.092	0.13	0.005
6 mm.....	6.10	0.240	5.90	0.232	4.00	0.157	1.00	0.039	0.10	0.004
8 mm.....	8.10	0.319	7.90	0.311	6.00	0.236	1.00	0.039	0.10	0.004
10 mm.....	10.13	0.399	9.87	0.389	7.00	0.276	1.50	0.059	0.10	0.004
12 mm.....	12.13	0.478	11.87	0.467	9.00	0.354	1.50	0.059	0.10	0.004
16 mm.....	16.13	0.635	15.87	0.625	12.00	0.472	2.00	0.079	0.13	0.005

S11.2 Labeling.

S11.2.1 Plastic air brake tubing. Plastic air brake tubing shall be labeled, or cut from bulk tubing that is labeled, at intervals of not more than 6 inches, measured from the end of one legend to the beginning of the next, in block capital letters and numerals at least one-eighth of an inch high, with the information listed in paragraphs (a) through (e) of this section. The information need not be present on tubing that is sold as part of a motor vehicle.

(a) The symbol DOT, constituting a certification by the hose manufacturer that the hose conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the tubing, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS-222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The month, day, and year, or the month and year, of manufacture, expressed in numerals. For example, 10/1/96 means October 1, 1996.

(d) The nominal outside diameter expressed in inches or fractions of inches or in millimeters followed by the letters OD. The abbreviation “mm” shall follow tubing sizes that are expressed in millimeters. (Examples: 3/8 OD, 6 mm OD.)

(e) The letter “A” shall indicate intended use in air brake systems.

S11.2.2 End fittings. Except for an end fitting that is attached by deformation of the fitting about the tubing by crimping or swaging, at least one component of each plastic air brake tubing end fitting shall be etched, embossed, or stamped in block capital letters and numerals at least one-sixteenth of an inch high with the following information:

(a) The symbol DOT, constituting a certification by the manufacturer that the end fitting conforms to all applicable motor vehicle safety standards.

(b) A designation that identifies the manufacturer of the end fitting, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS-

222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

(c) The letter “A” shall indicate intended use in air brake systems.

(d) The nominal outside diameter of the plastic tubing to which the fitting is properly attached expressed in inches or fractions of inches or in millimeters followed by the letters OD. The abbreviation “mm” shall follow tubing sizes that are expressed in millimeters. (Examples: 3/8 OD, 6 mm OD)

S11.2.3. Assemblies. Each plastic air brake tubing assembly made with end fittings that are attached by crimping or swaging, except those sold as part of a motor vehicle, shall be labeled by means of a band around the brake tubing assembly as specified in this paragraph or, at the option of the manufacturer, by means of labeling as specified in S11.2.3.1. The band may at the manufacturer’s option be attached so as to move freely along the length of the assembly, as long as it is retained by the end fittings. The band shall be etched, embossed, or stamped in block capital letters, numerals or symbols at least one-eighth of an inch high, with the following information:

(a) The symbol DOT, constituting certification by the tubing assembler that the tubing assembly conforms to all applicable motor vehicle safety standards.

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(b) A designation that identifies the manufacturer of the hose assembly, which shall be filed in writing with: Office of Vehicle Safety Compliance, Equipment Division NVS-222, National Highway Traffic Safety Administration, 400 Seventh St. SW., Washington, DC 20590. The designation may consist of block capital letters, numerals, or a symbol.

S11.2.3.1 At least one end fitting of a plastic air brake tubing assembly made with end fittings that are attached by crimping or swaging shall be etched, stamped, or embossed with a designation at least one-sixteenth of an inch high that identifies the manufacturer of the tubing assembly and is filed in accordance with S11.2.3(b).

S11.3 Test requirements. Each plastic air brake tubing assembly or appropriate part thereof shall be capable of meeting any of the requirements set forth under this heading, when tested under the conditions of S13 and the applicable procedures of S12. However, a particular tubing assembly or appropriate part thereof need not meet further requirements after having met the constriction requirement (S11.3.1) and then having been subjected to any one of the requirements specified in S11.3.2 through S11.3.24. Unless otherwise specified, testing is conducted on a sample of tubing 12 inches in length.

S11.3.1 Constriction. Every inside diameter of any section of a plastic air brake tubing assembly shall not be less than 66 percent of the nominal inside diameter of the brake tubing. (S12.2)

S11.3.2 High temperature conditioning and dimensional stability. Plastic air brake tubing shall conform to the dimensions in Table VII after conditioning in air at 230 degrees Fahrenheit (110 degrees Celsius) for four hours. (S12.3)

S11.3.3 Boiling water conditioning and dimensional stability. Plastic air brake tubing shall conform to the dimensions in Table VII after conditioning in boiling water for two hours. (S12.4)

S11.3.4 Burst Strength. Plastic air brake tubing shall not rupture when subjected to the burst strength pressure in Table VIII for the size of tubing being tested. (S12.5)

S11.3.5 Moisture absorption and burst strength. Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII, after the tubing has been dried in an oven and then conditioned in a 100 percent relative humidity atmosphere at 75 degrees Fahrenheit (24 degrees Celsius) for 100 hours. (S12.6)

TABLE VIII.—PLASTIC AIR BRAKE TUBING MECHANICAL PROPERTIES

Nominal tubing OD	Burst strength pressure		Supported bend radius ¹		Unsupported bend radius ²		Conditioned tensile load	
	kPa	Psi	Mm	inches	mm	inches	N	lbf
1/8 inch...	6900	1000	9.4	0.37	9.4	0.37	156	35
5/32 inch...	8300	1200	12.7	0.50	12.7	0.50	178	40
3/16 inch...	8300	1200	19.1	0.75	19.1	0.75	222	50
1/4 inch...	8300	1200	25.4	1.00	25.4	1.00	222	50
5/16 inch...	6900	1000	31.8	1.25	31.8	1.50	334	75

TABLE VIII.—PLASTIC AIR BRAKE TUBING MECHANICAL PROPERTIES, Continued

Nominal tubing OD	Burst strength pressure		Supported bend radius ¹		Unsupported bend radius ²		Conditioned tensile load	
	kPa	Psi	Mm	inches	mm	inches	N	lbf
3/8 inch...	9700	1400	38.1	1.50	38.1	1.50	667	150
1/2 inch...	6600	950	50.8	2.00	63.5	2.50	890	200
5/8 inch...	6200	900	63.5	2.50	76.2	3.00	1446	325
3/4 inch...	5500	800	76.2	3.00	88.9	3.50	1557	350
6 mm...	7600	1100	20.0	0.75	25.4	1.00	222	50
8 mm...	6200	900	31.8	1.25	38.1	1.50	334	75
10 mm...	8200	1200	38.1	1.50	38.1	1.50	667	150
12 mm...	6900	1000	44.5	1.75	63.5	2.50	890	200
16 mm...	6000	875	69.9	2.75	76.2	3.00	1446	325

Notes: (1) Supported bend radius for tests specifying cylinders around which the tubing is bent. (2) Unsupported bend radius for the collapse resistance test in which the tubing is not supported by a cylinder during bending.

S11.3.6 Ultraviolet light resistance. Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after being exposed to ultraviolet light for 300 hours and then impacted with a one pound weight dropped from a height of 12 inches. (S12.7)

S11.3.7 Low temperature flexibility. The outer surface of plastic air brake tubing shall not show cracks visible without magnification as a result of conditioning in air at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours, and then conditioning in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for four hours, and then bending the tubing 180 degrees around a test cylinder having a radius equal to six times the nominal outside diameter of the tubing. (S12.8)

S11.3.8 High temperature flexibility. Plastic air brake tubing shall not rupture or burst when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been:

(a) Conditioned in air at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours while bent 180 degrees around a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested; and

(b) Cooled to room temperature while remaining on the cylinder, then straightened; and

(c) Bent 180 degrees around the cylinder in the opposite direction of the first bending. (S12.9)

S11.3.9 High temperature resistance. Plastic air brake tubing shall not rupture or burst when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in air at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. (S12.10)

S11.3.10 High temperature conditioning, low temperature impact resistance. Plastic air brake tubing shall not rupture or burst when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in air at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours, then conditioned in air at

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minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours and impacted with a one pound weight dropped from a height of 12 inches. (S12.11)

S11.3.11 Boiling water conditioning, low temperature impact resistance. Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in boiling water for two hours, then conditioned in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours, and then impacted with a one pound weight dropped from a height of 12 inches. (S12.12)

S11.3.12 Zinc chloride resistance. The outer surface of plastic air brake tubing shall not show cracks visible under 7-power magnification after immersion in a 50 percent zinc chloride aqueous solution for 200 hours while bent around a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing tested. (S12.13)

S11.3.13 Methyl alcohol resistance. The outer surface of plastic air brake tubing shall not show cracks visible under 7-power magnification after immersion in a 95 percent methyl alcohol aqueous solution for 200 hours while bent around a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing tested. (S12.14)

S11.3.14 High temperature conditioning and collapse resistance. The collapse of the outside diameter of plastic air brake tubing shall not exceed twenty percent of the original outside diameter when bent 180 degrees on a holding fixture to the unsupported bend radius specified in Table VIII and conditioned in air at 200 degrees Fahrenheit (93 degrees Celsius) for 24 hours. (S12.15)

S11.3.15 Ozone resistance. The outer surface of plastic air brake tubing shall not show cracks visible under 7-power magnification after exposure to ozone for 70 hours at 104 degrees Fahrenheit (40 degrees Celsius). (S12.16)

S11.3.16 Oil resistance. Plastic air brake tubing shall not rupture when subjected to 80 percent of the burst strength pressure in Table VIII for the size of tubing being tested, after the tubing has been conditioned in ASTM IRM 903 oil at 212 degrees Fahrenheit (100 degrees Celsius) for 70 hours. (S12.17)

S11.3.17 Tensile strength. A plastic air brake tubing assembly designed for use between frame and axle or between a towed and a towing vehicle shall withstand, without separation of the tubing from its end fittings, a pull of 250 pounds if it is $\frac{3}{8}$ inch, 10 mm, or less in nominal outside diameter, or a pull of 325 pounds if it is larger than $\frac{3}{8}$ inch or 10 mm in nominal outside diameter. A plastic air brake tubing assembly designed for use in any other application shall withstand, without separation of the hose from its end fittings, a pull of 35 pounds if it is $\frac{1}{8}$ inch, 3 mm, or less in nominal outside diameter, 40 pounds if it is $\frac{5}{32}$ inch or 4 mm in nominal outside diameter, 50 pounds if it is $\frac{3}{16}$ to $\frac{1}{2}$ inch or 5 mm to 10 mm in nominal outside diameter, 150 pounds if it is $\frac{1}{2}$ to $\frac{5}{8}$ inch or 11 mm to 16 mm in nominal outside diameter, or 325 pounds if it is larger than $\frac{5}{8}$ inch or 16 mm in nominal outside diameter. (S12.18)

S11.3.18 Boiling water conditioning and tensile strength. A plastic air brake tubing assembly when subjected to a tensile pull test shall either elongate 50 percent or withstand the conditioned tensile load in Table VIII without separation from its end fittings, with one end of the assembly conditioned in boiling water for 5 minutes. (S12.19)

S11.3.19 Thermal conditioning and tensile strength. A plastic air brake tubing assembly when subjected to a tensile pull test shall either elongate 50 percent or withstand the conditioned tensile load in Table VIII without separation from its end fittings after the assembly has been subjected to four cycles of conditioning in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for thirty minutes, normalizing at room temperature, conditioning in boiling water for 15 minutes, and normalizing at room temperature. (S12.20)

S11.3.20 Vibration resistance. A plastic air brake tubing assembly with an internal air pressure of 120 psig shall not rupture or leak more than 50 cm³ per minute at a temperature of minus 40 degrees Fahrenheit (minus 40 degrees Celsius) and 25 cm³ per minute at a temperature of 75 degrees Fahrenheit (24 degrees Celsius), after the assembly has been subjected to 1,000,000 cycles of vibration testing with one end of the assembly fixed and the other end stroked $\frac{1}{2}$ -inch at 600 cycles per minute. In addition, end fittings that use a threaded retention nut shall retain at least 20 percent of the original retention nut tightening torque upon completion of the vibration testing. The vibration test shall be conducted in an environmental chamber and the air temperature shall be cycled between minus 40 degrees Fahrenheit (minus 40 degrees Celsius) and 220 degrees Fahrenheit (104 degrees Celsius) during the test. (S12.21)

S11.3.21 End fitting retention. The end fittings of a plastic air brake tubing assembly shall not rupture when the assembly is filled with water and pressurized to the burst strength pressure in Table VIII. (S12.22)

S11.3.22 Thermal conditioning and end fitting retention. The end fittings of a plastic air brake tubing assembly shall not rupture when the tubing assembly is filled with ASTM IRM 903 oil and:

(a) Conditioning in air at 200 degrees Fahrenheit (93 degrees Celsius) for 24 hours with atmospheric pressure inside the tubing assembly; and

(b) Increasing the pressure inside the tubing assembly to 450 psi, and holding this pressure for five minutes while maintaining an air temperature of 200 degrees Fahrenheit (93 degrees Celsius); and

(c) Reducing the pressure inside the tubing assembly to atmospheric and permitting the tubing assembly to cool at 75 degrees Fahrenheit (24 degrees Celsius) for 1 hour; and

(d) Conditioning the tubing assembly in air at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 24 hours with atmospheric pressure inside the tubing assembly; and

(e) Increasing the pressure inside the tubing assembly to 450 psi, and holding this pressure for five minutes

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while maintaining an air temperature of minus 40 degrees Fahrenheit (minus 40 degrees Celsius). (S12.23)

S11.3.23 End fitting serviceability. A plastic air brake end fitting that uses a threaded retention nut shall not rupture or leak more than 25 cm³ per minute when pressurized to 120 psi after five assembly cycles. (S12.24)

S11.3.24 End fitting corrosion resistance. After 24 hours of exposure to salt spray, air brake hose end fittings shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information causes a displacement of the protective coating. (S12.25)

S12. Test procedures—Plastic air brake tubing, plastic air brake tubing assemblies, plastic air brake tubing end fittings.

S12.1 Air brake tubing dimensions. Measure the tubing dimensions including wall thickness, inside diameter, and outside diameter, using appropriate metrology apparatus such as micrometers, dial indicators and gauges, or optical comparators. To account for slight out-of-round conditions, diameter measurements may be calculated using the average of the major and minor diameters.

S12.2 Constriction test. Perform the constriction test in S6.12 using an air brake tubing assembly, except that the spherical diameter “A” of the plug gauge in Figure 4, or the diameter of the rigid spherical ball in S6.12.3(a), shall be 66 percent of the nominal inside diameter of the tubing as specified in Table VII.

S12.3 High temperature conditioning and dimensional stability test. (a) Condition the tubing at 230 degrees Fahrenheit (110 degrees Celsius) for 4 hours in an air oven.

(b) Remove the tubing from the oven and allow to cool at room temperature for 30 minutes.

(c) Measure the dimensions of the tubing using the procedure in S12.1.

S12.4 Boiling water conditioning and dimensional stability test. (a) Utilize a container constructed of a nonreactive material large enough so that the tubing to be tested does not touch any surface of the container. Fill container with distilled water.

(b) Slip the tubing over a stainless steel wire for positioning it in the pot.

(c) Bring the water to a boil. Place the tubing in the water and position it so that it does not touch the container. Boil the tubing for two hours. Replenish the water as necessary, adding it slowly so that the water in the pot boils continuously.

(d) Remove the tubing from the water and allow to cool at room temperature for 30 minutes. Wipe off any water that remains on the tubing.

(e) Measure the dimensions of the tubing using the procedure in S12.1.

S12.5 Burst strength test. (a) Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer’s instructions.

(b) Plug one end of the assembly, fill it with water, and connect the other end to a source of water pressure. Bleed any air from the assembly and water pressure system.

(c) Increase the water pressure inside the tubing assembly at a rate of 3,000 psi per minute to the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.6 Moisture absorption and burst strength. (a) Prepare a sample of tubing twelve inches in length.

(b) Condition the tubing at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours in an air oven. Remove the tubing from the oven and within 30 seconds, and weigh it to establish the initial weight. The weight shall be measured with a resolution of 0.01 gram; if the scale has a higher resolution, then values of 0.005 gram and above shall be rounded to the nearest 0.01 gram and values below 0.005 gram shall be truncated.

(c) Place the tubing in an environmental chamber and condition it for 100 hours at 100 percent relative humidity and a temperature of 75 degrees Fahrenheit (24 degrees Celsius).

(d) Remove the tubing from the chamber and within a period of 5 minutes, remove all surface moisture from the tubing using cloth and weigh the tubing to establish the conditioned weight. Weight shall be measured to the nearest 0.01 gram as in S12.6(b).

(e) Calculate percentage of moisture absorption as follows: $[(\text{Conditioned Weight} - \text{Initial Weight}) \div (\text{Initial Weight})] \times 100$

(f) Install end fittings according to the end fitting manufacturers instructions.

(g) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.7 Ultraviolet light resistance test. (a) **Apparatus.** An accelerated weathering test machine for ultraviolet light conditioning of plastic air brake tubing. The machine shall be equipped with fluorescent UVA–340 light bulbs and automatic irradiance control. Also utilize an impact test apparatus as shown in Figure 8.

(b) **Test standards.** The testing is in accordance with ASTM G154-00, ASTM G151-97, and ASTM D4329-99 (all incorporated by reference, see §571.5).

(c) **Preparation.** (1) Utilize a 12 inch length of plastic air brake tubing. Mask 1 inch of each end of the tubing where end fittings will be attached using opaque tape.

(2) Attach the tubing to the test rack of the machine, securing it at the ends along the masked sections. Wipe the outside surface of the tubing with acetone to remove any surface contaminants. Place the tubing and rack in the accelerated weathering test machine so that the center of the tubing assembly is approximately in the center of the UV light exposure area of the test machine. (If multiple plastic brake tubing assemblies are tested, then their position in the machine should be rotated according to ASTM D4329–99 S7.4.1, except the rotation shall be each 96 hours instead of weekly.) The distance from the light bulb to the tubing shall be approximately 2 inches. Set the UV irradiance to 0.85 watts per square meter at 340 nm and maintain this level during the testing. Maintain a temperature inside the test chamber of

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113 degrees Fahrenheit (45 degrees Celsius), and use only atmospheric humidity. Expose the tubing at this UV irradiance level for 300 hours continuously. Remove the tubing from the test chamber.

(3) Place the tubing inside the impact test apparatus, and drop the impactor onto the tubing from a height of 12 inches.

(4) Remove the masking material from the ends of the tubing. Install end fittings according to the end fitting manufacturer's instructions. Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

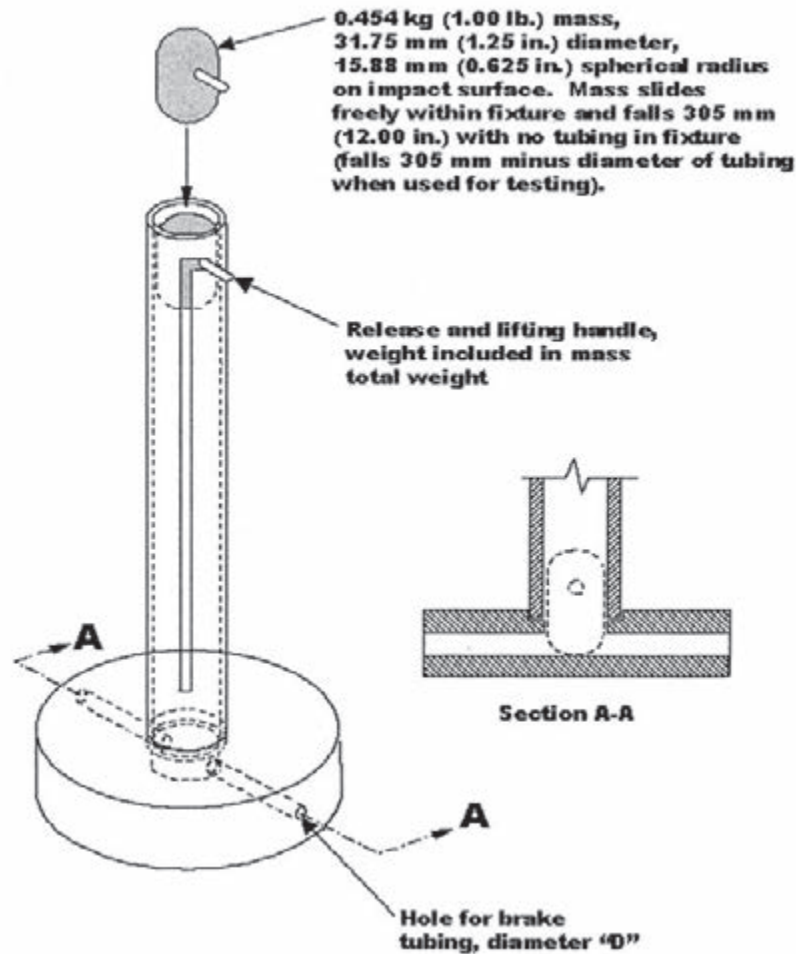


Fig. 8. Impact test apparatus

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TABLE ACCOMPANYING FIGURE 8

Nominal tubing outside diameter	Hole diameter "D"	
	mm	inches
1/8 inch	3.96	0.156
5/32 inch	4.75	0.187
3/16 inch	5.54	0.218
1/4 inch	7.14	0.281
5/16 inch	8.71	0.343
3/8 inch	10.31	0.406
1/2 inch	13.49	0.531
5/8 inch	16.66	0.656
3/4 inch	20.32	0.800
6 mm	6.80	0.268
8mm	8.80	0.346
10 mm	10.80	0.425
12 mm	12.80	0.504
16 mm	16.80	0.661

S12.8 Low temperature flexibility test. (a) Utilize a cylinder having a radius of six times the nominal outside diameter of the tubing.

(b) Condition the tubing in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 24 hours. Remove from the oven and cool at room temperature for 30 minutes.

(c) Condition the cylinder and the tubing in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for four hours.

(d) With the tubing and test cylinder at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), bend the tubing 180 degrees around the cylinder at a steady rate in a period of 4 to 8 seconds.

S12.9 High temperature flexibility test. (a) Utilize a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested.

(b) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support, applying only enough force on the tubing to hold it in position.

(c) Condition the tubing and cylinder in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. Remove the tubing and cylinder from the oven and cool at room temperature for two hours.

(d) Remove the clamps or supports from the tubing and straighten the tubing at a steady rate in a period of 4 to 8 seconds.

(e) Rebend the tubing 180 degrees around the cylinder, at the same point but in the opposite direction of the bending in S12.9(b), at a steady rate in a period of 4 to 8 seconds.

(f) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.10 High temperature resistance test. Condition the tubing in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. Remove the tubing and allow to cool at room temperature for 30 minutes. Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.11 High temperature conditioning, low tem-

perature impact resistance test. (a) Apparatus. Utilize an impact test apparatus as shown in Figure 8.

(b) Condition the tubing in an air oven at 230 degrees Fahrenheit (110 degrees Celsius) for 72 hours. Remove the tubing and allow to cool at room temperature for 30 minutes.

(c) Condition the tubing and the impact test apparatus in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours.

(d) With the tubing and impact test apparatus at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), place the tubing inside the apparatus and drop the impacter onto the tubing from a height of 12 inches. Remove the tubing from the chamber and allow to warm at room temperature for one hour.

(e) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.12 Boiling water conditioning, low temperature impact resistance test. (a) Apparatus. Utilize an impact test apparatus as shown in Figure 8.

(b) Condition the tubing in boiling water using the test in S12.4 (a) through (d), except that the length of tubing shall be 12 inches.

(c) Condition the tubing and the impact test apparatus in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 4 hours.

(d) With the tubing and impact test apparatus at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), place the tubing inside the apparatus and drop the impacter onto the tubing from a height of 12 inches. Remove the tubing from the chamber and allow to warm at room temperature for one hour.

(e) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.13 Zinc chloride resistance test. (a) Utilize a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested. The cylinder is constructed of a non-reactive material or coated to prevent chemical reaction with zinc chloride. The length of the tubing sample is long enough so that its ends will not be submerged during the immersion in zinc chloride, or the ends of the tubing are plugged to keep the zinc chloride from entering the tubing.

(b) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support constructed of non-reactive materials, applying only enough force on the tubing to hold it in position.

(c) Immerse the tubing and cylinder in a 50 percent zinc chloride aqueous solution at room temperature for 200 hours.

(d) Remove the tubing and cylinder from the solution. While still on the test cylinder, inspect the tubing under 7-power magnification for cracks.

S12.14 Methyl alcohol resistance. (a) Utilize a cylinder having a radius equal to the supported bend radius in Table VIII for the size of tubing being tested. The cylinder is constructed of a nonreactive material or coated to prevent chemical reaction with methyl alcohol.

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(b) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support constructed of non-reactive materials, applying only enough force on the tubing to hold it in position. The ends of the tubing may be shortened so that they will be fully submerged in the methyl alcohol.

(c) Immerse the tubing and cylinder in a 95 percent methyl alcohol aqueous solution at room temperature for 200 hours.

(d) Remove the tubing and cylinder from the solution. While still on the test cylinder, inspect the tubing under 7-power magnification for cracks.

S12.15 High temperature conditioning and collapse resistance test. (a) **Apparatus.** A holding device consisting of two vertical pins affixed to a flat, horizontal plate. Each pin projects 1 inch above the top surface of the plate. The diameter of each pin is approximately equal to the inside diameter of the tubing being tested. Using the unsupported bend radius for the size of tubing being tested from Table VIII, the distance between the pin centerlines is equal to: $[2 \times \text{unsupported bend radius}] + [\text{nominal OD of tubing}]$

(b) **Preparation.** (1) Use the unsupported bend radius for the size of tubing being tested from Table VIII and cut the tubing to the following length: $[3.14 \times [\text{unsupported bend radius}]] + [10 \times [\text{nominal tubing OD}]] + 2 \text{ inches}$ or $[3.14 \times [\text{unsupported bend radius}]] + [10 \times [\text{nominal tubing OD}]] + 50 \text{ mm}$

(2) Place a reference mark at the center of the sample. At this mark, measure the initial outside diameter of the tubing. If the tubing is slightly out-of-round, use the elliptical minor diameter as the initial outside diameter.

(3) Install the tubing completely over the pins of the holding device so that the tubing is bent 180 degrees. If the tubing has a natural curvature, the tubing shall be bent in the direction of the natural curvature.

(4) Condition the holding device and tubing in an air oven at 200 degrees Fahrenheit (93 degrees Celsius) for 24 hours. Remove the holding device and tubing and allow to cool at room temperature for thirty minutes.

(5) With the tubing still mounted to the holding device, measure the elliptical minor diameter of the tubing at the reference mark to determine the final outside diameter.

(c) **Calculation.** Calculate the percentage collapse of the outside diameter of the tubing as follows: $([\text{Initial Outside Diameter} - \text{Final Outside Diameter}] \div [\text{Initial Outside Diameter}]) \times 100$

S12.16 Ozone resistance test. Conduct the test specified in S6.8 using plastic air brake tubing.

S12.17 Oil resistance test. (a) Utilize a plastic air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions.

(b) Immerse the tubing in ASTM IRM 903 oil at 212 degrees Fahrenheit (100 degrees Celsius) for 70 hours. Remove and allow to cool at room temperature for 30 minutes. Wipe any excess oil from the tubing assembly.

(c) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of

tubing being tested as specified in Table VIII and, at the manufacturer's option, oil may be used as the test medium instead of water.

S12.18 Tensile strength test. Conduct the test in S8.9 using a plastic air brake tubing assembly or an assembly prepared from a 12 inch length of air brake tubing with end fittings installed according to the end fitting manufacturer's instructions.

S12.19 Boiling water conditioning and tensile strength. (a) **Apparatus.** Use a tension testing machine as specified in S8.9. The lower attachment point of the machine is equipped with a heated, open-top container that is water tight. The inside of the container (lower attachment point) and upper attachment point of the machine have provisions to quickly attach a brake hose assembly for tensile testing.

(b) **Preparation.** Prepare an air brake tubing assembly with a free length of 6 inches (six inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. If necessary install adapters on the end fittings to permit quick attachment to the machine, to keep water from entering the tubing assembly, and to ensure that the tubing assembly is in a straight position when installed on the machine. Fill the container with distilled water such that the lower 4 inches of exposed tubing will be submerged when the brake tubing assembly is installed on the machine. Heat the water until it boils. Then quickly install the plastic air brake tubing assembly on the machine with the lower end of the tubing assembly in the boiling water. After the water has boiled continuously for 5 minutes, apply tension to the tubing assembly at a rate of 1 inch per minute travel of the moving head until either the conditioned tensile load in Table VIII for the size of tubing being tested is reached or the free length of the tubing assembly reaches 9 inches, whichever occurs first.

S12.20 Thermal conditioning and tensile strength. (a) **Apparatus.** Use a tension testing machine as specified in S8.9.

(b) **Preparation.** Prepare an air brake tubing assembly with a free length of 6 inches (six inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. If necessary install adapters on the end fittings to permit attachment to the machine, to keep water from entering the tubing assembly, and/or to ensure that the tubing assembly is in a straight position when installed on the machine. Subject the tubing assembly to four complete cycles of the following sequence:

(1) Condition the tubing assembly in an environmental chamber at minus 40 degrees Fahrenheit (minus 40 degrees Celsius) for 30 minutes. Remove from the chamber and allow to warm at room temperature for 30 minutes.

(2) Condition the tubing assembly by submerging it in boiling water for 15 minutes. Remove and allow to cool at room temperature for 30 minutes. Install the tubing assembly on the tension testing machine and apply tension to the tubing assembly at a rate of one inch per

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minute travel of the moving head until either the conditioned tensile load in Table VIII for the size of tubing being tested is reached or the free length of the tubing assembly reaches 9 inches, whichever occurs first.

S12.21 Vibration resistance test. (a) **Apparatus.** A vibration testing machine that supports a brake tubing assembly by its end fittings in approximately a straight line and includes the following features:

(1) One tubing assembly attachment point is fixed and the other moves in a plane perpendicular to a line projected between the attachment points. The movable attachment point moves in a linear direction and travels $\frac{1}{2}$ inch total and at its midpoint of travel falls on a line projected between the attachment points. The movable attachment point has a cycle rate of 600 cycles per minute.

(2) The distance between the attachment points is adjustable to compensate for varying lengths of brake tubing assemblies.

(3) The actuating mechanism for the movable attachment point is balanced to prevent introduction of machine vibration into the brake tubing assembly.

(4) The machine has a compressed air supply system that pressurizes the air brake tubing assembly through one fitting while the other fitting is plugged. The machine's compressed air supply system includes a pressure gauge or monitoring system and an air flow meter.

(5) The machine is constructed so that an air brake tubing assembly mounted on it can be conditioned in an environmental test chamber.

(b) **Preparation.** (1) Prepare an air brake tubing assembly with a free length of 18 inches (18 inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. Record the initial tightening torque for an end fitting that uses a threaded retaining nut.

(2) Install the air brake tubing assembly on the vibration testing machine and, with the movable attachment point at the midpoint of its travel, adjust the distance between the attachment points so that they are $\frac{1}{2}$ inch closer together than the distance at which the tubing assembly is taut.

(3) With the tubing assembly inside the environmental chamber, apply compressed air to the tubing assembly at a regulated pressure of 120 psi and maintain the supply of air to the tubing assembly for the duration of the test. Set the temperature of the environmental chamber to 220 degrees Fahrenheit (104 degrees Celsius) and initiate cycling of the movable attachment point. After 250,000 cycles, set the temperature of the environmental chamber to minus 40 degrees Fahrenheit (minus 40 degrees Celsius). After 500,000 cycles, set the temperature of the environmental chamber to 220 degrees Fahrenheit (104 degrees Celsius). After 750,000 cycles, set the temperature of the environmental chamber to minus 40 degrees Fahrenheit (minus 40 degrees Celsius). Measure the air flow rate just prior to 1,000,000 cycles and if the compressed air flow rate supplied to the air brake tubing assembly exceeds 50 cubic centimeters per minute this constitutes failure of

the test. Stop the cycling at 1,000,000 cycles and set the environmental chamber temperature to 75 degrees Fahrenheit (24 degrees Celsius), while air pressure is still supplied to the air brake tubing assembly. After one hour, measure the compressed air flow rate supplied to the air brake tubing assembly and if the rate exceeds 25 cubic centimeters per minute this constitutes failure of the test.

(4) For end fittings that use a threaded retaining nut, apply 20 percent of the original tightening torque as recorded in S12.21(b)(1). If the retention nut visibly moves, this constitutes a failure of the test.

S12.22 End fitting retention test. (a) Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions.

(b) Plug one end of the assembly, fill it with water, and connect the other end to a source of water pressure. Bleed any air from the assembly and water pressure system.

(c) Increase the pressure inside the tubing assembly at a rate of 3,000 psi per minute to 50 percent of the burst strength pressure for the size of tubing being tested as specified in Table VIII. Hold the pressure constant for 30 seconds.

(d) Increase the pressure inside the tubing assembly at a rate of 3,000 psi per minute to the burst strength pressure for the size of tubing being tested as specified in Table VIII.

S12.23 Thermal conditioning and end fitting retention test. (a) **Apparatus.** A source of hydraulic pressure that includes a pressure gauge or monitoring system, uses ASTM IRM 903 oil, and is constructed so that an air brake tubing assembly mounted to it can be conditioned in an environmental test chamber.

(b) **Preparation.** Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions. Attach one end of the assembly to the hydraulic pressure supply and plug the other end of the assembly, fill the assembly with ASTM IRM 903 oil and bleed any air from the assembly, and place the tubing assembly inside an environmental chamber. Conduct the following tests:

(1) With atmospheric pressure applied to the oil inside the tubing assembly, set the environmental chamber temperature to 200 degrees Fahrenheit (93 degrees Celsius) and condition the tubing assembly for 24 hours.

(2) With the temperature maintained at 200 degrees Fahrenheit (93 degrees Celsius), increase the oil pressure inside the tubing assembly at a rate of 3,000 psi per minute to 450 psi, and hold this pressure for 5 minutes.

(3) Decrease the oil pressure inside the tubing assembly at a rate of 3,000 psi per minute to atmospheric pressure and set the temperature of the environmental chamber to 75 degrees Fahrenheit (24 degrees Celsius). Condition the tubing assembly at this temperature for 1 hour.

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(4) Set the temperature of the environmental chamber to minus 40 degrees Fahrenheit (minus 40 degrees Celsius) and condition the tubing assembly for 24 hours.

(5) With the temperature maintained at minus 40 degrees Fahrenheit (minus 40 degrees Celsius), increase the hydraulic pressure inside the tubing assembly at a rate of 3,000 psi per minute to 450 psi, and hold this pressure for 5 minutes.

S12.24 End fitting serviceability. (a) **Apparatus.** A source of air pressure that includes a pressure gauge or monitoring system and is equipped with a mass air flow meter.

(b) **Preparation.** Prepare a 12-inch length of tubing and plug one end. Assemble the end fitting with the threaded retention nut on the other end of the tubing according to the end fitting manufacturer's instructions, then disassemble the fitting. Repeat the assembly and disassembly sequence three more times, and then reassemble the end fitting (five total assembly steps).

(c) Attach the end fitting with the threaded retention nut to the source of air pressure. Pressurize the tubing at a rate of 3,000 psi per minute to a pressure of 120 psi. If the end fitting leaks, measure and record the leakage rate using the mass air flow meter.

S12.25 End fitting corrosion resistance. Utilize an air brake tubing assembly or prepare a 12-inch length of tubing and install end fittings according to the end fitting manufacturer's instructions. Conduct the test specified in S6.11 using a plastic air brake tubing assembly.

S13. Test Conditions. Each hose assembly or appropriate part thereof shall be able to meet the requirements of S5, S7, S9, and S11, under the following conditions.

S13.1 The temperature of the testing room is 75 degrees Fahrenheit (24 degrees Celsius).

S13.2 The brake hoses and brake hose assemblies are at least 24 hours old, and unused.

S13.3 Specified test pressures are gauge pressures (psig).

§571.108 Standard No. 108; Lamps, reflective devices, and associated equipment.

S1. Scope. This standard specifies requirements for original and replacement lamps, reflective devices, and associated equipment.

S2. Purpose. The purpose of this standard is to reduce traffic accidents and deaths and injuries resulting from traffic accidents, by providing adequate illumination of the roadway, and by enhancing the conspicuity of motor vehicles on the public roads so that their presence is perceived and their signals understood, both in daylight and in darkness or other conditions of reduced visibility.

S3. Application. This standard applies to:

S3.1 Passenger cars, multipurpose passenger vehicles, trucks, buses, trailers (except pole trailers and trailer converter dollies), and motorcycles;

S3.2 Retroreflective sheeting and reflex reflectors manufactured to conform to S8.2 of this standard; and

S3.3 Lamps, reflective devices, and associated equipment for replacement of like equipment on vehicles to which this standard applies.

S4. Definitions.

Aiming plane means a plane defined by the surface of the three aiming pads on the lens.

Aiming reference plane means a plane which is perpendicular to the longitudinal axis of the vehicle and tangent to the forwardmost aiming pad on the headlamp.

Aiming screws are the horizontal and vertical adjusting screws with self-locking features used to aim and retain a headlamp unit in the proper position.

Axis of reference means the characteristic axis of the lamp for use as the direction of reference ($H = 0^\circ$, $V = 0^\circ$) for angles of field for photometric measurements and for installing the lamp on the vehicle.

Backup lamp means a lamp or lamps which illuminate the road to the rear of a vehicle and provide a warning signal to pedestrians and other drivers when the vehicle is backing up or is about to back up.

Beam contributor means an indivisible optical assembly including a lens, reflector, and light source, that is part of an integral beam headlighting system and contributes only a portion of a headlamp beam.

Cargo lamp is a lamp that is mounted on a multipurpose passenger vehicle, truck, or bus for the purpose of providing illumination to load or unload cargo.

Clearance lamps are lamps which show to the front or rear of the vehicle, mounted on the permanent structure of the vehicle as near as practicable to the upper left and right extreme edges to indicate the overall width and height of the vehicle.

Coated materials means a material which has a coating applied to the surface of the finished sample to impart some protective properties. Coating identification means a mark of the manufacturer's name, formulation designation number, and recommendations for application.

Color Fundamental definitions of color are expressed by Chromaticity Coordinates according to the CIE 1931 Standard Colorimetric System, as described in the CIE 1931 Chromaticity Diagram (incorporated by reference, see §571.5).

Color bleeding means the migration of color out of a plastic part onto the surrounding surface.

Combination clearance and side marker lamps are single lamps which simultaneously fulfill the requirements of clearance and side marker lamps.

Combination headlamp means a headlamp that is a combination of two different headlamp types chosen from a type F sealed beam headlamp, an integral beam headlamp, or a replaceable bulb headlamp.

Cracking means a separation of adjacent sections of a plastic material with penetration into the specimen.

Crazing means a network of apparent fine cracks on or beneath the surface of materials.

Cutoff means a generally horizontal, visual/optical aiming cue in the lower beam that marks a separation between areas of higher and lower luminance.

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Daytime running lamps (DRLs) are steady burning lamps that are used to improve the conspicuity of a vehicle from the front and front sides when the regular headlamps are not required for driving.

Delamination means a separation of the layers of a material including coatings.

Design voltage means the voltage used for design purposes.

Direct reading indicator means a device that is mounted in its entirety on a headlamp or headlamp aiming or headlamp mounting equipment, is part of a VHAD, and provides information about headlamp aim in an analog or digital format.

Effective light-emitting surface means that portion of a lamp that directs light to the photometric test pattern, and does not include transparent lenses, mounting hole bosses, reflex reflector area, beads or rims that may glow or produce small areas of increased intensity as a result of uncontrolled light from an area of $\frac{1}{2}^\circ$ radius around a test point.

Effective projected luminous lens area means the area of the orthogonal projection of the effective light-emitting surface of a lamp on a plane perpendicular to a defined direction relative to the axis of reference. Unless otherwise specified, the direction is coincident with the axis of reference.

Exposed means material used in lenses or optical devices exposed to direct sunlight as installed on the vehicle.

Filament means that part of the light source or light emitting element(s), such as a resistive element, the excited portion of a specific mixture of gases under pressure, or any part of other energy conversion sources, that generates radiant energy which can be seen.

Flash means a cycle of activation and deactivation of a lamp by automatic means continuing until stopped either automatically or manually.

Fully opened means the position of the headlamp concealment device in which the headlamp is in the design open operating position.

H-V axis means the line from the center of the principal filament of a lamp to the intersection of the horizontal (H) and vertical (V) lines of a photometric test screen.

Haze means the cloudy or turbid appearance of an otherwise transparent specimen caused by light scattered from within the specimen or from its surface.

Headlamp means a lighting device providing an upper and/or a lower beam used for providing illumination forward of the vehicle.

Headlamp concealment device means a device, with its operating system and components, that provides concealment of the headlamp when it is not in use, including a movable headlamp cover and a headlamp that displaces for concealment purposes.

Headlamp mechanical axis means the line formed by the intersection of a horizontal and a vertical plane through the light source parallel to the longitudinal axis of the vehicle. If the mechanical axis of the headlamp is not at the geometric center of the lens, then the location will be indicated by the manufacturer on the headlamp.

Headlamp test fixture means a device designed to support a headlamp or headlamp assembly in the test position specified in the laboratory tests and whose mounting hardware and components are those necessary to operate the headlamp as installed in a motor vehicle.

High-mounted stop lamp means a lamp mounted high and possibly forward of the tail, stop, and rear turn signal lamps intended to give a steady stop warning through intervening vehicles to operators of following vehicles.

Identification lamps are lamps used in groups of three, in a horizontal row, which show to the front or rear or both, having lamp centers spaced not less than [6 in] 15.2 mm nor more than [12 in] 30.4 mm apart, mounted on the permanent structure as near as practicable to the vertical centerline and the top of the vehicle to identify certain types of vehicles.

Integral beam headlamp means a headlamp (other than a standardized sealed beam headlamp designed to conform to paragraph S10.13 or a replaceable bulb headlamp designed to conform to paragraph S10.15) comprising an integral and indivisible optical assembly including lens, reflector, and light source, except that a headlamp conforming to paragraph S10.18.8 or paragraph S10.18.9 may have a lens designed to be replaceable.

License plate lamp means a lamp used to illuminate the license plate on the rear of a vehicle.

Lower beam means a beam intended to illuminate the road and its environs ahead of the vehicle when meeting or closely following another vehicle.

Material means the type and grade of plastics, composition, and manufacturer's designation number and color.

Mechanically aimable headlamp means a headlamp having three pads on the lens, forming an aiming plane used for laboratory photometric testing and for adjusting and inspecting the aim of the headlamp when installed on the vehicle.

Motor driven cycle means every motorcycle, including every motor scooter, with a motor which produces not more than 5 horsepower, and every bicycle with motor attached.

Motorcycle or motor driven cycle headlamp means a major lighting device used to produce general illumination ahead of the vehicle.

Mounting ring means the adjustable ring upon which a sealed beam unit is mounted.

Mounting ring (type F sealed beam) means the adjustable ring upon which a sealed beam unit is mounted and which forces the sealed beam unit to seat against the aiming ring when assembled into a sealed beam assembly.

Multiple compartment lamp means a device which gives its indication by two or more separately lighted areas which are joined by one or more common parts, such as a housing or lens.

Multiple lamp arrangement means an array of two or more separate lamps on each side of the vehicle which operate together to give a signal.

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Optically combined means a lamp having a single or two filament light source or two or more separate light sources that operate in different ways, and has its optically functional lens area wholly or partially common to two or more lamp functions.

Overall width means the nominal design dimension of the widest part of the vehicle, exclusive of signal lamps, marker lamps, outside rearview mirrors, flexible fender extensions, mud flaps, and outside door handles determined with doors and windows closed, and the wheels in the straight-ahead position. Running boards may also be excluded from the determination of overall width if they do not extend beyond the width as determined by the other items excluded by this definition.

Parking lamps are lamps on both the left and right of the vehicle which show to the front and are intended to mark the vehicle when parked or serve as a reserve front position indicating system in the event of headlamp failure.

Protected means material used in inner lenses for optical devices where such lenses are protected from exposure to the sun by an outer lens made of materials meeting the requirements for exposed plastics.

Rated voltage means the nominal circuit or vehicle electrical system voltage classification.

Reflex reflectors are devices used on vehicles to give an indication to approaching drivers using reflected light from the lamps of the approaching vehicle.

Remote reading indicator means a device that is not mounted in its entirety on a headlamp or headlamp aiming or headlamp mounting equipment, but otherwise meets the definition of a direct reading indicator.

Replaceable bulb headlamp means a headlamp comprising a bonded lens and reflector assembly and one or two replaceable light sources, except that a headlamp conforming to paragraph S10.18.8 or paragraph S10.18.9 may have a lens designed to be replaceable.

Replaceable light source means an assembly of a capsule, base, and terminals that is designed to conform to the requirements of Appendix A or Appendix B of 49 CFR part 564 *Replaceable Light Source Information* of this Chapter.

Retaining ring means the clamping ring that holds a sealed beam unit against a mounting ring.

Retaining ring (type F sealed beam) means the clamping ring that holds a sealed beam unit against a mounting ring, and that provides an interface between the unit's aiming/seating pads and the headlamp aimer adapter (locating plate).

School bus signal lamps are alternately flashing lamps mounted horizontally both front and rear, intended to identify a vehicle as a school bus and to inform other users of the highway that such vehicle is stopped on the highway to take on or discharge school children.

Sealed beam headlamp means an integral and indivisible optical assembly including the light source with "SEALED BEAM" molded in the lens.

Sealed beam headlamp assembly means a major lighting assembly which includes one or more sealed beam units used to provide general illumination ahead

of the vehicle.

Seasoning means the process of energizing the filament of a headlamp at design voltage for a period of time equal to 1% of design life, or other equivalent method.

Semiautomatic headlamp beam switching device is one which provides either automatic or manual control of beam switching at the option of the driver. When the control is automatic the headlamps switch from the upper beam to the lower beam when illuminated by the headlamps on an approaching vehicle and switch back to the upper beam when the road ahead is dark. When the control is manual, the driver may obtain either beam manually regardless of the conditions ahead of the vehicle.

Side marker lamps are lamps which show to the side of the vehicle, mounted on the permanent structure of the vehicle as near as practicable to the front and rear edges to indicate the overall length of the vehicle. Additional lamps may also be mounted at intermediate locations on the sides of the vehicle.

Stop lamps are lamps giving a steady light to the rear of a vehicle to indicate a vehicle is stopping or diminishing speed by braking.

Taillamps are steady burning low intensity lamps used to designate the rear of a vehicle.

Test voltage means the specified voltage and tolerance to be used when conducting a test.

Turn signal lamps are the signaling element of a turn signal system which indicates the intention to turn or change direction by giving a flashing light on the side toward which the turn will be made.

Turn signal flasher means a device which causes a turn signal lamp to flash as long as it is turned on.

Turn signal operating unit means an operating unit that is part of a turn signal system by which the operator of a vehicle causes the signal units to function.

Upper beam means a beam intended primarily for distance illumination and for use when not meeting or closely following other vehicles.

Vehicle headlamp aiming device or VHAD means motor vehicle equipment, installed either on a vehicle or headlamp, which is used for determining the horizontal or vertical aim, or both the vertical and horizontal aim of the headlamp.

Vehicular hazard warning signal flasher means a device which, as long as it is turned on, causes all the required turn signal lamps to flash.

Vehicular hazard warning signal operating unit means a driver controlled device which causes all required turn signal lamps to flash simultaneously to indicate to approaching drivers the presence of a vehicular hazard.

Visually/optically aimable headlamp means a headlamp which is designed to be visually/optically aimable in accordance with the requirements of paragraph S10.18.9 of this standard.

S5. References to SAE publications. Each required lamp, reflective device, and item of associated equipment

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must be designed to conform to the requirements of applicable SAE publications as referenced and subreferenced in this standard. The words “it is recommended that,” “recommendations,” or “should be” appearing in any SAE publication referenced or subreferenced in this standard must be read as setting forth mandatory requirements.

S5.1 Each required lamp, reflective device, and item of associated equipment must be designed to conform to the requirements of applicable SAE publications as referenced and subreferenced in this standard. The words “it is recommended that,” “recommendations,” or “should be” appearing in any SAE publication referenced or subreferenced in this standard must be read as setting forth mandatory requirements.

S5.2 *Incorporation by reference.* The Director of the Federal Register approves the incorporation by reference of the following material in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. All material is available for inspection at the NHTSA Reading Room, 1200 New Jersey Avenue, SE., Washington, DC 20590, or at NARA. For information on the availability of this material at NARA, call 202-741-6030, or go to: http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.

The material is also available at the publisher whose name and address follow the standard number:

1. Society of Automotive Engineers (SAE) Standard J602, revised AUG 1963, “Headlamp Aiming Device for Mechanically Aimable Sealed Beam Headlamp Units.” Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2. Society of Automotive Engineers (SAE) Standard J941b, revised FEB 1969, “Motor Vehicle Driver’s Eye Range.” Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

3. Society of Automotive Engineers (SAE) Standard J602, revised OCT 1980, “Headlamp Aiming Device for Mechanically Aimable Sealed Beam Headlamp Units.” Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

4. Society of Automotive Engineers (SAE) Standard J2009, revised FEB 1993, “Forward Discharge Lighting Systems.” Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

5. Society of Automotive Engineers (SAE) Standard J573d, revised DEC 1968, “Lamp Bulbs and Sealed Units.” Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

6. Society of Automotive Engineers (SAE) Standard J567b, revised APR 1964, “Bulb Sockets.” Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

7. International Commission on Illumination (C.I.E.) 1931 Chromaticity Diagram. CIE Central Bureau, Kegelgasse 27, A-1030 Vienna, Austria.

8. General Services Administration (GSA) Federal Specification L-S-300, approved September 1965, “Sheeting and Tape, Reflective: Nonexposed Lens, Adhesive Backing.” Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, telephone 202-512-1800.

9. American Society for Testing and Materials (ASTM) D4956-90, published December 1990, “Standard Specification for Retroreflective Sheeting for Traffic Control.” ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

10. ECE 48 E/ECE/324-E/ECE/TRANS/505, Rev.1/ADD.47/Rev.1/Corr.2, 26 February 1996, “Uniform Provisions Concerning the Approval of Vehicles with Regard to the Installation of Lighting and Light-Signaling Devices.” United Nations, Conference Services Division, Distribution and Sales Section, Office C.115-1, Palais des Nations, CH-1211, Geneva 10, <http://www.unecce.org/trans/main/wp29/wp29regs.html>.

11. American Society for Testing and Materials (ASTM) D1003-92, published December 1992, “Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.” ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

12. American Society for Testing and Materials (ASTM) E308-66, reapproved 1981, “Standard Practice for Spectrophotometry and Description of Color in CIE 1931 System.” ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

13. American Society for Testing and Materials (ASTM) B117-73, reapproved 1979, “Standard Method of Salt Spray (Fog) Testing.” ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

14. American Society for Testing and Materials (ASTM) Co. 05.04 1985, “Annual Book of ASTM Standards: Test Methods for Rating Motor, Diesel, Aviation Fuels,” Section I, parts A2.3.2, A2.3.3, and A2.7 in Annex 2. ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

15. American Society for Testing and Materials (ASTM) D362-84, published March 1984, “Standard Specification for Industrial Grade Toluene.” ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

16. American Society for Testing and Materials (ASTM) C150-77, published April 1977, “Standard Specification for Portland Cement.” ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

17. American Society for Testing and Materials (ASTM) C150-56, published 1956, “Standard Specifications for Portland Cement.” ASTM International, 100 Barr Harbor Drive, PO Box C700, Conshohocken, PA 19428-2959.

18. Illuminating Engineering Society of North America (IES) LM 45, approved April 1980, “IES Approved Method for Electrical and Photometric Measurements of General Service Incandescent Filament Lamps.” Illuminating Engineering Society of North America, 345 East 47th St., New York, NY 10017.

S6 Vehicle requirements.

S6.1 *Required lamps, reflective devices, and associated equipment by vehicle type.*

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S6.1.1 Quantity. Except as provided in succeeding paragraphs of this S6.1.1 each vehicle must be equipped with at least the number of lamps, reflective devices, and items of associated equipment specified for that vehicle type and size in Table I and Section 6.6, designed to conform to the requirements of this standard. Multiple license plate lamps and backup lamps may be used to fulfill photometric requirements for those functions.

S6.1.1.1 Conspicuity systems. Each trailer of 2032 mm or more in overall width, and with a GVWR over 10,000 lbs., except a trailer designed exclusively for living or office use, and each truck tractor must be equipped with retroreflective sheeting, reflex reflectors, or a combination of retroreflective sheeting and reflex reflectors as specified in S8.2.

S6.1.1.2 High-mounted stop lamps. Each multipurpose passenger vehicle, truck, and bus required by this standard to be equipped with a high-mounted stop lamp, whose vertical centerline, when the vehicle is viewed from the rear, is not located on a fixed body panel but separates one or two moveable body sections, such as doors, which lacks sufficient space to install a single high-mounted stop lamp on the centerline above such body sections, must have two high-mounted stop lamps identical in size and shape.

S6.1.1.2.1 The two lamps must be located at the same height, with one vertical edge of each lamp on the vertical edge of the body section nearest the vehicle centerline.

S6.1.1.3 Truck tractor rear turn signal lamps. A truck tractor need not be equipped with turn signal lamps mounted on the rear if the turn signal lamps installed at or near the front are of double face construction and are located such that they meet the photometric requirements for double faced turn signal lamps specified in Footnote 6 of Table VII.

S6.1.1.3.1 The flashing signal from a double faced signal lamp must not be obliterated when subjected to external light rays from either in front or behind, at any and all angles.

S6.1.1.4 Daytime running lamps. Any pair of lamps on the front of a passenger car, multipurpose passenger vehicle, truck, or bus, whether or not required by this standard, other than parking lamps or fog lamps, may be wired to be automatically activated, as determined by the manufacturer of the vehicle, in a steady burning state as daytime running lamps (DRLs) in accordance with S7.10.5.

S6.1.2 Color. The color in all lamps and reflective devices to which this standard applies must be as specified in Table I. The color identified as amber is identical to the color identified as yellow.

S6.1.3 Mounting location.

S6.1.3.1 Each lamp, reflective device, and item of associated equipment must be securely mounted on a rigid part of the vehicle, other than glazing, that is not designed to be removed except for repair, within the mounting location and height limits as specified in Table I, and in a location where it complies with all applicable photometric requirements, effective pro-

jected luminous lens area requirements, and visibility requirements with all obstructions considered.

S6.1.3.2 When multiple lamp arrangements for rear turn signal lamps, stop lamps, or taillamps are used, with only a portion of the lamps installed on a fixed part of the vehicle, the lamp or lamps that are installed to the non-fixed part of the vehicle will be considered auxiliary lamps.

S6.1.3.3 License plate lamp. The license plate lamp or lamps installed on vehicles other than motorcycles and motor driven cycles must be mounted so as to illuminate the license plate without obstruction from any designed feature unless the lamp or lamps is (are) designed to comply with all the photometric requirements with these obstructions considered.

S6.1.3.4 High-mounted stop lamps.

S6.1.3.4.1 Interior mounting. A high-mounted stop lamp mounted inside the vehicle must have means provided to minimize reflections from the light of the lamp upon the rear window glazing that might be visible to the driver when viewed directly, or indirectly in the rearview mirror.

S6.1.3.4.2 Accessibility. Each high-mounted stop lamp must provide access for convenient replacement of bulbs without special tools.

S6.1.3.5 Headlamp beam mounting.

S6.1.3.5.1 Vertical headlamp arrangement.

S6.1.3.5.1.1 Where multiple headlamps with single light sources are installed in a vertical orientation the lower beam must be provided by the uppermost headlamp.

S6.1.3.5.1.2 Where headlamps with two vertically oriented light sources are installed the lower beam must be provided by the uppermost light source or by all light sources.

S6.1.3.5.2 Horizontal headlamp arrangement.

S6.1.3.5.2.1 Where multiple headlamps with single light sources are installed in a horizontal orientation the lower beam must be provided by the most outboard headlamp.

S6.1.3.5.2.2 Where headlamps with two horizontally oriented light sources are installed the lower beam must be provided by the outboard light source or by all light sources.

S6.1.3.6 Auxiliary lamps mounted near identification lamps. Each auxiliary lamp must be located at least twice the distance from any required identification lamp as the distance between two adjacent required identification lamps.

S6.1.4 Mounting height. The mounting height of each lamp and reflective device must be measured from the center of the item, as mounted on the vehicle at curb weight, to the road surface.

S6.1.4.1 High-mounted stop lamps.

S6.1.4.1.1 A high-mounted stop lamp mounted below the rear window must have no lens portion lower than 153 mm [6 in] below the lower edge of the rear glazing on convertibles, or 77 mm [3 in] on other passenger cars.

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S6.1.5 Activation. Each lamp must be activated as specified, in the combinations specified, and in response to the inputs specified in Table I and Table II.

S6.1.5.1 Hazard warning signal. In all passenger cars, multipurpose passenger vehicles, trucks, and buses, the activation of the vehicular hazard warning signal operating unit must cause to flash simultaneously sufficient turn signal lamps to meet, as a minimum, the turn signal photometric requirements of this standard.

S6.1.5.2 Simultaneous beam activation.

S6.1.5.2.1 On any vehicle to which this standard applies where the headlighting system is designed to conform to the photometric requirements of UB1 of Table XVIII and LB1M or LB1V of Table XIX-a, the lamps marked “L” or “LF” may remain permanently activated when the lamps marked “U” or “UF” are activated.

S6.1.5.2.2 On any vehicle to which this standard applies where an integral beam headlighting system is designed to conform to the photometric requirements of UB6 of Table XVIII and LB5M of Table XIX-b or LB4V of Table XIX-c, the lower beam headlamps must remain permanently activated when the upper beam headlamps are activated.

S6.1.5.2.3 On any vehicle to which this section applies where the headlighting system is designed to conform to the photometric requirements of UB2 of Table XVIII and LB2M or LB2V of Table XIX-a, a lower beam light source may remain permanently activated when an upper beam light source is activated if the lower beam light source contributes to the upper beam photometric compliance of the headlighting system.

S6.2 Impairment.

S6.2.1 No additional lamp, reflective device, or other motor vehicle equipment is permitted to be installed that impairs the effectiveness of lighting equipment required by this standard.

S6.2.2 If any required lamp or reflective device is obstructed by motor vehicle equipment (e.g., mirrors, snow plows, wrecker booms, backhoes, winches, etc.) including dealer installed equipment, and cannot meet the applicable photometry and visibility requirements, the vehicle must be equipped with an additional lamp or device of the same type which meet all applicable requirements of this standard, including photometry and visibility.

S6.2.3 Headlamp obstructions.

S6.2.3.1 When activated in the steady burning state, headlamps (excluding headlamps mounted on motorcycles) must not have any styling ornament or other feature, such as a translucent cover or grill, in front of the lens.

S6.2.3.2 Headlamp wipers may be used in front of the lens provided that the headlamp system is designed to conform with all applicable photometric requirements with the wiper stopped in any position in front of the lens.

S6.3 Equipment combinations. Two or more lamps, reflective devices, or items of associated equipment may be combined if the requirements for each lamp, reflec-

tive device, and item of associated equipment are met with the following exceptions:

S6.3.1 No high-mounted stop lamp is permitted to be combined with any other lamp or reflective device, other than with a cargo lamp.

S6.3.2 No high-mounted stop lamp is permitted to be optically combined with any cargo lamp.

S6.3.3 No clearance lamp is permitted to be optically combined with any taillamp.

S6.4 Lens area, visibility and school bus signal lamp aiming.

S6.4.1 Effective projected luminous lens area. Each turn signal lamp, stop lamp, high-mounted stop lamp, and school bus signal lamp must meet the applicable effective projected luminous lens area requirement specified in Tables IV-a, IV-b, and IV-c.

S6.4.2 Visibility. Each backup lamp, single or combination of dual high-mounted stop lamp(s), and school bus signal lamp must meet the applicable visibility requirement specified in Table V-a.

S6.4.3 Visibility options. A manufacturer must certify compliance of each lamp function to one of the following visibility requirement options, and it may not thereafter choose a different option for that vehicle:

(a) *Lens area option.* When a vehicle is equipped with any lamp listed in Table V-b each such lamp must provide not less than 1250 sq mm of unobstructed effective projected luminous lens area in any direction throughout the pattern defined by the corner points specified in Table V-b for each such lamp; or

(b) *Luminous intensity option.* When a vehicle is equipped with any lamp listed in Table V-c each such lamp must provide a luminous intensity of not less than that specified in Table V-c in any direction throughout the pattern defined by the corner points specified in Table V-c for each such lamp when measured in accordance with the photometry test requirements of this standard.

S6.4.4 Legacy visibility alternative. As an alternative to S6.4.3, each passenger car and motorcycle, and each multipurpose passenger vehicle, truck, trailer, and bus that is of less than 2032 mm overall width, that is manufactured on or before September 1, 2011, and each multipurpose passenger vehicle, truck, trailer, and bus that is of 2032 mm or more overall width, that is manufactured on or before September 1, 2014, must have each lamp located so that it meets the visibility requirements specified in Table V-d.

S6.4.5 School bus signal lamp aiming. Each school bus signal lamp must be mounted on the vehicle with its aiming plane vertical and normal to the vehicle longitudinal axis. Aim tolerance must be no more than 5 in vertically and 10 in horizontally at 25 ft from the lamp. If the lamps are aimed or inspected by use of SAE Recommended Practice J602-1963 (incorporated by reference, see §571.5), the graduation settings for aim must be 2° D and 0° sideways for aiming and the limits must be 3° U to 7° D and from 10° R to 10° L for inspection.

S6.5 Marking. A summary of the marking requirements of this standard and their location in the standard is contained in Table III.

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S6.5.1 DOT marking. The lens of each original equipment and replacement headlamp, and of each original equipment and replacement beam contributor, and each replacement headlamp lens for an integral beam or replaceable bulb headlamp, must be marked with the symbol “DOT” either horizontally or vertically to indicate certification under 49 U.S.C. 30115.

S6.5.1.1 The DOT marking requirements for conspicuity materials are specified in S8.2 of this standard.

S6.5.1.2 Each original equipment or replacement lamp or reflective device specified in Table I, except for a headlamp, or an item of associated equipment specified in S9 may be marked with the symbol “DOT” which constitutes a certification that it conforms to the requirements of this standard.

S6.5.2 DRL marking. Each original equipment and replacement lamp used as a daytime running lamp (DRL), unless optically combined with a headlamp, must be permanently marked “DRL” on its lens in letters not less than 3 mm high.

S6.5.3 Headlamp markings.

S6.5.3.1 Trademark. The lens of each original and replacement equipment headlamp, and of each original and replacement equipment beam contributor must be marked with the name and/or trademark registered with the U.S. Patent and Trademark Office of the manufacturer of such headlamp or beam contributor, of its importer, or any manufacturer of a vehicle equipped with such headlamp or beam contributor. Nothing in this standard authorizes the marking of any such name and/or trademark by one who is not the owner, unless the owner has consented to it.

S6.5.3.2 Voltage and trade number. Each original and replacement equipment headlamp, and each original and replacement equipment beam contributor must be marked with its voltage and with its part or trade number.

S6.5.3.3 Sealed beam headlamp markings.

S6.5.3.3.1 Each sealed beam headlamp lens must be molded with “sealed beam” and the appropriate designation code as shown in Table II in characters no less than 6.35 mm in size.

S6.5.3.3.2 The face of any character molded on the surface of the lens must not be raised more than 0.5 mm above the lens surface.

S6.5.3.3.3 Type 1C1, 2C1, and 2D1 headlamps must have no raised markings on the outside surface of the lens between the diameters of 40 mm and 90 mm about the lens center.

S6.5.3.3.4 Type 1A1, 2A1, 2B1, and 2E1 headlamps must have no raised markings on the outside surface of the lens within a diameter of 70 mm about the lens center.

S6.5.3.3.5 Type LF, UF, 1G1, 2G1, and 2H1 headlamps must have no raised markings on the outside surface of the lens within a diameter of 35 mm about the lens center.

S6.5.3.3.6 A Type 1C1 replacement headlamp may be marked “1” rather than “1C1”. A Type 2C1 replacement headlamp may be marked “2” rather than “2C1”. A Type

2D1 replacement headlamp may be marked “TOP” or “2” rather than “2D1”.

S6.5.3.4 Replaceable bulb headlamp markings.

S6.5.3.4.1 The lens of each replaceable bulb headlamp must bear permanent marking in front of each replaceable light source with which it is equipped that states either: The HB Type, if the light source conforms to S11 of this standard for filament light sources, or the bulb marking/designation provided in compliance with Section VIII of Appendix A of 49 CFR Part 564 (if the light source conforms to S11 of this standard for discharge light sources).

S6.5.3.4.1.1 No marking need be provided if the only replaceable light source in the headlamp is type HB1.

S6.5.3.5 Additional headlamp markings. Additional marking requirements for headlamps are found in, S10.14.4, S10.15.4, S10.17.2, S10.18.5, S10.18.7, and S10.18.9 of this standard.

S6.5.3.6 Each replacement headlamp lens must also be marked with the manufacturer and the part or trade number of the headlamp for which it is intended, and with the name and/or trademark of the lens manufacturer or importer that is registered with the U.S. Patent and Trademark Office. Nothing in this standard authorizes the marking of any such name and/or trademark by one who is not the owner, unless the owner has consented to it.

S6.6 Associated equipment.

S6.6.1 All vehicles to which this standard applies, except trailers, must be equipped with a turn signal operating unit, a turn signal flasher, a turn signal pilot indicator, a headlamp beam switching device, and an upper beam headlamp indicator meeting the requirements of S9.

S6.6.2 All vehicles to which this standard applies except trailers and motorcycles must be equipped with a vehicular hazard warning operating unit, a vehicular hazard warning signal flasher, and a vehicular hazard warning signal pilot indicator meeting the requirements of S9.

S6.6.3 License plate holder. Each rear license plate holder must be designed and constructed to provide a substantial plane surface on which to mount the plate. The plane of the license plate mounting surface and the plane on which the vehicle stands must be perpendicular within $\pm 15^\circ$.

S6.7 Replacement equipment.

S6.7.1 General.

S6.7.1.1 Each replacement lamp, reflective device, or item of associated equipment, including a combination lamp, must:

(a) Be designed to conform to meet all requirements specified in this standard for that type of lamp, reflective device, or other item of equipment (in the case of a combination lamp, it must meet these requirements for each function); and

(b) Include all of the functions of the lamp, reflective device, or item of associated equipment, including a combination lamp, it is designed to replace or is capable

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of replacing (other than functions not required by this standard).

S6.7.1.2 Each replacement lamp, reflective device, or item of associated equipment, including a combination lamp, which is designed or recommended for particular vehicle models must be designed so that it does not take the vehicle out of compliance with this standard when the individual device is installed on the vehicle. Except as provided in S6.7.1.3, the determination of whether a vehicle would be taken out of compliance with this standard when an individual device is installed on the vehicle is made without regard to whether additional devices, including separate lamps or reflective devices sold together with the device, would also be installed.

S6.7.1.3 In the case of a lamp or other device that is used on each side of the vehicle in pairs, the determination (for the purposes of S6.7.1.2) of whether a vehicle would be taken out of compliance with this standard when an individual device is installed on the vehicle is made assuming that the other matched paired device would be installed on the other side of the vehicle, whether or not the matched paired devices are sold together. This provision does not limit the responsibilities of manufacturers, distributors, dealers or motor vehicle repair businesses under 49 U.S.C. 30122, *Making safety devices and elements inoperative*.

S6.7.2 *Version of this standard.* The requirements of S6.7.1 must be met, at the option of the manufacturer, using either the current version of this standard or the standard in effect at the time of manufacture of the original equipment being replaced.

S7. Signal lamp requirements.

S7.1 Turn signal lamps.

S7.1.1 Front turn signal lamps.

S7.1.1.1 *Number.* See Tables I-a and I-c.

S7.1.1.2 *Color of light.* See Tables I-a and I-c.

S7.1.1.3 *Mounting location.* See Tables I-a and I-c.

S7.1.1.4 *Mounting height.* See Tables I-a and I-c.

S7.1.1.5 *Activation.* See Tables I-a and I-c.

S7.1.1.6 *Effective projected luminous lens area.* See Table IV-a.

S7.1.1.7 *Visibility.* See S6.4.

S7.1.1.8 *Indicator.* See S9.3.

S7.1.1.9 *Markings.* See S6.5.1.2.

S7.1.1.10 *Spacing to other lamps.*

S7.1.1.10.1 Each front turn signal lamp must also be designed to comply with any additional photometry requirements based on its installed spacing to other lamps as specified by this section. Where more than one spacing relationship exists for a turn signal lamp the requirement must be the one that specifies the highest luminous intensity multiplier of Tables VI-a and VI-b.

S7.1.1.10.2 *Spacing measurement for non-reflector lamps.* For any front turn signal lamp that does not employ a reflector to meet photometric requirements, the spacing must be measured from the light source of the turn signal lamp to the lighted edge of any lower beam headlamp, or any lamp such as an auxiliary lower

beam headlamp or fog lamp used to supplement the lower beam headlamp.

S7.1.1.10.3 *Spacing measurement for lamps with reflectors.* For any front turn signal lamp which employs a reflector, such as a parabolic reflector, to meet photometric requirements, the spacing must be measured from the geometric centroid of the turn signal lamp effective projected luminous lens area to the lighted edge of any lower beam headlamp, or any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp.

S7.1.1.10.4 *Spacing based photometric multipliers.*

(a) where the spacing measurement as measured from the optical center of the turn signal lamp, to the lighted edge of a lower beam headlamp is less than 100 mm the photometric multiplier must be 2.5.

(b) where the spacing measurement of S7.1.1.10.2 or S7.1.1.10.3 between a turn signal lamp and the lighted edge of any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp is at least 75 mm but less than 100 mm the photometric multiplier of Table VI must be 1.5.

(c) where the spacing measurement of S7.1.1.10.2 or S7.1.1.10.3 between a turn signal lamp and the lighted edge of any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp is at least 60 mm but less than 75 mm the photometric multiplier must be 2.0.

(d) where the spacing measurement of S7.1.1.10.2 or S7.1.1.10.3 between a turn signal lamp and the lighted edge of any lamp such as an auxiliary lower beam headlamp or fog lamp used to supplement the lower beam headlamp is less than 60 mm the photometric multiplier must be 2.5.

S7.1.1.11 *Multiple compartment lamps and multiple lamps.*

S7.1.1.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric requirements of a front turn signal lamp provided the requirements of S6.1.3.2 are met.

S7.1.1.11.2 If a multiple compartment lamp or multiple lamps are used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between adjacent light sources does not exceed 560 mm for two compartment or lamp arrangements and does not exceed 410 mm for three compartments or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Tables VI-a or VI-b.

S7.1.1.11.3 If the distance between adjacent light sources exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Tables VI-a or VI-b.

S7.1.1.11.4 *Lamps installed on vehicles 2032 mm or more in overall width.* Multiple compartment front turn signal lamps installed on multipurpose passenger vehicles, trucks, and buses 2032 mm or more in overall

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width require measurement of the photometrics for the entire lamp and not for individual compartments.

S7.1.1.12 Ratio to parking lamps and clearance lamps.

S7.1.1.12.1 When a parking lamp, or a clearance lamp on a multipurpose passenger vehicle, truck, trailer, or bus of 2032 mm or more in overall width, is combined with a front turn signal lamp, the luminous intensity of the front turn signal lamp at each identified test point must not be less than the luminous intensity of the parking lamp or clearance lamp at that same test point times the multiplier shown for that test point in Tables VI-a or VI-b.

S7.1.1.12.2 If a multiple compartment or multiple lamp arrangement is used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between the optical axes for both the parking lamp and turn signal lamp is within 560 mm for two compartment or lamp arrangements or 410 mm for three compartment or lamp arrangements, then the ratio must be computed with all compartments or lamps lighted.

S7.1.1.12.3 If a multiple compartment or multiple lamp arrangement is used and the distance between optical axes for one of the functions exceeds 560 mm for two compartment or lamp arrangements or 410 mm for three compartments or lamp arrangements, then the ratio must be computed for only those compartments or lamps where the parking lamp and turn signal lamp are optically combined.

S7.1.1.12.4 Where the clearance lamp is combined with the turn signal lamp, and the maximum luminous intensity of the clearance lamp is located below horizontal and within an area generated by a 1.0 degree radius around a test point, the ratio for the test point may be computed using the lowest value of the clearance lamp luminous intensity within the generated area.

S7.1.1.13 Photometry.

S7.1.1.13.1 When tested according to the procedure of S14.2.1, each front turn signal lamp must be designed to conform to the base photometry requirements plus any applicable multipliers as shown in Tables VI-a and VI-b for the number of lamp compartments or individual lamps and the type of vehicle it is installed on.

S7.1.1.13.2 As an alternative to S7.1.1.13.1, a front turn signal lamp installed on a motorcycle may be designed to conform to the photometry requirements of Table XIII-a when tested according to the procedure of S14.2.1.

S7.1.1.14 Physical tests. Each front turn signal lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.1.2 Rear turn signal lamps.

S7.1.2.1 Number. See Tables I-a, I-b, and I-c.

S7.1.2.2 Color of light. See Tables I-a, I-b, and I-c.

S7.1.2.3 Mounting location. See Tables I-a, I-b, and I-c and S6.1.3.2.

S7.1.2.4 Mounting height. See Tables I-a, I-b, and I-c.

S7.1.2.5 Activation. See Tables I-a, I-b, and I-c.

S7.1.2.6 Effective projected luminous lens area. See Table IV-a.

S7.1.2.7 Visibility. See S6.4.

S7.1.2.8 Indicator. See S9.3.

S7.1.2.9 Markings. See S6.5.1.2.

S7.1.2.10 Spacing to other lamps. No requirement.

S7.1.2.11 Multiple compartments and multiple lamps.

S7.1.2.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric requirements of a rear turn signal lamp provided the requirements of S6.1.3.2 are met

S7.1.2.11.2 If a multiple compartment lamp or multiple lamps are used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between adjacent light sources does not exceed 560 mm for two compartment or lamp arrangements and does not exceed 410 mm for three compartment or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Table VII.

S7.1.2.11.3 If the distance between adjacent light sources exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Table VII.

S7.1.2.11.4 Lamps installed on vehicles 2032 mm or more in overall width. Multiple compartment rear turn signal lamps installed on multipurpose passenger vehicles, trucks, and buses 2032 mm or more in overall width require measurement of the photometrics for the entire lamp and not for individual compartments.

S7.1.2.12 Ratio to taillamps and clearance lamps.

S7.1.2.12.1 When a taillamp, or a clearance lamp on a multipurpose passenger vehicle, truck, trailer, or bus of 2032 mm or more in overall width, is combined with a rear turn signal lamp, the luminous intensity of the rear turn signal lamp at each identified test point must not be less than the luminous intensity of the taillamp or clearance lamp at that same test point times the multiplier shown for that test point in Table VII.

S7.1.2.12.2 If a multiple compartment or multiple lamp arrangement is used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between the optical axes for both the taillamp and turn signal lamp is within 560 mm for two compartment or lamp arrangement or 410 mm for three compartments or lamp arrangements, then the ratio must be computed with all compartments or lamps lighted.

S7.1.2.12.3 If a multiple compartment or multiple lamp arrangement is used and the distance between optical axes for one of the functions exceeds 560 mm for two compartment or lamp arrangements or 410 mm for three compartment or lamp arrangements, then the ratio must be computed for only those compartments or lamps where the taillamp and turn signal lamp are optically combined.

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S7.1.2.12.4 Where the taillamp or clearance lamp is combined with the turn signal lamp, and the maximum luminous intensity of the taillamp or clearance lamp is located below horizontal and within an area generated by a 0.5° radius around a test point for a taillamp on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, or by a 1.0° radius around a test point for a taillamp or clearance lamp on a vehicle 2032 mm or more in overall width, the ratio for the test point may be computed using the lowest value of the taillamp or clearance lamp luminous intensity within the generated area.

S7.1.2.13 *Photometry.*

S7.1.2.13.1 Each rear turn signal lamp must be designed to conform to the photometry requirements of Table VII, when tested according to the procedure of S14.2.1, for the number of lamp compartments or individual lamps, the type of vehicle it is installed on, and the lamp color as specified by this section.

S7.1.2.13.2 As an alternative to S7.1.2.13.1, a rear turn signal lamp installed on a motorcycle may be designed to conform to the photometry requirements of Table XIII-a when tested according to the procedure of S14.2.1.

S7.1.2.14 *Physical tests.* Each rear turn signal lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.1.3 *Combined lamp bulb indexing.*

S7.1.3.1 Each turn signal lamp optically combined with a taillamp or a parking lamp, or clearance lamp where installed on a vehicle 2032 mm or more in overall width, where a two-filament bulb is used must have a bulb with an indexing base and a socket designed so that bulbs with non-indexing bases cannot be used.

S7.1.3.2 Removable sockets must have an indexing feature so that they cannot be re-inserted into lamp housings in random positions, unless the lamp will perform its intended function with random light source orientation.

S7.2 *Taillamps.*

S7.2.1 *Number.* See Tables I-a, I-b, and I-c.

S7.2.2 *Color of light.* See Tables I-a, I-b, and I-c.

S7.2.3 *Mounting location.* See Tables I-a, I-b, and I-c and S6.1.3.2.

S7.2.4 *Mounting height.* See Tables I-a, I-b, and I-c.

S7.2.5 *Activation.* See Tables I-a, I-b, and I-c.

S7.2.6 *Effective projected luminous lens area.* No requirement.

S7.2.7 *Visibility.* See S6.4.

S7.2.8 *Indicator.* No requirement.

S7.2.9 *Markings.* See S6.5.1.2.

S7.2.10 *Spacing to other lamps.* No requirement.

S7.2.11 *Multiple compartments and multiple lamps.*

S7.2.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric require-

ments of a taillamp provided the requirements of S6.1.3.2 are met.

S7.2.11.2 If a multiple compartment lamp or multiple lamps are used and the distance between the optical axes does not exceed 560 mm for two compartment or lamp arrangements and does not exceed 410 mm for three compartment or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Table VIII.

S7.2.11.3 If the distance between optical axes exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Table VIII.

S7.2.11.4 *Taillamps installed on vehicles 2032 mm or more in overall width.* A maximum of two taillamps and/or two compartments per side may be mounted closer together than 560 mm providing that each compartment and/or lamp meets the single lighted section photometric requirements specified in Table VIII. Each lamp and/or compartment utilized in this manner must meet the single lighted section requirements for all functions for which it is designed.

S7.2.12 *Ratio.* See S7.1.2.12 for rear turn signal lamps and S7.3.12 for stop lamps.

S7.2.13 *Photometry.* Each taillamp must be designed to conform to the photometry requirements of Table VIII, when tested according to the procedure of S14.2.1, for the number of lamp compartments or individual lamps and the type of vehicle it is installed on.

S7.2.14 *Physical tests.* Each taillamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.3 *Stop lamps.*

S7.3.1 *Number.* See Tables I-a, I-b, and I-c.

S7.3.2 *Color of light.* See Tables I-a, I-b, and I-c.

S7.3.3 *Mounting location.* See Tables I-a, I-b, and I-c and S6.1.3.2.

S7.3.4 *Mounting height.* See Tables I-a, I-b, and I-c.

S7.3.5 *Activation.* See Tables I-a, I-b, and I-c.

S7.3.6 *Effective projected luminous lens area.* See Table IV-a.

S7.3.7 *Visibility.* See S6.4.

S7.3.8 *Indicator.* No requirement.

S7.3.9 *Markings.* See S6.5.1.2.

S7.3.10 *Spacing to other lamps.* No requirement.

S7.3.11 *Multiple compartments and multiple lamps.*

S7.3.11.1 A multiple compartment lamp or multiple lamps may be used to meet the photometric requirements of a stop lamp provided the requirements of S6.1.3.2 are met.

S7.3.11.2 If a multiple compartment lamp or multiple lamps are used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between adjacent light sources does not exceed 560 mm for two

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compartment or lamp arrangements and does not exceed 410 mm for three compartment or lamp arrangements, then the combination of the compartments or lamps must be used to meet the photometric requirements for the corresponding number of lighted sections specified in Table IX.

S7.3.11.3 If the distance between adjacent light sources exceeds the previously stated dimensions, each compartment or lamp must comply with the photometric requirements for one lighted section specified in Table IX.

S7.3.11.4 *Lamps installed on vehicles 2032 mm or more in overall width.* Multiple compartment stop lamps installed on multipurpose passenger vehicles, trucks, and buses 2032 mm or more in overall width require measurement of the photometrics for the entire lamp and not for individual compartments.

S7.3.12 *Ratio to taillamps.*

S7.3.12.1 When a taillamp is combined with a stop lamp, the luminous intensity of the stop lamp at each identified test point must not be less than the luminous intensity of the taillamp at that same test point times the multiplier shown for that test point in Table IX.

S7.3.12.2 If a multiple compartment or multiple lamp arrangement is used on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, and the distance between the optical axes for both the taillamp and stop lamp is within 560 mm for two compartment or lamp arrangements or 410 mm for three compartment or lamp arrangements, then the ratio must be computed with all compartments or lamps lighted.

S7.3.12.3 If a multiple compartment or multiple lamp arrangement is used and the distance between optical axes for one of the functions exceeds 560 mm for two compartment or lamp arrangements or 410 mm for three compartments or lamp arrangements, then the ratio must be computed for only those compartments or lamps where the taillamp and stop lamp are optically combined.

S7.3.12.4 Where the taillamp is combined with the stop lamp, and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5° radius around a test point for a taillamp on a passenger car or on a multipurpose passenger vehicle, truck, bus, or trailer of less than 2032 mm in overall width, or by a 1.0° radius around a test point for a taillamp on a vehicle 2032 mm or more in overall width, the ratio for the test point may be computed using the lowest value of the taillamp luminous intensity within the generated area.

S7.3.13 *Photometry.*

S7.3.13.1 Each stop lamp must be designed to conform to the photometry requirements of Table IX, when tested according to the procedure of S14.2.1, for the number of lamp compartments or individual lamps and the type of vehicle it is installed on.

S7.3.13.2 A stop lamp installed on a motor driven cycle may be designed to conform to the photometry requirements of Table XIII-b when tested according to the procedure of S14.2.1.

S7.3.14 *Physical tests.* Each stop lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.3.15 *Combined lamp bulb indexing.*

S7.3.15.1 Each stop lamp optically combined with a taillamp where a two-filament bulb is used must have a bulb with an indexing base and a socket designed so that bulbs with non-indexing bases cannot be used.

S7.3.15.2 Removable sockets must have an indexing feature so that they cannot be re-inserted into lamp housings in random positions, unless the lamp will perform its intended function with random light source orientation.

S7.4 *Side marker lamps.*

S7.4.1 *Number.* See Tables I-a, I-b, and I-c.

S7.4.2 *Color of light.* See Tables I-a, I-b, and I-c.

S7.4.3 *Mounting location.* See Tables I-a, I-b, and I-c.

S7.4.4 *Mounting height.* See Tables I-a, I-b, and I-c.

S7.4.5 *Activation.* See Tables I-a, I-b, and I-c.

S7.4.6 *Effective projected luminous lens area.* No requirement.

S7.4.7 *Visibility.* No requirement.

S7.4.8 *Indicator.* No requirement.

S7.4.9 *Markings.* See S6.5.1.2.

S7.4.10 *Spacing to other lamps.* No requirement.

S7.4.11 *Multiple compartments and multiple lamps.* No requirement.

S7.4.12 *Ratio.* No requirement.

S7.4.13 *Photometry.*

S7.4.13.1 Each side marker lamp must be designed to conform to the photometry requirements of Table X, when tested according to the procedure of S14.2.1, for the lamp color as specified by this section.

S7.4.13.2 *Inboard photometry.* For each motor vehicle less than 30 feet in overall length and less than 2032 mm in overall width, the minimum photometric intensity requirements for a side marker lamp may be met for all inboard test points at a distance of 15 feet from the vehicle and on a vertical plane that is perpendicular to the longitudinal axis of the vehicle and located midway between the front and rear side marker lamps.

S7.4.14 *Physical tests.* Each side marker lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.5 *Clearance and identification lamps.*

S7.5.1 *Number.* See Tables I-a and I-b.

S7.5.2 *Color of light.* See Tables I-a and I-b.

S7.5.3 *Mounting location.* See Tables I-a and I-b.

S7.5.4 *Mounting height.* See Tables I-a and I-b.

S7.5.5 *Activation.* See Tables I-a and I-b.

S7.5.6 *Effective projected luminous lens area.* No requirement.

S7.5.7 *Visibility.* No requirement.

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S7.5.8 *Indicator*. No requirement.

S7.5.9 *Markings*. See S6.5.1.2.

S7.5.10 *Spacing to other lamps*. No requirement.

S7.5.11 *Multiple compartments and multiple lamps*. No requirement.

S7.5.12 *Ratio*.

S7.5.12.1 *Clearance lamps*. See S7.1.1.12 for front turn signal lamps and S7.1.2.12 for rear turn signal lamps.

S7.5.12.2 *Identification lamps*. No requirement.

S7.5.13 *Photometry*. Each clearance or identification lamp must be designed to conform to the photometry requirements of Table XI, for the applicable lamp color, when tested according to the procedure of S14.2.1.

S7.5.14 *Physical tests*. Each clearance and identification must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.6 *Backup lamps*.

S7.6.1 *Number*. See Table I-a and S6.1.1.

S7.6.2 *Color of light*.

S7.6.2.1 See Table I-a.

S7.6.2.2 A backup lamp may project incidental red, yellow, or white light through reflectors or lenses that are adjacent, close to, or a part of the lamp assembly.

S7.6.3 *Mounting location*. See Table I-a.

S7.6.4 *Mounting height*. No requirement.

S7.6.5 *Activation*. See Table I-a.

S7.6.6 *Effective projected luminous lens area*. No requirement.

S7.6.7 *Visibility*. See Table V-a.

S7.6.8 *Indicator*. No requirement.

S7.6.9 *Markings*. See S6.5.1.2.

S7.6.10 *Spacing to other lamps*. No requirement.

S7.6.11 *Multiple compartments and multiple lamps*. No requirement.

S7.6.12 *Ratio*. No requirement.

S7.6.13 *Photometry*. Each backup lamp must be designed to conform to the photometry requirements of Table XII, when tested according to the procedure of S14.2.1, as specified by this section.

S7.6.14 *Physical tests*. Each backup lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.7 *License plate lamps*.

S7.7.1 *Number*. See Tables I-a, I-b, and I-c and S6.1.1.

S7.7.2 *Color of light*. See Tables I-a, I-b, and I-c.

S7.7.3 *Mounting location*. See Tables I-a, I-b, and I-c.

S7.7.4 *Mounting height*. No requirement.

S7.7.5 *Activation*. See Tables I-a, I-b, and I-c.

S7.7.6 *Effective projected luminous lens area*. No requirement.

S7.7.7 *Visibility*. No requirement.

S7.7.8 *Indicator*. No requirement.

S7.7.9 *Markings*. See S6.5.1.2.

S7.7.10 *Spacing to other lamps*. No requirement.

S7.7.11 *Multiple compartments and multiple lamps*. No requirement.

S7.7.12 *Ratio*. No requirement.

S7.7.13 *Photometry*.

S7.7.13.1 Each license plate lamp must be designed to conform to the photometry requirements of this section when tested according to the procedure of S14.2.2.

S7.7.13.2 An illumination value of no less than 8 lx [0.75 fc] must be met at each test station target location shown in Figure 19.

S7.7.13.3 The ratio of the average of the two highest illumination values divided by the average of the two lowest illumination values must not exceed 20:1 for vehicles other than motorcycles and motor driven cycles.

S7.7.13.4 The ratio of the highest illumination value divided by the average of the two lowest illumination values must not exceed 15:1 for motorcycles and motor driven cycles.

S7.7.14 *Physical tests*. Each license plate lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.7.15 *Installation*.

S7.7.15.1 Each license plate lamp installed on a vehicle other than a motorcycle or motor driven cycle must be of such size and design as to provide illumination on all parts of a 150 mm by 300 mm test plate.

S7.7.15.2 Each license plate lamp installed on a motorcycle or motor driven cycle must be of such size and design as to provide illumination on all parts of a 100 mm by 175 mm test plate.

S7.7.15.3 The light rays must reach all portions of an imaginary plate of the same size at least 25 mm ahead of the actual plate measured perpendicular to the plane of the plate.

S7.7.15.4 *Incident light from single lamp*. When a single lamp as shown in Figure 20 is used to illuminate the license plate, the lamp and license plate holder must bear such relation to each other that at no point on the plate must the incident light make an angle of less than 8° to the plane of the plate, this angle being measured from the edge of the light emitting surface of the lamp farthest from the surface of the plate.

S7.7.15.5 *Incident light from multiple lamps*. When two or more lamps as shown in Figure 20 are used to illuminate the license plate, the minimum 8° incident light angle must apply only to that portion of the plate which the particular lamp is designed to illuminate. The angle must be measured in the same manner as S7.7.15.4.

S7.8 *Parking lamps*.

S7.8.1 *Number*. See Table I-a.

S7.8.2 *Color of light*. See Table I-a.

S7.8.3 *Mounting location*. See Table I-a.

S7.8.4 *Mounting height*. See Table I-a.

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S7.8.5 *Activation*. See Table I-a.

S7.8.6 *Effective projected luminous lens area*. No requirement.

S7.8.7 *Visibility*. See S6.4.

S7.8.8 *Indicator*. No requirement.

S7.8.9 *Markings*. See S6.5.1.2.

S7.8.10 *Spacing to other lamps*. No requirement.

S7.8.11 *Multiple compartments and multiple lamps*. No requirement.

S7.8.12 *Ratio*. See S7.1.1.12 for front turn signal lamps.

S7.8.13 *Photometry*. Each parking lamp must be designed to conform to the photometry requirements of Table XIV, when tested according to the procedure of S14.2.1, as specified by this section.

S7.8.14 *Physical tests*. Each parking lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S7.9 *High-mounted stop lamps*.

S7.9.1 *Number*. See Table I-a and S6.1.1.2.

S7.9.2 *Color of light*. See Table I-a.

S7.9.3 *Mounting location*. See Table I-a.

S7.9.4 *Mounting height*. See Table I-a and S6.1.4.1.

S7.9.5 *Activation*. See Table I-a.

S7.9.6 *Effective projected luminous lens area*. See Table IV-b.

S7.9.7 *Visibility*. See Table V-a.

S7.9.8 *Indicator*. No requirement.

S7.9.9 *Markings*. See S6.5.1.2.

S7.9.10 *Spacing to other lamps*. No requirement.

S7.9.11 *Multiple compartments and multiple lamps*. No requirement.

S7.9.12 *Ratio*. No requirement.

S7.9.13 *Photometry*. Each high-mounted stop lamp must be designed to conform to the photometry requirements of Table XV, when tested according to the procedure of S14.2.1, as specified by this section.

S7.9.14 *Physical tests*.

S7.9.14.1 Each high-mounted stop lamp must be designed to conform to the performance requirements of the vibration test of S14.5, and the color test and plastic optical material test of S14.4.

S7.9.14.2 Each high-mounted stop lamp that is not mounted inside the vehicle must be designed to conform to the performance requirements of the moisture test, dust test, and corrosion test of S14.5.

S7.10 *Daytime running lamps (DRLs)*.

S7.10.1 *Number*. See Table I-a.

S7.10.2 *Color of light*. See Table I-a.

S7.10.3 *Mounting location*. See Table I-a.

S7.10.4 *Mounting height*. See Table I-a. and S7.10.13(b).

S7.10.5 *Activation*. See Table I-a. and S7.10.10.1(c).

S7.10.6 *Effective projected luminous lens area*. No requirement.

S7.10.7 *Visibility*. No requirement.

S7.10.8 *Indicator*. No requirement.

S7.10.9 *Markings*. See S6.5.

S7.10.10 *Spacing to other lamps*.

S7.10.10.1 *Spacing to turn signal lamps*. Each DRL not optically combined with a turn signal lamp must be located on the vehicle so that the distance from its lighted edge to the optical center of the nearest turn signal lamp is not less than 100 mm unless,

(a) The luminous intensity of the DRL is not more than 2,600 cd at any location in the beam and the turn signal lamp meets 2.5 times the base front turn signal photometric requirements, or

(b) The DRL is optically combined with a lower beam headlamp and the turn signal lamp meets 2.5 times the base front turn signal photometric requirements, or

(c) The DRL is deactivated when the turn signal or hazard warning signal lamp is activated.

S7.10.11 *Multiple compartments and multiple lamps*. No requirement.

S7.10.12 *Ratio*. No requirement.

S7.10.13 *Photometry*. Each DRL must have a luminous intensity not less than 500 cd at test point H-V, nor more than 3,000 cd at any location in the beam when tested according to the procedure of S14.2.4 as specified by this section, unless it is:

(a) A lower beam headlamp intended to operate as a DRL at full voltage, or a voltage lower than used to operate it as a lower beam headlamp, or

(b) An upper beam headlamp intended to operate as a DRL, whose luminous intensity at test point H-V is not more than 7,000 cd, and whose mounting height is not higher than 864 mm.

S7.10.14 *Physical tests*. Each DRL that is not combined with another required lamp must be designed to conform to the performance requirements of the color test and plastic optical material test of S14.4.

S7.11 *School bus signal lamps*.

S7.11.1 *Number*. See Table I-a.

S7.11.2 *Color of light*. See Table I-a.

S7.11.3 *Mounting location*. See Table I-a.

S7.11.4 *Mounting height*. See Table I-a.

S7.11.5 *Activation*. See Table I-a.

S7.11.6 *Effective projected luminous lens area*. See Table IV-c.

S7.11.7 *Visibility*. See Table V-a.

S7.11.8 *Indicator*. No requirement.

S7.11.9 *Markings*. See S6.5.1.2.

S7.11.10 *Spacing to other lamps*. No requirement.

S7.11.11 *Multiple compartments and multiple lamps*. No requirement.

S7.11.12 *Ratio*. No requirement.

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S7.11.13 Photometry. Each school bus signal lamp must be designed to conform to the photometry requirements of Table XVII, when tested according to the procedure of S14.2.1, for the lamp color as specified by this section.

S7.11.14 Physical tests. Each school bus signal lamp must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S8 Reflective device requirements.

S8.1 Reflex reflectors.

S8.1.1 Number. See Tables I-a, I-b, and I-c.

S8.1.2 Color. See Tables I-a, I-b, and I-c.

S8.1.3 Mounting location. See Tables I-a, I-b, and I-c.

S8.1.4 Mounting height. See Tables I-a, I-b, and I-c.

S8.1.5 Activation. No requirement.

S8.1.6 Effective projected luminous lens area. No requirement.

S8.1.7 Visibility. No requirement.

S8.1.8 Indicator. No requirement.

S8.1.9 Markings. See S6.5.1.2.

S8.1.10 Spacing to other lamps or reflective devices. No requirement.

S8.1.11 Photometry. Each reflex reflector must be designed to conform to the photometry requirements of Table XVI-a when tested according to the procedure of S14.2.3 for the reflex reflector color as specified by this section.

S8.1.12 Physical tests. Each reflex reflector must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, and the color test and plastic optical material test of S14.4.

S8.1.13 Alternative side reflex reflector material. Reflective material conforming to GSA Federal Specification L-S-300 (incorporated by reference, see §571.5), may be used for side reflex reflectors if this material as used on the vehicle, meets the performance requirements of Table XVI-a.

S8.2 Conspicuity systems. The requirement for conspicuity systems may be met with retroreflective sheeting, conspicuity reflex reflectors, or a combination of retroreflective sheeting and conspicuity reflex reflectors.

S8.2.1 Retroreflective sheeting.

S8.2.1.1 Retroreflective sheeting must consist of a smooth, flat, transparent exterior film with retroreflective elements embedded or suspended beneath the film so as to form a non-exposed retroreflective optical system.

S8.2.1.2 Retroreflective sheeting material. Retroreflective sheeting must meet the requirements, except photometry, of ASTM D 4956-90 (incorporated by reference, see §571.5) for Type V Sheeting. Sheeting of Grade DOT-C2 of no less than 50 mm wide, Grade DOT-C3 of no less than 75 mm wide, or Grade DOT-C4 of no less than 100 mm wide may be used.

S8.2.1.3 Certification marking. The letters DOT-C2, DOT-C3, or DOT-C4, as appropriate, constituting a certification that the retroreflective sheeting conforms to the requirements of this standard, must appear at least once on the exposed surface of each white or red segment of retroreflective sheeting, and at least once every 300 mm on retroreflective sheeting that is white only. The characters must be not less than 3 mm high, and must be permanently stamped, etched, molded, or printed in indelible ink.

S8.2.1.4 Application pattern.

S8.2.1.4.1 Alternating red and white materials.

S8.2.1.4.1.1 As shown in Figures 12-1 and 12-2, where alternating material is installed, except for a segment that is trimmed to clear obstructions, or lengthened to provide red sheeting near red lamps, alternating material must be installed with each white and red segment having a length of 300 ± 150 mm.

S8.2.1.4.1.2 Neither white nor red sheeting must represent more than two thirds the aggregate of any continuous strip marking the width of a trailer, or any continuous or broken strip marking its length.

S8.2.1.5 Application location. Conspicuity systems need not be installed, as illustrated in Figure 12-2, on discontinuous surfaces such as outside ribs, stake post pickets on platform trailers, and external protruding beams, or to items of equipment such as door hinges and lamp bodies on trailers and body joints, stiffening beads, drip rails, and rolled surfaces on truck tractors.

S8.2.1.6 Application spacing. As illustrated in Figure 12-2, the edge of any white sheeting must not be located closer than 75 mm to the edge of the luminous lens area of any red or amber lamp that is required by this standard. The edge of any red sheeting must not be located closer than 75 mm to the edge of the luminous lens area of any amber lamp that is required by this standard.

S8.2.1.7 Photometry. Each retroreflective sheeting must be designed to conform to the photometry requirements of Table XVI-c when tested according to the procedure of S14.2.3 for the color and grade as specified by this section.

S8.2.2 Conspicuity reflex reflectors.

S8.2.2.1 Certification marking. The exposed surface of each conspicuity reflex reflector must be marked with the letters DOT-C which constitutes a certification that the reflector conforms to the conspicuity reflex reflector requirements of this standard. The certification must be not less than 3 mm high, and must be permanently stamped, etched, molded, or printed in indelible ink.

S8.2.2.2 Application pattern.

S8.2.2.2.1 Alternating red and white materials. Conspicuity reflex reflectors must be installed in a repetitive pattern of two or three white reflectors alternating with two or three red reflectors, with the center of each reflector not more than 100 mm from the center of each adjacent reflector.

S8.2.2.2.2 White material. White conspicuity reflex reflectors must be installed with the center of each reflector not more than 100 mm from the center of each adjacent reflector.

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S8.2.2.3 *Photometry.*

S8.2.2.3.1 Each red conspicuity reflex reflector must be designed to conform to the photometry requirements of Table XVI-a for a red reflex reflector and Table XVI-b for a red conspicuity reflex reflector when tested according to the procedure of S14.2.3 as specified by this section.

S8.2.2.3.2 Each white conspicuity reflex reflector installed in only a horizontal orientation must be designed to conform to the photometry requirements of Table XVI-a for a white reflex reflector and Table XVI-b for a white horizontal conspicuity reflex reflector when tested according to the procedure of S14.2.3 as specified by this section.

S8.2.2.3.3 Each white conspicuity reflex reflector installed in a vertical orientation must be designed to conform to the photometry requirements of Table XVI-a for a white reflex reflector, and Table XVI-b for a white horizontal conspicuity reflex reflector and a white vertical conspicuity reflex reflector when tested according to the procedure of S14.2.3 as specified by this section.

S8.2.3 *Conspicuity system installation on trailers.*

S8.2.3.1 *Trailer rear.*

S8.2.3.1.1 *Element 1-alternating red and white materials.* As shown in Figure 11, a strip of sheeting or conspicuity reflex reflectors, as horizontal as practicable, must be applied across the full width of the trailer, as close to the extreme edges as practicable, and as close as practicable to not less than 375 mm and not more than 1525 mm above the road surface at the strip centerline with the trailer at curb weight.

S8.2.3.1.2 *Element 2-white.* (not required for container chassis or for platform trailers without bulkheads).

S8.2.3.1.2.1 As shown in Figure 11, two pairs of strips of sheeting or conspicuity reflex reflectors, each pair consisting of strips 300 mm long of Grade DOT-C2, DOT-C3, or DOT-C4, must be applied horizontally and vertically to the right and left upper contours of the body, as viewed from the rear, as close to the top of the trailer and as far apart as practicable.

S8.2.3.1.2.2 If the perimeter of the body, as viewed from the rear, is other than rectangular, the strips may be applied along the perimeter, as close as practicable to the uppermost and outermost areas of the rear of the body on the left and right sides.

S8.2.3.1.3 *Element 3-alternating red and white materials.* (not required for trailers without underride protection devices).

S8.2.3.1.3.1 As shown in Figure 11, a strip of Grade DOT-C2 sheeting no less than 38 mm wide or reflectors must be applied across the full width of the horizontal member of the rear underride protection device.

S8.2.3.2 *Trailer side-alternating red and white materials.*

S8.2.3.2.1 As shown in Figure 11, a strip of sheeting or conspicuity reflex reflectors must be applied to each side, as horizontal as practicable, originating and terminating as close to the front and rear as practicable, as close as practicable to not less than 375 mm and not

more than 1525 mm above the road surface at the strip centerline at curb weight, except that at the location chosen the strip must not be obscured in whole or in part by other motor vehicle equipment or trailer cargo.

S8.2.3.2.2 The strip need not be continuous as long as not less than half the length of the trailer is covered and the spaces are distributed as evenly as practicable.

S8.2.3.2.3 If necessary to clear rivet heads or other similar obstructions, Grade DOT-C2 sheeting may be separated into two 25 mm wide strips of the same length and color, separated by a space of not more than 25 mm and used in place of the retroreflective sheeting that would otherwise be applied.

S8.2.4 *Conspicuity system installation on truck tractors.*

S8.2.4.1 *Element 1-alternating red and white materials.* As shown in Figure 13, two strips of sheeting or conspicuity reflex reflectors, each not less than 600 mm long, located as close as practicable to the edges of the rear fenders, mudflaps, or the mudflap support brackets, must be applied to mark the width of the truck tractor.

S8.2.4.1.1 The strips must be mounted as horizontal as practicable, in a vertical plane facing the rear, on the rear fenders, on the mudflap support brackets, on plates attached to the mudflap support brackets, or on the mudflaps.

S8.2.4.1.2 Strips on mudflaps must be mounted not lower than 300 mm below the upper horizontal edge of the mudflap. If the vehicle is certified with temporary mudflap support brackets, the strips must be mounted on the mudflaps or on plates transferable to permanent mudflap support brackets.

S8.2.4.1.3 For a truck tractor without mudflaps, the strips may be mounted outboard of the frame on brackets behind the rear axle or on brackets ahead of the rear axle and above the top of the rear tires at unladen vehicle height, or they may be mounted directly or indirectly to the back of the cab as close to the outer edges as practicable, above the top of the tires, and not more than 1525 mm above the road surface at unladen vehicle height.

S8.2.4.1.4 If the strips are mounted on the back of the cab, no more than 25% of their cumulative area may be obscured by vehicle equipment as determined in a rear orthogonal view.

S8.2.4.2 *Element 2-white.* As shown in Figure 13, two pairs of strips of sheeting or conspicuity reflex reflectors, each pair consisting of strips 300 mm long, must be applied horizontally and vertically as practicable to the right and left upper contours of the cab, as close to the top of the cab and as far apart as practicable.

S8.2.4.2.1 No more than 25% of their cumulative area may be obscured by vehicle equipment as determined in a rear orthogonal view.

S8.2.4.2.2 If one pair must be relocated to avoid obscuration by vehicle equipment, the other pair may be relocated in order to be mounted symmetrically.

S8.2.4.2.3 If the rear window is so large as to occupy all the practicable space, the material may be attached to the edge of the window itself.

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S9 Associated equipment requirements.

S9.1 Turn signal operating unit.

S9.1.1 The turn signal operating unit installed on passenger cars, multipurpose passenger vehicles, trucks, and buses less than 2032 mm in overall width must be self-canceling by steering wheel rotation and capable of cancellation by a manually operated control.

S9.1.2 *Physical tests.* Each turn signal operating unit must be designed to conform to all applicable performance requirements of S14.9.

S9.2 Turn signal flasher.

S9.2.1 The means of producing the turn signal pilot indicator signal may be incorporated in the flasher. A means of producing an audible signal may be incorporated in the flasher.

S9.2.2 *Physical tests.* Each turn signal flasher must be designed to conform to all applicable performance requirements of S14.9.

S9.3 Turn signal pilot indicator.

S9.3.1 Each vehicle equipped with a turn signal operating unit where any turn signal lamp is not visible to the driver must also have an illuminated pilot indicator to provide a clear and unmistakable indication that the turn signal system is activated.

S9.3.2 The indicator must consist of one or more lights flashing at the same frequency as the turn signal lamps.

S9.3.3 The indicator must function satisfactorily under all test conditions imposed on the turn signal flasher in S14.9.

S9.3.4 Indicator size and color.

S9.3.4.1 If the indicator is located inside the vehicle it must emit a green colored light and have a minimum area equivalent to a $\frac{3}{16}$ in diameter circle.

S9.3.4.2 If the indicator is located outside of the vehicle it must emit a yellow light and have a minimum projected illuminated area of 0.1 sq in.

S9.3.5 The minimum required illuminated area of the indicator must be visible to any tangent on the 95th eyellipse as defined in SAE Recommended Practice J941b (1969) (incorporated by reference, see §571.5), with the steering wheel turned to a straight ahead driving position and in the design location for an adjustable wheel or column.

S9.3.6 *Turn signal lamp failure.* Failure of one or more turn signal lamps such that the minimum photometric performance specified in Tables VI or VII is not being met must be indicated by the turn signal pilot indicator by a “steady on”, “steady off”, or by a significant change in the flashing rate, except when a variable-load turn signal flasher is used on a multipurpose passenger vehicle, truck, or bus 2032 mm or more in overall width, on a truck that is capable of accommodating a slide in camper, or on any vehicle equipped to tow trailers.

S9.4 *Headlamp beam switching device.* Each vehicle must have a means of switching between lower and upper beams designed and located so that it may be operated conveniently by a simple movement of the driver's hand or foot. The switch must have no dead

point and, except as provided by S6.1.5.2, the lower and upper beams must not be energized simultaneously except momentarily for temporary signaling purposes or during switching between beams.

S9.4.1 *Semi-automatic headlamp beam switching device.* As an alternative to S9.4, a vehicle may be equipped with a semi-automatic means of switching between lower and upper beams.

S9.4.1.1 *Operating instructions.* Each semi-automatic headlamp switching device must include operating instructions to permit a driver to operate the device correctly including; how to turn the automatic control on and off, how to adjust the provided sensitivity control, and any other specific instructions applicable to the particular device.

S9.4.1.2 *Manual override.* The device must include a means convenient to the driver for switching to the opposite beam from the one provided.

S9.4.1.3 *Fail safe operation.* A failure of the automatic control portion of the device must not result in the loss of manual operation of both upper and lower beams.

S9.4.1.4 *Automatic dimming indicator.* There must be a convenient means of informing the driver when the device is controlling the headlamps automatically. The device shall not affect the function of the upper beam indicator light.

S9.4.1.5 *Lens accessibility.* The device lens must be accessible for cleaning when the device is installed on a vehicle.

S9.4.1.6 *Mounting height.* The center of the device lens must be mounted no less than 24 in. above the road surface.

S9.4.1.7 *Physical tests.* Each semi-automatic headlamp beam switching device must be designed to conform to all applicable performance requirements of S14.9.

S9.5 *Upper beam headlamp indicator.* Each vehicle must have a means for indicating to the driver when the upper beams of the headlighting system are activated.

S9.5.1 *Indicator size and location.* The upper beam headlamp indicator must have a minimum area equivalent to that of a $\frac{3}{16}$ in diameter circle, and be plainly visible to drivers of all heights under normal driving conditions when headlamps are required.

S9.6 Vehicular hazard warning signal operating unit.

S9.6.1 The unit may be an independent device or it may be combined with the turn signal operating unit. If combined with the turn signal operating unit, the actuating motion of the hazard function must differ from the actuating motion of the turn signal function.

S9.6.2 *Operating unit switch.* The unit must operate independently of the ignition or equivalent switch. If the actuation of the hazard function requires the operation of more than one switch, a means must be provided for actuating all switches simultaneously by a single driver action.

S9.6.3 *Physical tests.* Each vehicular hazard warning signal operating unit must be designed to conform to all applicable performance requirements of S14.9.

S9.7 Vehicular hazard warning signal flasher.

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S9.7.1 The means of producing the hazard warning signal pilot indicator signal may be incorporated in the flasher. A means of producing an audible signal may be incorporated in the flasher.

S9.7.2 *Physical tests.* Each vehicular hazard warning signal flasher must be designed to conform to all applicable performance requirements of S14.9.

S9.8 *Vehicular hazard warning signal pilot indicator.*

S9.8.1 In vehicles equipped with right hand and left hand turn signal pilot indicators, both pilot indicators and /or a separate pilot indicator must flash simultaneously while the vehicle hazard warning signal operating unit is turned on.

S9.8.2 In vehicles equipped with a single turn signal pilot indicator, a separate vehicular hazard warning signal pilot indicator must flash and the turn signal pilot indicator may flash while the vehicle hazard warning signal operating unit is turned on.

S9.8.3 The indicator must function satisfactorily under all test conditions imposed on the vehicular hazard warning signal flasher in S14.9.

S9.8.4 *Indicator size and color.* If the vehicular hazard warning signal pilot indicator is not combined with the turn signal pilot indicator, it must emit a red color and have a minimum area equivalent to a 0.5 in diameter circle.

S10 *Headlighting system requirements*

S10.1 *Vehicle headlighting systems.*

S10.1.1 Each passenger car, multipurpose passenger vehicle, truck and bus must be equipped with a headlighting system conforming to the requirements of Table II and this standard.

S10.1.2 Each motorcycle must be equipped with a headlighting system conforming to S10.17 of this standard.

S10.2 [Reserved]

S10.3 *Number.* See Tables I-a and I-c.

S10.4 *Color of light.* See Tables I-a and I-c.

S10.5 *Mounting location.* See Tables I-a and I-c and S6.1.3.5.

S10.6 *Mounting height.* See Tables I-a and I-c.

S10.7 *Activation.* See Tables I-a and I-c, Table II, and S6.1.5.

S10.8 *Effective projected luminous lens area.* No requirement.

S10.9 *Visibility.* No requirement.

S10.10 *Indicator.* See S9.5.

S10.11 *Markings.* See S6.5.

S10.12 *Spacing to other lamps.* See S6.1.3.5.

S10.13 *Sealed beam headlighting systems.* All sealed beam headlighting systems must be of a type designated in Table II-a. Each sealed beam headlamp must be designed to conform to the specifications furnished with respect to it pursuant to Appendix C of part 564 of this chapter and Table II-a of this standard. The dimensions applicable to the design of a specific type are those identified with an "I" for interchangeability specified on the applicable drawing(s) filed in Docket No. NHTSA 98-3397.

S10.13.1 *Installation.* A sealed beam headlighting system must consist of the correct number of designated headlamp units as specified for the applicable system in Table II-a. The units must have their beams activated as specified in Table II-a. A system must provide in total not more than two upper beams and two lower beams.

S10.13.2 *Simultaneous aim.* Type F sealed beam headlamps may be mounted on common or parallel seating and aiming planes to permit simultaneous aiming of both headlamps provided that there is no provision for adjustment between the common or parallel aiming and seating planes of the two lamps. When tested with any conforming Type UF and LF headlamps in accordance with S14.2.5, the assembly (consisting of the Type UF and LF headlamps, mounting rings, the aiming/seating rings, and aim adjustment mechanism) must be designed to conform to the applicable photometric requirements.

S10.13.3 *Photometry.* Each sealed beam headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-a for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5.

S10.13.4 *Physical tests.*

S10.13.4.1 Each sealed beam headlamp must be designed to conform to the performance requirements of the corrosion test, vibration test, inward force test (for lamps which are externally aimed only), torque deflection test (for lamps which are externally aimed only), headlamp connector test, headlamp wattage test, and aiming adjustment tests of S14.6.

S10.13.4.2 Each sealed beam headlamp except a Type G or Type H must be designed to conform to the performance requirements of the retaining ring test of S14.6.

S10.13.4.3 Each sealed beam headlamp must be designed to conform to the performance requirements of the color test of S14.4. Each sealed beam headlamp that does not incorporate a glass lens must be designed to conform to the plastic optical materials test of S14.4.

S10.14 *Integral beam headlighting systems.* All integral beam headlighting systems must be of a type designated in Table II-c.

S10.14.1 *Installation.* An integral beam headlighting system must consist of the correct number of designated headlamp units as specified for the applicable system in Table II-c. The units must have their beams activated as specified in Table II-c. A system must provide in total not more than two upper beams and two lower beams.

S10.14.2 *Aimability.*

S10.14.2.1 A system that incorporates any headlamp or beam contributor that does not have a VHAD as an integral and indivisible part of the headlamp or beam contributor must be designed so that the applicable photometric requirements are met when any correctly aimed and photometrically conforming headlamp or beam contributor is removed from its mounting and aiming mechanism, and is replaced without reaim by any conforming headlamp or beam contributor of the same type.

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S10.14.2.2 A system that incorporates more than one beam contributor providing a lower beam, and/or more than one beam contributor providing an upper beam, shall be designed to conform to the on-vehicle aiming requirements specified in S10.18.8.

S10.14.3 *Simultaneous aim.* An integral beam headlighting system consisting of four individual headlamps or beam contributors may have the headlamp units mounted in an assembly to permit simultaneous aiming of the beam(s) contributors, providing that with any complying contributor the assembly complete with all lamps meets the applicable photometric requirements when tested in accordance with S14.2.5.

S10.14.4 *Markings.* An integral beam headlamp with a single light source providing the lower beam must have its lens permanently marked with “L”. An integral beam headlamp with a single light source providing the upper beam must have its lens permanently marked with “U”.

S10.14.5 *Additional light sources.* An integral beam headlamp may incorporate light sources that are used for purposes other than headlighting and are capable of being replaced.

S10.14.6 *Photometry.* Each integral beam headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-c for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5.

S10.14.7 *Physical tests.*

S10.14.7.1 Each integral beam headlamp must be designed to conform to the performance requirements of the corrosion test, temperature cycle test, vibration test, inward force test (for lamps which are externally aimed only), headlamp connector test, and aiming adjustment tests of S14.6.

S10.14.7.2 Each integral beam headlamp that is not designed to conform to the performance requirements of the sealing test of S14.6 must be designed to conform to the performance requirements of the connector-corrosion test, dust test, and humidity test of S14.6.

S10.14.7.3 Each integral beam headlamp except those with a glass lens must be designed to conform to the performance requirements of the abrasion test of S14.6.

S10.14.7.4 Each integral beam headlamp except those with a nonreplaceable glass lens must be designed to conform to the performance requirements of the chemical resistance test of S14.6.

S10.14.7.5 Each integral beam headlamp except those with a glass lens and a non-plastic reflector must be designed to conform to the performance requirements of the internal heat test of S14.6.

S10.14.7.6 Each integral beam headlamp incorporating a replaceable lens must be designed to conform to the performance requirements of the chemical resistance of reflectors of replaceable lens headlamps test and the corrosion resistance of reflectors of replaceable lens headlamps test of S14.6.

S10.14.7.7 Each integral beam headlamp capable of being mechanically aimed by externally applied head-

lamp aiming devices specified in SAE Recommended Practice J602-1980 (incorporated by reference, see §571.5), must be designed to conform to the performance requirements of the torque deflection test of S14.6.

S10.14.7.8 Each integral beam headlamp must be designed to conform to the performance requirements of the color test of S14.4. Each integral beam headlamp that does not incorporate a glass lens must be designed to conform to the performance requirements of the plastic optical materials test of S14.4.

S10.15 *Replaceable bulb headlighting systems.* All replaceable bulb headlighting systems must be of a type designated in Table II-d.

S10.15.1 *Installation.* A replaceable bulb headlighting system must consist of either two or four headlamps as specified for the applicable system in Table II-d. The headlamps must have their beams activated as specified in Table II-d. A system must provide in total not more than two upper beams and two lower beams and must incorporate not more than two replaceable light sources in each headlamp.

S10.15.2 *Aiming restrictions.* Each replaceable bulb headlamp designed to conform to the external aiming requirements of S10.18.7 must have no mechanism that allows adjustment of an individual light source, or if there are two light sources, independent adjustments of each reflector.

S10.15.3 *Replacement lens reflector units.* Each lens reflector unit manufactured as replacement equipment must be designed to conform to applicable photometry requirements when any replaceable light source designated for such a unit is inserted in it.

S10.15.4 *Markings.*

S10.15.4.1 A replaceable bulb headlamp in a four headlamp system providing lower beam must have its lens permanently marked with “L”. A replaceable bulb headlamp in a four headlamp system providing upper beam must have its lens permanently marked with “U”.

S10.15.4.1.1 No such markings are required if the light sources in the headlamp are any combination of dual filament light sources other than HB2.

S10.15.5 *Additional light sources.* A replaceable bulb headlamp may incorporate replaceable light sources that are used for purposes other than headlighting.

S10.15.6 *Photometry.* Each replaceable bulb headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-d for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5 using any replaceable light source designated for use in the system under test.

S10.15.7 *Physical tests.*

S10.15.7.1 Each replaceable bulb headlamp must be designed to conform to the performance requirements of the corrosion test, corrosion-connector test, dust test, temperature cycle test, humidity test, vibration test, inward force test (for lamps which are externally aimed only), headlamp connector test, and aiming adjustment tests of S14.6.

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S10.15.7.2 Each replaceable bulb headlamp except those with a glass lens must be designed to conform to the performance requirements of the abrasion test of S14.6.

S10.15.7.3 Each replaceable bulb headlamp except those with a nonreplaceable glass lens must be designed to conform to the performance requirements of the chemical resistance test of S14.6.

S10.15.7.4 Each replaceable bulb headlamp except those with a glass lens and a non-plastic reflector must be designed to conform to the performance requirements of the internal heat test of S14.6.

S10.15.7.5 Each replaceable bulb headlamp incorporating a replaceable lens must be designed to conform to the performance requirements of the chemical resistance of reflectors of replaceable lens headlamps test and the corrosion resistance of reflectors of replaceable lens headlamps test of S14.6.

S10.15.7.6 Each replaceable bulb headlamp capable of being mechanically aimed by externally applied headlamp aiming devices specified in SAE Recommended Practice J602-1980 (incorporated by reference, see §571.5), must be designed to conform to the performance requirements of the torque deflection test of S14.6.

S10.15.7.7 Each replaceable bulb headlamp must be designed to conform to the performance requirements of the color test of S14.4. Each replaceable bulb headlamp that does not incorporate a glass lens must be designed to conform to the performance requirements of the plastic optical materials test of S14.4.

S10.16 *Combination headlighting systems.* All combination headlighting systems must be of a type designated in Table II-b.

S10.16.1 *Installation.* A combination headlighting system must consist of the correct number of designated headlamp units as specified for the applicable system in Table II-b. The units must have their beams activated as specified in Table II-b. A system must provide in total not more than two upper beams and two lower beams. When installed on a motor vehicle, the headlamps (or parts thereof) that provide the lower beam must be of the same type, and provide a symmetrical effective projected luminous lens area when illuminated.

S10.16.2 *Photometry.* Each combination headlamp must be designed to conform to the photometry requirements of Table XVIII for upper beam and Table XIX for lower beam as specified in Table II-b for the specific headlamp unit and aiming method, when tested according to the procedure of S14.2.5.

S10.16.3 *Physical tests.*

S10.16.3.1 Any component headlamp of a combination headlighting system that is a Type F sealed beam headlamp must be designed to conform to the performance requirements of S10.13.4.

S10.16.3.2 Any component headlamp of a combination headlighting system that is an integral beam headlamp must be designed to conform to the performance requirements of S10.14.7.

S10.16.3.3 Any component headlamp of a combination headlighting system that is a replaceable bulb

headlamp must be designed to conform to the performance requirements of S10.15.7.

S10.17 *Motorcycle headlighting systems.* A motorcycle headlighting system may consist of:

(a) One half of any headlighting system of Table II which provides both a full upper beam and full lower beam, and is designed to conform to the requirements for that headlamp type. Where more than one lamp must be used, the lamps shall be mounted vertically, with the lower beam as high as practicable, or

(b) A headlighting system designed to conform to the requirements of paragraphs S10.17.1 through S10.17.5.

S10.17.1 *Installation.* The headlighting system installed on a motorcycle must consist of one of the system types specified in this paragraph, and must be located on the front.

S10.17.1.1 *Single headlamp.*

S10.17.1.1.1 If the system consists of a single headlamp, it must be mounted on the vertical centerline of the motorcycle.

S10.17.1.1.2 If the headlamp contains more than one light source, each light source must be mounted on the vertical centerline with the upper beam no higher than the lower beam, or horizontally disposed about the vertical centerline and mounted at the same height.

S10.17.1.1.3 If the light sources are horizontally disposed about the vertical centerline, the distance between the closest edges of the effective projected luminous lens area in front of the light sources must not be greater than 200 mm.

S10.17.1.2 *Two headlamps with both beams.*

S10.17.1.2.1 If the system consists of two headlamps, each of which provides both an upper and lower beam, the headlamps must be mounted either at the same height and symmetrically disposed about the vertical centerline or mounted on the vertical centerline.

S10.17.1.2.2 If the headlamps are horizontally disposed about the vertical centerline, the distance between the closest edges of their effective projected luminous lens areas must not be greater than 200 mm.

S10.17.1.3 *Two headlamps, upper beam and lower beam.*

S10.17.1.3.1 If the system consists of two headlamps, one of which provides an upper beam and one of which provides the lower beam, the headlamps must be located on the vertical centerline with the upper beam no higher than the lower beam, or horizontally disposed about the vertical centerline and mounted at the same height.

S10.17.1.3.2 If the headlamps are horizontally disposed about the vertical centerline, the distance between the closest edges of their effective projected luminous lens areas must not be greater than 200 mm.

S10.17.2 *Motorcycle replaceable bulb headlamp marking.* Each replaceable bulb headlamp that is designed to conform to S10.17(b) and that is equipped with a light source other than a replaceable light source meeting the requirements of S11, must have the word "motorcycle" permanently marked on the lens in characters not less than 3 mm in height.

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S10.17.3 *Photometry*. Each motorcycle headlamp that is not designed to conform to S10.17(a), must be designed to conform to the photometry requirements of Table XX when tested according to the procedure of S14.2.5.

S10.17.4 *Physical tests*. Each motorcycle headlamp that is not designed to conform to S10.17(a) must be designed to conform to the performance requirements of the vibration test, moisture test, dust test, and corrosion test of S14.5, the out of focus test of S14.3, the color test of S14.4, and each motorcycle headlamp that does not incorporate a glass lens must be designed to conform to the performance requirements of the plastic optical materials test of S14.4.

S10.17.5 *Motorcycle headlamp modulation system*. A headlamp on a motorcycle may be activated to modulate either the upper beam or the lower beam from its maximum intensity to a lesser intensity, provided that:

S10.17.5.1 *Modulation*.

(a) The rate of modulation must be 240 ± 40 cycles per minute.

(b) The headlamp must be operated at maximum power for 50 to 70 percent of each cycle.

(c) The lowest intensity at any test point must be not less than 17 percent of the maximum intensity measured at the same point.

(d) The modulator switch must be wired in the power lead of the beam filament being modulated and not in the ground side of the circuit.

(e) Means must be provided so that both the lower beam and upper beam remain operable in the event of a modulator failure.

(f) The system must include a sensor mounted with the axis of its sensing element perpendicular to a horizontal plane. Headlamp modulation must cease whenever the level of light emitted by a tungsten filament light operating at 3000° Kelvin is either less than 270 lux of direct light for upward pointing sensors or less than 60 lux of reflected light for downward pointing sensors. The light is measured by a silicon cell type light meter that is located at the sensor and pointing in the same direction as the sensor. A Kodak Gray Card (Kodak R-27) is placed at ground level to simulate the road surface in testing downward pointing sensors.

(g) When tested in accordance with the test profile shown in Figure 9, the voltage drop across the modulator when the lamp is on at all test conditions for 12 volt systems and 6 volt systems must not be greater than 0.45 volt. The modulator must meet all the provisions of the standard after completion of the test profile shown in Figure 9.

(h) Means must be provided so that both the lower and upper beam function at design voltage when the headlamp control switch is in either the lower or upper beam position when the modulator is off.

S10.17.5.2 *Replacement modulators*. Each modulator not intended as original equipment, or its container, must be labeled with the maximum wattage, and the minimum wattage appropriate for its use.

S10.17.5.2.1 *Replacement performance*. Each modulator, not intended as original equipment, must comply with S10.17.5.1 (a) through (g) when connected to a headlamp of the maximum rated power and a headlamp of the minimum rated power, and must provide means so that the modulated beam functions at design voltage when the modulator is off.

S10.17.5.2.2 *Replacement instructions*. Instructions, with a diagram, must be provided for mounting the light sensor including location on the motorcycle, distance above the road surface, and orientation with respect to the light.

S10.18 *Headlamp aimability performance requirements (except for motorcycles)*.

S10.18.1 *Headlamp mounting and aiming*. Except as provided in this paragraph, each headlamp must be installed on a motor vehicle with a mounting and aiming mechanism that permits aim inspection and adjustment of both vertical and horizontal aim, and is accessible for those purposes without removal of any vehicle parts, except for protective covers removable without the use of tools.

S10.18.1.1 The axis of the light beams must be adjustable to the left, right, up, or down from the designed setting, the amount of adjustability to be determined by practical operating conditions and the type of equipment.

S10.18.1.2 The adjustments must be conveniently made by one person with tools ordinarily available. When the headlamps are secured, the aim will not be disturbed under ordinary conditions of service.

S10.18.2 *Headlamp aiming systems*. When a headlamp system is installed on a motor vehicle, it must be aimable with at least one of the following: An externally applied aiming device, as specified in S10.18.7; an on-vehicle headlamp aiming device installed by the vehicle or lamp manufacturer, as specified in S10.18.8; or by visual/optical means, as specified in S10.18.9.

S10.18.3 *Aim adjustment interaction*. When installed on the vehicle, adjustment of one aim axis through its full on-vehicle range must not cause the aim of the other axis to deviate more than $\pm 0.76^\circ$. If the performance specified is not achievable, the requirements of S10.18.3.1 apply, except that if the aiming mechanism is not a VHAD, the requirements specific to VHADs are not applicable, and the instruction must be specific to the aiming mechanism installed.

S10.18.3.1 Should the mechanism not meet the requirements of S10.18.3, a cautionary label must be placed adjacent to the mechanism stating the caution and including either the reason for the caution or the corrective action necessary. Each such label must also refer the reader to the vehicle operator's manual for complete instructions. Each such vehicle must be equipped with an operator's manual containing the complete instructions appropriate for the mechanism installed.

S10.18.4 *Horizontal adjustment-visually aimed headlamp*. A visually/optically aimable headlamp that has a lower beam must not have a horizontal adjustment

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mechanism unless such mechanism meets the requirements of this standard for on vehicle aiming as specified in S10.18.8.

S10.18.5 *Optical axis marking.*

S10.18.5.1 *Optical axis marking-vehicle.* Each motor vehicle must be equipped with headlamps or beam contributors which have a mark or markings that are visible from the front of the headlamp when installed on the vehicle to identify the optical axis of the headlamp to assure proper horizontal and vertical alignment of the aiming screen or optical aiming equipment. The manufacturer is free to choose the design of the mark or markings. The mark or markings may be on the interior or exterior of the lens or indicated by a mark or central structure on the interior or exterior of the headlamp.

S10.18.5.2 *Optical axis marking-lamp.* Each headlamp or beam contributor that is not visually/optically aimable in accordance with S10.18.9 of this standard must be equipped with fiducial marks, aiming pads, or similar references of sufficient detail and accuracy, for determination of an appropriate vehicle plane to be used with the photometric procedures of S14.2.5 for correct alignment with the photometer axis when being tested for photometric compliance, and to serve for the aiming reference when the headlamp or beam contributor is installed on a motor vehicle. The fiducial marks, aiming pads, or similar references are protrusions, bubble vials, holes, indentations, ridges, scribed lines, or other readily identifiable marks established and described by the vehicle or headlamp manufacturer.

S10.18.5.3 *Optical axis marking-visual/optical aim headlamp.* There must be a mark or markings identifying the optical axis of the headlamp visible from the front of the headlamp when installed on the vehicle, to assure proper horizontal and vertical alignment of the aiming screen or optical aiming equipment with the headlamp being aimed. The manufacturer is free to choose the design of the mark or markings. The mark or markings may be on the interior or exterior of the lens or indicated by a mark or central structure on the interior or exterior of the headlamp.

S10.18.6 *Moveable reflectors.* Each headlamp aimed by moving the reflector relative to the lens and headlamp housing, or vice versa, must conform with the photometric requirements applicable to it when tested according to the procedure of S14.2.5 with the lens at any position relative to the reflector within the full range of vertical pitch on the vehicle on which the headlamp system is installed and a horizontal range of $\pm 2.5^\circ$. Additionally it must comply with the aiming adjustment requirements of S14.6.

S10.18.7 *External aiming.* Each headlighting system that is capable of being mechanically aimed by externally applied headlamp aiming devices must be mechanically aimable using the equipment specified in SAE Recommended Practice J602-1980 (incorporated by reference, see §571.5), without the removal of any ornamental trim rings, covers, wipers or other vehicle parts.

S10.18.7.1 *Headlamp aiming device locating plates.* Each headlighting system which is designed to use the Headlamp Aiming Device Locating Plates with adjust-

able legs for the 100×165 mm unit and the 142×200 mm unit, and which has adjustable length legs, must meet the following requirements:

S10.18.7.1.1 The lens must have three aiming pads which meet the requirements of Figure 4, *Dimensional Specifications for Location of Aiming Pads on Replaceable Bulb Headlamp Units*. The aiming pads need not be centered at the geometric center of the lens, or on the optical axis. Except as provided in S10.18.7.1.2, a whole number, which represents the distance in tenths of an inch (i.e. 0.3 inch = 3) from the aiming reference plane to the respective aiming pads which are not in contact with that plane, must be inscribed adjacent to each respective aiming pad on the lens. The height of these numbers must be not less than .157 inch (4 mm). If there is interference between the plane and the area of the lens between the aiming pads, the whole number represents the distance to a secondary plane. The secondary plane must be located parallel to the aiming reference plane and as close to the lens as possible without causing interference.

S10.18.7.1.2 If the most forward aiming pad is the lower inboard aiming pad, then the dimensions may be placed anywhere on the lens. The dimension for the outboard aiming pad (Dimension F in Figure 4) must be followed by the letter "H" and the dimension for the center aiming pad must be followed by the letter "V." The dimensions must be expressed in tenths of an inch.

S10.18.7.2 *Nonadjustable headlamp aiming device locating plates.* Each headlamp may be designed to use the nonadjustable Headlamp Aiming Device Locating Plate for the 100 × 165 mm unit, the 142 × 200 mm unit, the 146 mm diameter unit, or the 178 mm diameter unit of SAE Recommended Practice J602-1980 (incorporated by reference, see §571.5), or the 92 × 150 mm Type F unit, and incorporate lens-mounted aiming pads as specified for those units pursuant to Appendix C of part 564 of this chapter. If so designed, no additional lens marking is necessary to designate the type of plate or dimensions.

S10.18.8 *On-vehicle aiming.* Each headlighting system that is capable of being aimed by equipment installed on the vehicle must include a Vehicle Headlamp Aiming Device (VHAD) that conforms to the following requirements:

S10.18.8.1 *Aim.* The VHAD must provide for headlamp aim inspection and adjustment in both the vertical and horizontal axes.

S10.18.8.1.1 *Vertical aim.* The VHAD must include the necessary references and scales relative to the horizontal plane to assure correct vertical aim for photometry and aiming purposes. An off vehicle measurement of the angle of the plane of the ground is permitted. In addition, an equal number of graduations from the "0" position representing angular changes in the axis in the upward and downward directions must be provided.

S10.18.8.1.1.1 Each graduation must represent a change in the vertical position of the mechanical axis not larger than 0.19° (1 in at 25 ft) to provide for variations in aim at least 1.2° above and below the horizontal, and have an accuracy relative to the zero mark of less than 0.1° .

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S10.18.8.1.1.2 The VHAD must be marked to indicate headlamp aim movement in the upward and downward directions.

S10.18.8.1.1.3 Each graduation must indicate a linear movement of the scale indicator of not less than 0.05 in (1.27 mm) if a direct reading analog indicator is used. If a remote reading indicator is provided, it must represent the actual aim movement in a clear, understandable format.

S10.18.8.1.1.4 The vertical indicator must perform through a minimum range of $\pm 1.2^\circ$.

S10.18.8.1.1.5 Means must be provided in the VHAD for compensating for deviations in floor slope less than 1.2° from the horizontal that would affect the correct positioning of the headlamp for vertical aim.

S10.18.8.1.1.6 The graduations must be legible under an illumination level not greater than 30 foot candles, measured at the top of the graduation, by an observer having 20/20 vision (Snellen), and must permit aim adjustment to within 0.19° (1 in at 25 ft).

S10.18.8.1.2 *Horizontal aim.* The VHAD must include references and scales relative to the longitudinal axis of the vehicle necessary to assure correct horizontal aim for photometry and aiming purposes. An “0” mark must be used to indicate alignment of the headlamps relative to the longitudinal axis of the vehicle. In addition, an equal number of graduations from the “0” position representing equal angular changes in the axis relative to the vehicle axis must be provided.

S10.18.8.1.2.1 Each graduation must represent a change in the horizontal position of the mechanical axis not greater than 0.38° (2 in at 25 ft) to provide for variations in aim at least 0.76° (4 in at 25 ft) to the left and right of the longitudinal axis of the vehicle, and must have an accuracy relative to the zero mark of less than 0.1° .

S10.18.8.1.2.2 The VHAD must be marked to indicate headlamp aim movement in the left and right directions.

S10.18.8.1.2.3 The graduations must be legible under an illumination level not greater than 30 foot candles, measured at the top of the graduation, by an observer having 20/20 vision (Snellen), and must permit aim adjustment to within 0.38° (2 in at 25 ft).

S10.18.8.1.2.4 The horizontal indicator must perform through a minimum range of $\pm 0.76^\circ$ (4 in at 25 ft); however, the indicator itself must be capable of recalibration over a movement of $\pm 2.5^\circ$ relative to the longitudinal axis of the vehicle to accommodate any adjustment necessary for recalibrating the indicator after vehicle repair from accident damage.

S10.18.8.2 *Aiming instructions.*

S10.18.8.2.1 The instructions for properly aiming the headlighting system using the VHAD must be provided on a label permanently affixed to the vehicle adjacent to the VHAD, or in the vehicle operator’s manual. The instructions must advise that the headlighting system is properly aimed if the appropriate vertical plane (as defined by the vehicle manufacturer) is perpendicular to both the longitudinal axis of the vehicle, and a horizon-

tal plane when the vehicle is on a horizontal surface, and the VHAD is set at “0” vertical and “0” horizontal.

S10.18.8.2.2 Should a remote indicator or a remote indicator and adjuster be provided, the instructions must be placed in the operator’s manual, and may also be placed on a label adjacent to the VHAD.

S10.18.8.3 *Permanent calibration.* Each headlamp equipped with a VHAD must be manufactured with its calibration permanently fixed by its manufacturer. Calibration in this case means the process of accurately aligning the geometry of the VHAD devices with the beam pattern for the purposes of compliance with the standard.

S10.18.8.4 *Replacement units.* When tested according to the procedure of S14.2.5 with any replacement headlamp unit(s) or light sources intended for use in the system under test, the VHAD and headlighting system must be designed to conform to the photometric performance requirements applicable for the system under test.

S10.18.8.5 *Physical tests.* Each VHAD must be designed to conform with the performance requirements of S14.8.

S10.18.9 *Visual/optical aiming.* Each visually/optically aimable headlamp must be designed to conform to the following requirements:

S10.18.9.1 *Vertical aim, lower beam.* Each lower beam headlamp must have a cutoff in the beam pattern. It may be either on the left side or the right side of the optical axis, but once chosen for a particular headlamp system’s design, the side chosen for the cutoff must not be changed for any headlamps intended to be used as replacements for those system’s headlamps.

S10.18.9.1.1 *Vertical position of the cutoff.* The headlamp must be aimed vertically so that the cutoff is on the left side, at 0.4° down from the H-H line, or on the right side, at the H-H line.

S10.18.9.1.2 *Vertical gradient.* The gradient of the cutoff measured at either 2.5° L or 2.0° R must be not less than 0.13 based on the procedure of S10.18.9.1.5.

S10.18.9.1.3 *Horizontal position of the cutoff.* The width must be not less than 2° , with not less than 2° of its actual width centered at either 2.5° L, or 2.0° R.

S10.18.9.1.4 *Maximum inclination of the cutoff.* The vertical location of the highest gradient at the ends of the minimum width must be within $\pm 0.2^\circ$ of the vertical location of the maximum gradient measured at the appropriate vertical line (at either 2.5° L for a left side cutoff, or 2.0° R for a right side cutoff).

S10.18.9.1.5 *Measuring the cutoff parameter.*

S10.18.9.1.5.1 The headlamp is mounted on a headlamp test fixture which simulates its actual design location on any vehicle for which the headlamp is intended. The fixture, with the headlamp installed, is attached to the goniometer table in such a way that the fixture alignment axes are coincident with the goniometer axes. The headlamp is energized at the specified test voltage. The cutoff parameter must be measured at a distance of 10 m from a photosensor with a 10 mm diameter.

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S10.18.9.1.5.2 The headlamp beam pattern is aimed with the cutoff at the H-H axis. There is no adjustment, shimming, or modification of the horizontal axis of the headlamp or test fixture, unless the headlamp is equipped with a VHAD. In this case the VHAD is adjusted to zero.

S10.18.9.1.5.3 A vertical scan of the beam pattern is conducted for a headlamp with a left side gradient by aligning the goniometer on a vertical line at 2.5° L and scanning from 1.5° U to 1.5° D. For a headlamp with a right side gradient, a vertical scan of the beam pattern is conducted by aligning the goniometer on a vertical line at 2.0° R and scanning from 1.5° U to 1.5° D.

S10.18.9.1.5.4 Determine the maximum gradient within the range of the scan by using the formula: $G = \log E(a) - \log E(a + 0.1)$, where “G” is the gradient, “E” is illumination and “a” is vertical angular position. The maximum value of the gradient “G” determines the vertical angular location of the cutoff. Perform vertical scans at 1.0° L and R of the measurement point of the maximum gradient to determine the inclination.

S10.18.9.2 *Horizontal aim, lower beam.* There is no adjustment of horizontal aim unless the headlamp is equipped with a horizontal VHAD. If the headlamp has a VHAD, it is set to zero.

S10.18.9.3 *Vertical aim, upper beam.*

S10.18.9.3.1 If the upper beam is combined in a headlamp with a lower beam, the vertical aim of the upper beam must not be changed from the aim set using the procedures of S10.18.9.1 and S10.18.9.2 used for the lower beam.

S10.18.9.3.2 If the upper beam is not combined in a headlamp with a lower beam, the vertical aim of the upper beam is adjusted so that the maximum beam intensity is located on the H-H axis.

S10.18.9.4 *Horizontal aim, upper beam.*

S10.18.9.4.1 If the upper beam is combined in a headlamp with a lower beam, the horizontal aim of the upper beam must not be changed from the aim set using the procedures of S10.18.9.1 and S10.18.9.2 used for the lower beam.

S10.18.9.4.2 If the upper beam is not combined in a headlamp with the lower beam and has fixed horizontal aim or has a horizontal VHAD, then the headlamp is mounted on a headlamp test fixture which simulates its actual design location on any vehicle for which the headlamp is intended. The fixture, with the headlamp installed, is attached to the goniometer table in such a way that the fixture alignment axes are coincident with the goniometer axes. The headlamp must be energized at 12.8 ± 0.20 mV. There is no adjustment, shimming, or modification of the horizontal axis of the headlamp or test fixture, unless the headlamp is equipped with a VHAD. In this case the VHAD is adjusted to zero.

S10.18.9.4.3 If the upper beam is not combined in a headlamp with a lower beam, and it does not have a VHAD, the horizontal aim of the upper beam is adjusted so that the maximum beam intensity is located on the V-V axis.

S10.18.9.5 *Photometry.* When tested according to the procedure of S14.2.5, a visually/optically aimable head-

lamp must be designed to conform to the lower beam requirements of columns; LB1V or LB2V of Table XIX-a, or LB3V of Table XIX-b, or LB4V of Table XIX-c.

S10.18.9.6 *Visual/optical aiming identification marking.* Each letter used in marking according to this paragraph must be not less than 3 mm high.

S10.18.9.6.1 The lens of a lower beam headlamp must be marked “VOL” if the headlamp is intended to be visually/optically aimed using the left side of the lower beam pattern. The lens of a lower beam headlamp must be marked “VOR” if the headlamp is intended to be visually/optically aimed using the right side of the lower beam pattern. The lens of a headlamp that is solely an upper beam headlamp and intended to be visually/optically aimed using the upper beam must be marked “VO”.

S10.18.9.6.2 The lens of each sealed beam or integral beam headlamp must be marked “VOR” if the headlamp is of a type that was manufactured before May 1, 1997, and if such headlamp type has been redesigned since then to be visually/optically aimable.

S11 *Replaceable light source requirements.* Each replaceable light source must be designed to conform to the dimensions and electrical specifications furnished with respect to it pursuant to part 564 of this chapter, on file in Docket No. NHTSA 98-3397, and must conform to the following requirements:

S11.1 *Markings.* If other than an HB Type, the light source must be marked with the bulb marking designation specified for it in compliance with Appendix A or Appendix B of part 564 of this chapter. The base of each HB Type must be marked with its HB Type designation. Each replaceable light source must also be marked with the symbol DOT and with a name or trademark in accordance with S6.5.

S11.2 *Ballast markings.* If a ballast is required for operation, each ballast must bear the following permanent markings:

- (a) Name or logo of ballast manufacturer;
- (b) Ballast part number or unique identification;
- (c) Part number or other unique identification of the light source for which the ballast is designed;
- (d) Rated laboratory life of the light source/ballast combination, if the information for the light source has been filed in Appendix B of part 564 of this chapter;
- (e) A warning that ballast output voltage presents the potential for severe electrical shock that could lead to permanent injury or death;
- (f) Ballast output power in watts and output voltage in rms volts AC or DC; and
- (g) The symbol ‘DOT’.

S11.3 *Gas discharge laboratory life.* For light sources that use excited gas mixtures as a filament or discharge arc, the “rated laboratory life” is determined in accordance with sections 4.3 and 4.9 of SAE Recommended Practice J2009 FEB93, Forward Discharge Lighting Systems (incorporated by reference, see 571.108 S5.2 of this title).

S11.4 *Physical tests.*

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S11.4.1 Each replaceable light source must be designed to conform with the performance requirements of the deflection test and pressure test requirements of S14.7.

S11.4.2 Replaceable light sources must be designed to conform with the requirements of section VII of Appendix A of part 564 of this chapter, or section IV of Appendix B of part 564 of this chapter, for maximum power and luminous flux when test by the procedure of S14.7.3.

S12 Headlamp concealment device requirements.

S12.1 While the headlamp is illuminated, its fully opened headlamp concealment device must remain fully opened should any loss of power to or within the headlamp concealment device occur.

S12.2 Whenever any malfunction occurs in a component that controls or conducts power for the actuation of the concealment device, each closed headlamp concealment device must be capable of being fully opened by a means not requiring the use of any tools. Thereafter, the headlamp concealment device must remain fully opened until intentionally closed.

S12.3 Except for malfunctions covered by S12.2, each headlamp concealment device must be capable of being fully opened and the headlamps illuminated by actuation of a single switch, lever, or similar mechanism, including a mechanism that is automatically actuated by a change in ambient light conditions.

S12.4 Each headlamp concealment device must be installed so that the headlamp may be mounted, aimed, and adjusted without removing any component of the device, other than components of the headlamp assembly.

S12.5 Except for cases of malfunction covered by S12.2, each headlamp concealment device must, within an ambient temperature range of -20°F to $+120^{\circ}\text{F}$, be capable of being fully opened in not more than 3 seconds after the actuation of a driver-operated control.

S12.6 As an alternative to complying with the requirements of S12.1 through S12.5, a vehicle with headlamps incorporating VHAD or visual/optical aiming in accordance with this standard may meet the requirements for concealable lamps in paragraph 5.14 of UNECE Regulation 48 page 17 (incorporated by reference, see §571.5), in the English language version.

S12.7 *Certification election.* Manufacturers of vehicles with headlamps incorporating VHAD or visual/optical aiming must elect to certify to S12.1 through S12.5 or to S12.6 prior to, or at the time of certification of the vehicle, pursuant to 49 CFR Part 567. The selection is irrevocable.

S13 Replaceable headlamp lens requirements.

S13.1 A replacement lens for a replaceable bulb headlamp or integral beam headlamp that is not required to have a bonded lens must be provided with a replacement seal in a package that includes instructions for the removal and replacement of the lens, the cleaning of the reflector, and the sealing of the replacement lens to the reflector assembly.

S13.2 Each replacement headlamp lens with seal, when installed according to the lens manufacturer's in-

structions on an integral beam or replaceable bulb headlamp, must not cause the headlamp to fail to comply with any of the requirements of this standard.

S14 Physical and photometry test procedures and performance requirements.

S14.1 General test procedures and performance requirements.

S14.1.1 Each lamp, reflective device, item of conspicuity treatment, and item of associated equipment required or permitted by this standard must be designed to conform to all applicable physical test performance requirements specified for it.

S14.1.2 *Plastic optical materials.* All plastic materials used for optical parts such as lenses and reflectors on lamps or reflective devices required or allowed by this standard must conform to the material test requirements of S14.4.2.

S14.1.3 All coatings used on optical materials must have added to their formulations an optical brightener, whose presence is detectable by ultraviolet light, to aid in testing for their presence. Other equivalent industry accepted methods may be used as an alternative.

S14.1.4 Samples.

S14.1.4.1 Samples submitted for laboratory test must be new, unused, manufactured from production tooling and assembled by production processes, and representative of the devices as regularly manufactured and marketed.

S14.1.4.2 Each test sample must include not only the device but also accessory equipment necessary to operate in its intended manner. Where necessary a mounting bracket shall be provided so that the device may be rigidly bolted in its operating position on the various test equipment.

S14.1.4.3 Dust and photometric tests may be made on a second set of mounted samples, if desired, to expedite completion of the tests.

S14.1.5 *Laboratory facilities.* The laboratory must be equipped to test the sample in accordance with the requirements of the specific device.

S14.2 *Photometric test procedures.* Each lamp and reflective device required or permitted by this standard must be designed to conform to the applicable photometric requirements.

S14.2.1 Photometry measurements for all lamps except license plate lamps, headlamps, and DRLs.

S14.2.1.1 *Mounting.* Photometry measurements are made with the sample lamp mounted in its normal operating position.

S14.2.1.2 *School bus signal lamp aiming.* A school bus signal lamp must be aimed with its aiming plane normal to the photometer axis and may be reaimed for photometry by $\pm 1/2^{\circ}$ vertically and $\pm 1^{\circ}$ horizontally.

S14.2.1.3 *Measurement distance.* Photometric measurements are made at a distance between the light source and the point of measurement of at least 1.2 m for side marker lamps, clearance lamps, identification lamps, and parking lamps, and at least 3 m for turn signal lamps, stop lamps, taillamps, backup lamps, and school bus signal lamps.

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S14.2.1.4 *Location of test points.* Test point location must comply with the following nomenclature:

(a) The line formed by the intersection of a vertical plane through the light source of the lamp and normal to the test screen is designated “V”.

(b) The line formed by the intersection of a horizontal plane through the light source and normal to the test screen is designated “H”.

(c) The point of intersection of these two lines is designated “H-V”.

(d) Other test points on the test screen are measured in terms of angles from the H and V lines.

(e) Angles to the right (R) and to the left (L) are regarded as being to the right and left of the V line when the observer stands behind the lamp and looks in the direction of its light beam when it is properly aimed for photometry. Similarly, the upward angles designated as U and the downward angles designated as D, refer to light directed at angles above and below the H line, respectively.

S14.2.1.5 *Multiple compartment and multiple lamp photometry of turn signal lamps, stop lamps, and tail-lamps.*

S14.2.1.5.1 When compartments of lamps or arrangements of multiple lamps are photometered together, the H-V axis intersects the midpoint between the optical axes.

S14.2.1.5.2 Luminous intensity measurements of multiple compartment lamps or multiple lamp arrangements are made either by:

(a) Measuring all compartments together, provided that a line from the optical axis of each compartment or lamp to the center of the photometer sensing device does not make an angle more than 0.6° with the H-V axis, or

(b) Measuring each compartment or lamp separately by aligning its optical axis with the photometer and adding the value at each test point.

S14.2.1.5.3 Multiple compartment turn signal lamps or stop lamps or multiple lamp arrangements of these lamps installed on multipurpose passenger vehicles, trucks, trailers, or buses 2032 mm or more in overall width must use the method of S14.2.1.5.2(b) only.

S14.2.1.6 *Bulbs.* Except for a lamp having a sealed-in bulb, a lamp must meet the applicable requirements of this standard when tested with a bulb whose filament is positioned within $\pm .010$ in of the nominal design position specified in SAE Recommended Practice J573d (1968) (incorporated by reference, see §571.5) or specified by the bulb manufacturer and operated at the bulb's rated mean spherical candela.

S14.2.1.6.1 Each lamp designed to use a type of bulb that has not been assigned a mean spherical candela rating by its manufacturer and is not listed in SAE Recommended Practice J573d (1968) (incorporated by reference, see §571.5), must meet the applicable requirements of this standard when used with any bulb of the type specified by the lamp manufacturer, operated at the bulb's design voltage. A lamp that contains a

sealed-in bulb must meet these requirements with the bulb operated at the bulb's design voltage.

S14.2.1.6.2 A bulb that is not listed in SAE Recommended Practice J573d (1968) (incorporated by reference, see §571.5) is not required to use a socket that conforms to the requirements of SAE Recommended Practice J567b (1964) (incorporated by reference, see §571.5).

S14.2.2 *License plate lamp photometry.* Photometry compliance of license plate lamps is determined by measurement of the illumination falling upon test stations located on a test plate.

S14.2.2.1 *Illumination surface.* All illumination measurements are made on a rectangular test plate of clean, white blotting paper mounted on the license plate holder in the position normally taken by the license plate. The face of the test plate must be 1.5 mm from the face of the license plate holder.

S14.2.2.2 *Test stations.* Test stations must be located on the face of the test plate as shown in Figure 19 according to the type of vehicle on which the license plate lamps are installed.

S14.2.2.3 Bulb requirements of S14.2.1.6 apply to license plate lamp photometry.

S14.2.3 *Reflex reflector and retroreflective sheeting photometry.*

S14.2.3.1 *Mounting.* Each reflex reflector is mounted for photometry with the center of the reflex area at the center of goniometer rotation and at the same horizontal level as the source of illumination.

S14.2.3.2 *Illumination source.* The source of illumination is a lamp with a 50 mm effective diameter and with a filament operating at 2856 °K.

S14.2.3.3 *Measurement distance.* The test distance is 30.5 m [100ft].

S14.2.3.4 *Test setup* The observation point is located directly above the source of illumination. The H-V axis of reflex reflectors is taken as parallel to the longitudinal axis of the vehicle for rear reflectors and perpendicular to a vertical plane passing through the longitudinal axis of the vehicle for side reflectors.

S14.2.3.5 *Photodetector.* The photodetector has an opening of not more than 13 mm vertically and 25 mm horizontally.

S14.2.3.6 *Photometry surface.* Reflex reflectors may have any linear or area dimensions but must have no more than 7740 sq mm projected area contained within a 254 mm diameter circle exposed for photometry.

S14.2.3.7 *Procedure.* Photometric measurements of reflex reflectors and retroreflective sheeting must be made at various observation and entrance angles as shown in Table XVI.

S14.2.3.7.1 The observation angle is the angle formed by a line from the observation point to the center of the reflector and a second line from the center of the reflector to the source of illumination.

S14.2.3.7.2 The entrance angle is the angle between the axis of the reflex reflector and a line from the center of the reflector to the source of illumination.

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S14.2.3.7.3 The entrance angle is designated left, right, up, and down in accordance with the position of the source of illumination with respect to the axis of the reflex reflector as viewed from behind the reflector.

S14.2.3.7.4 Measurements are made of the luminous intensity which the reflex reflector is projecting toward the observation point and the illumination on the reflex reflector from the source of illumination.

S14.2.3.8 *Measurements.*

S14.2.3.8.1 *Reflex reflectors.* The required measurement for reflex reflectors at each test point as shown in Table XVI is the quotient of the projected luminous intensity divided by the illumination expressed as millicandela per lux or candela per footcandle.

S14.2.3.8.2 *Retroreflective sheeting.* The required measurement for retroreflective sheeting reflectors at each test point as shown in Table XVI is candela per lux per square meter of area.

S14.2.3.8.3 *Reflex reflector photometry measurement adjustments.*

S14.2.3.8.3.1 Reflex reflectors, which do not have a fixed rotational position on the vehicle, are rotated about their axis through 360° to find the minimum photometric value which must be reported for each test point. If the output falls below the minimum requirement at any test point, the reflector is rotated $\pm 5^\circ$ about its axis from the angle where the minimum output occurred, and the maximum value within this angle is reported as a tolerance value.

S14.2.3.8.3.2 Reflex reflectors, which by their design or construction, permit mounting on a vehicle in a fixed rotational position, are tested in this position. A visual locator, such as the word TOP is not considered adequate to establish a fixed rotational position on the vehicle.

S14.2.3.8.3.3 If uncolored reflections from the front surface interfere with photometric readings at any test point, additional readings are taken 1° above, below, right, and left of the test point, and the lowest of these readings and its location is reported provided the minimum test point requirement for the test point is met.

S14.2.4 *Daytime running lamp (DRL) photometry measurements.*

S14.2.4.1 Each DRL is tested to the procedure of S14.2.5 when a test voltage of $12.8 \text{ v} \pm 20 \text{ mv}$ is applied to the input terminals of the lamp switch module or voltage-reducing equipment, whichever is closer to the electrical source on the vehicle.

S14.2.4.2 The test distance from the lamp to the photometer is not less than 18.3 m if the lamp is optically combined with a headlamp, or is a separate lamp, and not less than 3 m if the lamp is optically combined with a lamp, other than a headlamp, that is required by this standard.

S14.2.4.3 Except for a lamp having a sealed-in bulb, a lamp must meet the applicable requirements of this standard when tested with a bulb whose filament is positioned within $\pm 0.10 \text{ in.}$ of the nominal design position specified in SAE J573d, Lamp bulbs and Sealed Units, December 1968, (incorporated by reference, para-

graph S5.2 of this section) or specified by the bulb manufacturer.

S14.2.5 *Headlamp photometry measurements.*

S14.2.5.1 *Mounting.* Photometry measurements at the applicable test points are made with the sample headlamp mounted in its normal operating position.

S14.2.5.2 Test points in the area from 10° U to 90° U must be measured from the normally exposed surface of the lens face.

S14.2.5.3 *Measurement distance.* Photometric measurements are made at a distance between the light source and the photometer sensor of at least 18.3 m.

S14.2.5.4 *Seasoning and test voltage.* All sealed beam headlamps, integral beam headlamps, beam contributors, and replaceable light sources are seasoned at design voltage for 1% of its average design life or 10 hours, whichever is less prior to a photometry test. A headlamp is tested at $12.8 \text{ v.} \pm 20 \text{ mv, D.C.}$ as measured at the terminals of the lamp.

S14.2.5.5 *Aiming.* Each headlamp is aimed prior to a photometry test in accordance with the procedure appropriate to its aiming system. A $\frac{1}{4}^\circ$ reaim is permitted in any direction at any test point to allow for variations in readings between laboratories for all headlamps except a Type F upper beam unit not equipped with a VHAD.

S14.2.5.5.1 *Mechanically aimable headlamps using an external aimer.* The headlamp is aimed mechanically with the aiming plane at the design angle(s) to the photometer axis and the mechanical axis of the headlamp on the photometer axis.

S14.2.5.5.2 *Mechanically aimable headlamps equipped with a VHAD.* The headlamp is aimed mechanically using the VHAD in accordance with the manufacturer's instructions as provided with the vehicle on which the headlamp is intended to be used.

S14.2.5.5.3 *Visually aimable lower beam headlamps-vertical aim.*

S14.2.5.5.3.1 A VOL cutoff headlamp must have the location of the cutoff maximum gradient, as determined by the method of this standard, positioned at 0.4° down from the H-H line.

S14.2.5.5.3.2 A VOR cutoff headlamp must have the location of the cutoff maximum gradient, as determined by the method of this standard, positioned at the H-H line.

S14.2.5.5.4 *Visually aimable lower beam headlamps-horizontal aim.* There must be no adjustment of horizontal aim unless the headlamp is equipped with a horizontal VHAD. If the headlamp has a VHAD, it must be set to zero.

S14.2.5.5.5 *Visually aimable upper beam headlamps-vertical aim.*

S14.2.5.5.5.1 A headlamp whose upper beam is combined with a lower beam must not have its vertical aim changed from that set for the lower beam.

S14.2.5.5.5.2 A headlamp whose upper beam is not combined with a lower beam must have its maximum beam intensity positioned on the H-H axis.

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S14.2.5.5.6 *Visually aimable upper beam headlamps-horizontal aim.*

S14.2.5.5.6.1 A headlamp whose upper beam is combined with a lower beam must not have its horizontal aim changed from that set for the lower beam.

S14.2.5.5.6.2 A headlamp whose upper beam is not combined with a lower beam and has a fixed horizontal aim or has a horizontal VHAD must be mounted in its normal operating position on a goniometer such that the mounting fixture alignment axes are coincident with the goniometer axes and must be energized at $12.8 \text{ v} \pm 20 \text{ mv}$. There must be no adjustment, shimming, or modification of the horizontal axis of the headlamp or test fixture, unless the headlamp is equipped with a VHAD, in which case the VHAD must be adjusted to zero.

S14.2.5.5.6.3 A headlamp whose upper beam is not combined with a lower beam and is not equipped with a horizontal VHAD, the horizontal aim must be adjusted so that the maximum beam intensity is positioned on the V-V axis.

S14.2.5.5.7 *Simultaneous aim Type F sealed beam headlamps and beam contributor integral beam headlamps.*

S14.2.5.5.7.1 A headlamp system permitted to use simultaneous aim of lower beams and upper beams must be aimed mechanically for lower beam photometry by centering the lower beam unit or the geometric center of all lower beam contributors on the photometer axis and aligning the aiming plane, aiming reference plane, or other appropriate vertical plane defined by the manufacturer perpendicular to the photometer axis.

S14.2.5.5.7.2 The headlamp must be aimed for upper beam photometry by moving the assembly in a plane parallel to the established lower beam aiming plane until the upper beam unit or the geometric center of all upper beam contributors is centered in the photometric axis.

S14.2.5.5.8 *Motorcycle headlamp-upper beam headlamps designed to comply with Table XX.* The upper beam of a multiple beam headlamp designed to comply with the requirements of Table XX must be aimed photoelectrically so that the center of the zone of highest intensity falls 0.4° vertically below the lamp axis and is centered laterally. The center of the zone of highest intensity must be established by the intersection of a horizontal plane passing through the point of maximum intensity, and the vertical plane established by balancing the photometric values at 3°L and 3°R .

S14.2.5.5.9 *Motorcycle headlamp-lower beam headlamps designed to comply with Table XX.* The beam from a single beam headlamp designed to comply with the requirements of Table XX must be aimed straight ahead with the top of the beam aimed vertically to obtain 2000 cd at H-V.

S14.2.5.6 *Positioner.* The goniometer configuration, used to position the sample headlamp when making photometric measurements at specific angular test points, is horizontal rotation over elevation. The vertical axis of the goniometer must correspond to the design position vertical axis of the sample headlamp which is

vertical and perpendicular to the longitudinal axis of the vehicle.

S14.2.5.7 *Photometer.*

S14.2.5.7.1 The photometer must be capable of measuring the luminous intensity of the sample headlamp throughout its illumination range.

S14.2.5.7.2 *Sensor.*

S14.2.5.7.2.1 The maximum effective area of the photometric sensor must fit within a circle whose diameter is equal to 0.009 times the actual test distance from the light source of the sample headlamp to the sensor.

S14.2.5.7.2.2 The sensor effective area is defined as the actual area of intercepted light striking the detector surface of the photometer. Sensor systems incorporating lens(es) that change the diameter of the intercepted light beam before it reaches the actual detector surface, the maximum size requirements must apply to the total area of the light actually intercepted by the lens surface.

S14.2.5.7.2.3 The sensor must be capable of intercepting all direct illumination from the largest illuminated dimension of the sample lamp at the test distance.

S14.2.5.7.3 The color response of the photometer must be corrected to that of the 1931 CIE Standard Observer (2-degree) Photopic Response Curve, as shown in the CIE 1931 Chromaticity Diagram (incorporated by reference, see §571.5).

S14.2.5.8 *Location of test points.*

S14.2.5.8.1 Test point positions are defined by the positioner. The following nomenclature applies:

S14.2.5.8.1.1 The letters "V" and "H" designate the vertical and horizontal planes intersecting both the headlamp light source and the photometer axis. "H-V" designates the zero test point angle at the intersection of the H and V planes. This intersection is parallel to the longitudinal axis of the vehicle.

S14.2.5.8.1.2 The letters "U", "D", "L", and "R", indicating up, down, left and right, respectively, designate the angular position from the H and V planes to the photometer as viewed from the headlamp.

S14.2.5.8.1.3 Horizontal angles designated L and R are defined as the plan view angle between the vertical plane and the projection of the light ray from the headlamp onto the horizontal plane.

S14.2.5.8.1.4 Vertical angles designated U and D are defined as the true angle between the horizontal plane and the light ray from the headlamp.

S14.2.5.9 *Beam contributor photometry measurements.* In a headlighting system where there is more than one beam contributor providing a lower beam, and/or more than one beam contributor providing an upper beam, each beam contributor must be designed to meet only the applicable photometric performance requirements based upon the following mathematical expression: conforming test point value = $2(\text{test point value})/\text{total number of lower or upper beam contributors for the vehicle, as appropriate}$.

S14.2.5.10 *Moveable reflector aimed headlamp photometry measurements.*

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S14.2.5.10.1 A headlamp aimed by moving the reflector relative to the lens and headlamp housing, or vice versa, must conform to the photometry requirements applicable to it with the lens at any position relative to the reflector.

S14.2.5.10.2 These positions include not less than the full range of vertical pitch of the vehicle on which the headlamp is installed and not less than $\pm 2.5^\circ$ from the nominal horizontal aim position for the vehicle on which the headlamp is installed unless the headlamp is visually/optically aimed with a fixed horizontal aim.

S14.3 *Motorcycle headlamp out of focus test procedure and performance requirements.*

S14.3.1 *Procedure.* The sample device must be tested for photometry using bulbs having each of four out-of-focus filament positions. Where conventional bulbs with two pin bayonet bases are used, tests must be made with the light source 0.060 in. above, below, ahead, and behind the designated position. If prefocused bulbs are used, the limiting positions at which tests are made must be 0.020 in. above, below, ahead, and behind the designated position. The sample device may be reaimed for each of the out-of-focus positions of the light source.

S14.3.2 *Performance requirements.* The minimum photometric values for the out-of-design position must be 80% of the in-design position.

S14.4 *General test procedures and performance requirements.*

S14.4.1 *Color test.* The requirement applies to the overall effective color of light emitted by the device and not to the color of the light from a small area of the lens. It does not apply to any pilot, indicator, or tell-tale lights. The color of the sample device must comply when tested by either the Visual Method or the Tristimulus Method.

S14.4.1.1 *Samples.* A test sample for a reflex reflector may be either the reflex reflector or a disc of the same material, technique of fabrication, and dye formulation as the reflex reflector. If a disc is used, the thickness must be twice the thickness of the reflector as measured from the face of the lens to the apexes of the reflecting elements.

S14.4.1.2 *General procedure.*

S14.4.1.2.1 The device must be operated at design voltage.

S14.4.1.2.2 Components (bulbs, caps, lenses, and the like) must be tested in a fixture or manner simulating the intended application.

S14.4.1.2.3 The lamp shall be allowed to reach operating temperature before measurements are made.

S14.4.1.2.4 The entire light emitting surface of the sample must be visible from any point on the entrance window of the test instrument.

S14.4.1.2.5 The distance between the test instrument and the sample must be large enough so that further increases in distance will not affect the results.

S14.4.1.3 *Visual method.*

S14.4.1.3.1 *Visual method procedure.* The color of light from the sample device must be compared visually with the color of the light from a standard. The stan-

dard may consist of a filter or limit glass. In the case of white, CIE Source A is used only as a color reference. The chromaticity coordinates of the color standards must be as close as possible to the limits listed. The color of the standard filters is determined spectrophotometrically.

S14.4.1.3.2 *Visual method performance requirements.* The color must comply with the applicable requirement.

S14.4.1.3.2.1 *Red.* Red is not acceptable if it is less saturated (paler), yellower, or bluer than the limit standards.

S14.4.1.3.2.2 *Yellow (Amber).* Yellow is not acceptable if it is less saturated (paler), greener, or redder than the limit standards.

S14.4.1.3.2.3 *White.* White is not acceptable if its color differs materially from that of CIE Source A.

S14.4.1.3.2.4 *Green.* Green is not acceptable if it is less saturated (paler), yellower, or bluer than the limit standards.

S14.4.1.3.2.5 *Blue.* Blue is not acceptable if it is less saturated (paler), greener, or redder than the limit standards.

S14.4.1.4 *Tristimulus method.*

S14.4.1.4.1 *Tristimulus method procedure.*

S14.4.1.4.1.1 The color of light from the H-V point of a sample device must be measured by photoelectric receivers with spectral responses that approximate CIE standard spectral tristimulus valves.

S14.4.1.4.1.2 A sphere may be used to integrate light from a colored source provided that the color shift that results from the spectral selectivity of the sphere paint be corrected by the use of a filter, correction factor, or an appropriate calibration.

S14.4.1.4.1.3 Where the sample device does not have uniform spectral characteristics in all useful directions, color measurements must be made at as many directions of view as are required to evaluate the color for those directions that apply to the end use of the device.

S14.4.1.4.2 *Tristimulus method performance requirements.* The color must comply with the applicable requirement.

S14.4.1.4.2.1 *Red.* The color of light emitted must fall within the following boundaries:

$y = 0.33$ (yellow boundary)

$y = 0.98 - x$ (purple boundary)

S14.4.1.4.2.2 *Yellow (Amber).* The color of light emitted must fall within the following boundaries:

$y = 0.39$ (red boundary)

$y = 0.79 - 0.67x$ (white boundary)

$y = x - 0.12$ (green boundary)

S14.4.1.4.2.3 *White (achromatic).* The color of light emitted must fall within the following boundaries:

$x = 0.31$ (blue boundary)

$y = 0.44$ (green boundary)

$x = 0.50$ (yellow boundary)

$y = 0.15 + 0.64x$ (green boundary)

$y = 0.38$ (red boundary)

$y = 0.05 + 0.75x$ (purple boundary)

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S14.4.1.4.2.4 *Green*. The color of light emitted must fall within the following boundaries:

$y = 0.73 - 0.73x$ (yellow boundary)

$x = 0.63y - 0.04$ (white boundary)

$y = 0.50 - 0.50x$ (blue boundary)

S14.4.1.4.2.5 *Restricted Blue*. The color of light emitted must fall within the following boundaries:

$y = 0.07 + 0.81x$ (green boundary)

$x = 0.40 - y$ (white boundary)

$y = 0.13 + 0.60y$ (violet boundary)

S14.4.1.4.2.6 *Signal Blue*. The color of light emitted must fall within the following boundaries:

$y = 0.32$ (green boundary)

$x = 0.16$ (white boundary)

$x = 0.40 - y$ (white boundary)

$x = 0.13 + 0.60y$ (violet boundary)

S14.4.2 *Plastic optical materials tests*. Accelerated weathering procedures are not permitted.

S14.4.2.1 *Samples*.

S14.4.2.1.1 Samples of materials shall be injection molded into polished metal molds to produce test specimens with two flat and parallel faces. Alternative techniques may be used to produce equivalent specimens.

S14.4.2.1.2 Test specimens shape may vary, but each exposed surface must contain a minimum uninterrupted area of 32 sq cm.

S14.4.2.1.3 Samples must be furnished in thicknesses of 1.6 ± 0.25 mm, 2.3 ± 0.25 mm, 3.2 ± 0.25 mm, and 6.4 ± 0.25 mm.

S14.4.2.1.4 All samples must conform to the applicable color test requirement of this standard prior to testing.

S14.4.2.1.5 A control sample, kept properly protected from influences which may change its appearance and properties of each thickness, must be retained.

S14.4.2.2 *Outdoor exposure test*.

S14.4.2.2.1 Outdoor exposure tests of 3 years in duration must be made on samples of all materials, including coated and uncoated versions, used for optical parts of devices covered by this standard. Tests are to be conducted in Florida and Arizona.

S14.4.2.2.2 Concentrations of polymer components and additives used in plastic materials may be changed without outdoor exposure testing provided the changes are within the limits of composition represented by higher and lower concentrations of these polymer components and additives previously tested to this section and found to meet its requirements.

S14.4.2.2.3 *Procedure*.

S14.4.2.2.3.1 One sample of each thickness of each material must be mounted at each exposure site so that at least a minimum uninterrupted area of 32 sq cm of the exposed upper surface of the sample is at an angle of 45° to the horizontal facing south. The sample must be mounted in the open no closer than 30 cm (11.8 in) to its background.

S14.4.2.2.3.2 During the exposure time the samples must be cleaned once every three months by washing

with mild soap or detergent and water, and then rinsing with distilled water. Rubbing must be avoided.

S14.4.2.2.4 *Performance requirements*. Plastic lenses, other than those incorporating reflex reflectors, used for inner lenses or those covered by another material and not exposed directly to sunlight must meet the optical material test requirements when covered by the outer lens or other material.

S14.4.2.2.4.1 After completion of the outdoor exposure test the haze and loss of surface luster as measured by ASTM D1003-92 (incorporated by reference, see §571.5) must not be greater than:

(a) 30% for materials used for outer lenses, other than those incorporating reflex reflectors;

(b) 7% for materials used for reflex reflectors and lenses used in front of reflex reflectors.

S14.4.2.2.4.2 After completion of the outdoor exposure test materials used for headlamp lenses must show no deterioration.

S14.4.2.2.4.3 After completion of the outdoor exposure test all materials, when compared with the unexposed control samples, must not show physical changes affecting performance such as color bleeding, delamination, crazing, or cracking. Additionally materials used for reflex reflectors and lenses used in front of reflex reflectors must not show surface deterioration or dimensional changes.

S14.4.2.2.4.4 After completion of the outdoor exposure test all materials, when compared with the unexposed control samples, must not have their luminous transmittance changed by more than 25% when tested in accordance with ASTM E308-66 (incorporated by reference, see §571.5) using CIE Illuminant A (2856K).

S14.4.2.2.4.5 After completion of the outdoor exposure test all materials must conform to the color test of this standard in the range of thickness stated by the material manufacturer.

S14.4.2.3 *Heat test*.

S14.4.2.3.1 *Procedure*. Two samples of each thickness of each material must be supported at the bottom, with at least 51 mm of the sample above the support, in the vertical position in such a manner that, on each side, the minimum uninterrupted area of exposed surface is not less than 3225 sq mm. The samples are placed in a circulating air oven at $79 \pm 3^\circ\text{C}$ for two hours.

S14.4.2.3.2 *Performance requirements*. After completion of the heat exposure and cooling to room ambient temperature, a test specimen must show no change in shape and general appearance discernable to the naked eye when compared with an unexposed specimen and continue to conform to the applicable color test requirement of this standard.

S14.5 *Signal lamp and reflective device physical test procedures and performance requirements*.

S14.5.1 *Vibration test*.

S14.5.1.1 *Procedure*. The sample device, as mounted on the support supplied, must be bolted to the anvil end of the table of the vibration test machine of Figure 21 and vibrated approximately 750 cpm through a distance of $\frac{1}{8}$ in. The table must be spring mounted at one end

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and fitted with steel calks on the underside of the other end. The calks are to make contact with the steel anvil once during each cycle at the completion of the fall. The rack must be operated under a spring tension of 60 to 70 lb. The test must be continued for 1 hour.

S14.5.1.2 Performance requirements. After completion of the vibration test a device showing evidence of material physical weakness, lens or reflector rotation, displacement or rupture of parts except bulb failures, must be considered to have failed, providing that the rotation of lens or reflector must not be considered as a failure when tests show compliance with specifications despite such rotation.

S14.5.2 Moisture test.

S14.5.2.1 Procedure. The sample device must be mounted in its normal operating position with all drain holes open and subjected to a precipitation of 0.1 in of water per minute, delivered at an angle of 45° from a nozzle with a solid cone spray. During the test the device must revolve about its vertical axis at a rate of 4 rpm for a period of 12 hours followed by a one hour drain period where the device does not rotate and the spray stops. After completion of the moisture test the device must be examined for moisture accumulation.

S14.5.2.2 Performance requirements. Accumulation of moisture in excess of 2 cc or any visible moisture in a sealed reflex unit must constitute a failure.

S14.5.3 Dust test.

S14.5.3.1 Samples. A sealed unit is not required to meet the requirements of this test.

S14.5.3.2 Procedure. The sample device with any drain hole closed must be mounted in its normal operating position, at least 6 in from the wall in a cubical box with inside measurements of 3 ft on each side containing 10 lb of fine powered cement in accordance with ASTM C150-56 (incorporated by reference, see §571.5). At intervals of 15 minutes during a test period of 5 hours, the dust must be agitated by compressed air or fan blower by projecting blasts of air for a 2 second period in a downward direction into the dust in such a way that the dust is completely and uniformly diffused throughout the entire cube and allowed to settle. After the completion of the dust test the exterior surface of the device must be cleaned.

S14.5.3.3 Performance requirements. If after a photometry test the maximum photometric intensity of the device is not more than 10% less than the maximum photometric intensity of the same device after being cleaned both inside and outside, the device is considered to have met the requirements of the dust test.

S14.5.4 Corrosion test.

S14.5.4.1 Procedure. The sample device must be subjected to a salt spray (fog) test in accordance with the latest version of ASTM B117-73 (Reapproved 1979) (incorporated by reference, see §571.5), for a period of 50 hours, consisting of two periods of 24 hour exposure followed by a 1 hr drying time.

S14.5.4.2 Performance requirements. After the completion of the corrosion test there must be no evidence of excessive corrosion which would affect the proper function of the device.

S14.6 Headlamp physical test procedures and performance requirements.

S14.6.1 Abrasion test.

S14.6.1.1 Procedure.

S14.6.1.1.1 Abrading pad. A new, unused abrading pad constructed of 0000 steel wool not less than 2.5 ± 1 cm wide, rubber cemented to a rigid base shaped to the same vertical contour of the lens, is used for each test. The abrading pad support is equal in size to the pad and the center of the support surface is within ± 2 mm of parallel to the lens surface. The "grain" of the pad is oriented perpendicular to the direction of motion. The density of the pad is such that when the pad is resting unweighted on the lens, the base of the pad is no closer than 3.2 mm to the lens at its closest point.

S14.6.1.1.2 Abrading pad alignment. A sample headlamp is mounted in the abrasion test fixture of Figure 5 with the lens facing upward. When mounted on its support and resting on the lens of the test headlamp, the abrading pad is then weighted such that a pad pressure of 14 ± 1 KPa. exists at the center and perpendicular to the face of the lens.

S14.6.1.1.3 Abrasion test procedure. The pad is cycled back and forth (1 cycle) for 11 cycles at 4 ± 0.8 in (10 ± 2 cm) per second over at least 80% of the lens surface, including all the area between the upper and lower aiming pads, but not including lens trim rings and edges. A pivot must be used if it is required to follow the contour of the lens.

S14.6.1.2 Performance requirements. After completion of the abrasion test the sample headlamp must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A $\frac{1}{4}^\circ$ reaim is permitted in any direction at any test point.

S14.6.2 Chemical resistance test.

S14.6.2.1 Procedure.

S14.6.2.1.1 Test fluids. The five test fluids used in the chemical resistance test include:

(a) ASTM Reference Fuel C, which is composed of Isooctane 50% volume and Toluene 50% volume. Isooctane must conform to A2.7 in the ASTM Motor Fuels section (incorporated by reference, see §571.5), and Toluene must conform to ASTM D362-84 (incorporated by reference, see §571.5). ASTM Reference Fuel C must be used as specified in: Paragraph A2.3.2 and A2.3.3 of the ASTM Motor Fuels section (incorporated by reference, see §571.5); and OSHA Standard 29 CFR 1910.106—Handling Storage and Use of Flammable Combustible Liquids;

(b) Tar remover (consisting by volume of 45% xylene and 55% petroleum base mineral spirits);

(c) Power steering fluid (as specified by the vehicle manufacturer for use in the motor vehicle on which the headlamp is intended to be installed);

(d) Windshield washer fluid consisting of 0.5% monoethanolamine with the remainder 50% concentration of methanol/distilled water by volume; and

(e) Antifreeze (50% concentration of ethylene glycol/distilled water by volume).

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S14.6.2.1.2 Fluid application. The entire exterior lens surface of the sample headlamp mounted in the headlamp test fixture and top surface of the lens-reflector joint is wiped once to the left and once to the right with a 6 inch square soft cotton cloth (with pressure equally applied) which has been saturated once in a container with 2 ounces of five different test fluids listed above. The lamp is wiped within 5 seconds after removal of the cloth from the test fluid. A new lamp sample may be used with each fluid.

S14.6.2.1.3 Test duration. After the headlamp sample has been wiped with the test fluid, it must be stored in its designed operating attitude for 48 hours at a temperature of $23^{\circ}\text{C} \pm 4^{\circ}\text{C}$ and a relative humidity of $30\% \pm 10\%$. At the end of the 48-hour period, the headlamp is wiped clean with a soft dry cotton cloth and visually inspected.

S14.6.2.2 Performance requirements. After completion of the chemical resistance test, the sample headlamp must have no surface deterioration, coating delamination, fractures, deterioration of bonding or sealing materials, color bleeding, or color pickup visible without magnification and the headlamp must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A $\frac{1}{4}^{\circ}$ reaim is permitted in any direction at any test point.

S14.6.3 Corrosion test.

S14.6.3.1 Procedure. A sample headlamp, mounted on a headlamp test fixture in designed operating position and including all accessory equipment necessary to operate in its normal manner, is subjected to a salt spray (fog) test in accordance with ASTM B117-73 (incorporated by reference, see §571.5), for 50 total hours, consisting of two periods of 24 hours exposure followed by a 1 hour drying period. If a portion of the device is completely protected in service, that portion is covered to prevent salt fog entry during exposure. After removal from the salt spray and the final 1 hour drying period the sample headlamp is examined for corrosion that affects any other applicable tests contained in S14.6. If such corrosion is found, the affected test(s) must be performed on the corrosion sample and the results recorded.

S14.6.3.2 Performance requirements. After completion of the corrosion test, the sample headlamp must not have any observed corrosion which would result in the failure of any other applicable tests contained in S14.6 and no corrosion of the headlamp mounting and aiming mechanism that would result in the failure of the aiming adjustment tests, inward force test, or torque deflection test of S14.6.

S14.6.4 Corrosion-connector test.

S14.6.4.1 Procedure.

S14.6.4.1.1 A headlamp connector test must be performed on each filament circuit of the sample headlamp prior to the test in S14.6.4.1.2 according to Figure 4 and S14.6.15. The power source is set to provide 12.8 volts and the resistance must be set to produce 10 amperes.

S14.6.4.1.2 The headlamp, with connector attached to the terminals, unfixed and in its designed operating attitude with all drain holes, breathing devices or other

designed openings in their normal operating positions, is subjected to a salt spray (fog) test in accordance with ASTM B117-73 (incorporated by reference, see §571.5), for 240 hours, consisting of ten successive 24-hour periods.

S14.6.4.1.3 During each period, the headlamp is mounted in the middle of the chamber and exposed for 23 hours to the salt spray. The spray is not activated during the 24th hour. The bulb is removed from the headlamp and from the test chamber during the one hour of salt spray deactivation and reinserted for the start of the next test period, at the end of the first and last three 23-hour periods of salt spray exposure, and at the end of any two of the fourth through seventh 23-hour periods of salt-spray exposure.

S14.6.4.1.4 The test chamber is closed at all times except for a maximum of 2 minutes which is allowed for removal or replacement of a bulb during each period.

S14.6.4.1.5 After the ten periods, the lens-reflector unit without the bulb must be immersed in deionized water for 5 minutes, then secured and allowed to dry by natural convection only.

S14.6.4.1.6 Using the voltage, resistance and pre-test set up of S14.6.4.1.1 the current in each filament circuit must be measured after the test conducted in S14.6.4.1.2.

S14.6.4.2 Performance requirements.

S14.6.4.2.1 After the completion of the corrosion-connector test, the sample headlamp must show no evidence of external or internal corrosion or rust visible without magnification.

S14.6.4.2.2 Loss of adhesion of any applied coating must not occur more than 3.2 mm from any sharp edge on the inside or out.

S14.6.4.2.3 Corrosion may occur on terminals only if the test current produced during the test of S14.6.4.1.6 is not less than 9.7 amperes.

S14.6.5 Dust test.

S14.6.5.1 Procedure.

S14.6.5.1.1 A sample headlamp, mounted on a headlamp test fixture, with all drain holes, breathing devices or other designed openings in their normal operating positions, is positioned within a cubical box, with inside measurements of 900 mm on each side or larger if required for adequate wall clearance (*i.e.*, a distance of at least 150 mm between the headlamp and any wall of the box).

S14.6.5.1.2 The box contains 4.5 kg of fine powdered cement which conforms to the ASTM C150-77 (incorporated by reference, see §571.5). Every 15 minutes, the cement is agitated by compressed air or fan blower(s) by projecting blasts of air for a two-second period in a downward direction so that the cement is diffused as uniformly as possible throughout the entire box.

S14.6.5.1.3 This test is continued for five hours after which the exterior surfaces of the headlamp are wiped clean.

S14.6.5.2 Performance requirements. After completion of the dust test, the sample headlamp must meet the requirements of the applicable photometry tests of

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Table XIX and Table XVIII. A $\frac{1}{4}^\circ$ reaim is permitted in any direction at any test point.

S14.6.6 *Temperature cycle test and internal heat test.*

S14.6.6.1 *Samples.* A sample headlamp with one or more replaceable light sources is tested according to the procedures of this section for a temperature cycle test and an internal heat test. The same sample headlamp is used in the temperature cycle test and then in the internal heat test.

S14.6.6.2 *General procedure.*

S14.6.6.2.1 Tests are made with all filaments lighted at design voltage that are intended to be used simultaneously in the headlamp and which in combination draw the highest total wattage. These include but are not limited to filaments used for turn signal lamps, fog lamps, parking lamps, and headlamp lower beams lighted with upper beams when the wiring harness is so connected on the vehicle.

S14.6.6.2.2 If a turn signal is included in the headlamp assembly, it is operated at 90 flashes a minute with a $75\% \pm 2\%$ current "on time."

S14.6.6.2.3 If the lamp produces both the upper and lower beam, it is tested in both the upper beam mode and the lower beam mode under the conditions above described, except for a headlamp with a single type HB1 or type HB2 light source.

S14.6.6.3 *Temperature cycle test.*

S14.6.6.3.1 *Procedure.*

S14.6.6.3.1.1 A sample headlamp, mounted on a headlamp test fixture, is subjected to 10 complete consecutive cycles having the thermal cycle profile shown in Figure 6.

S14.6.6.3.1.2 During the hot cycle, the lamp, is energized commencing at point "A" of Figure 6 and de-energized at point "B."

S14.6.6.3.1.3 Separate or single test chambers may be used to generate the environment of Figure 6.

S14.6.6.3.1.4 All drain holes, breathing devices or other openings or vents of the headlamps are set in their normal operating positions.

S14.6.6.3.2 *Performance requirements.* After completion of the temperature cycle test, the sample headlamp must:

(a) show no evidence of delamination, fractures, entry of moisture, or deterioration of bonding material, color bleeding, warp or deformation visible without magnification;

(b) show no lens warpage greater than 3 mm when measured parallel to the optical axis at the point of intersection of the axis of each light source with the exterior surface of the lens; and

(c) meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A $\frac{1}{4}^\circ$ reaim is permitted in any direction at any test point.

S14.6.6.4 *Internal heat test.*

S14.6.6.4.1 *Procedure.*

S14.6.6.4.1.1 A sample headlamp lens surface that would normally be exposed to road dirt is uniformly sprayed with any appropriate mixture of dust and wa-

ter or other materials to reduce the photometric output at the H-V test point of the upper beam (or the $\frac{1}{2}^\circ$ D-1 $\frac{1}{2}^\circ$ R test point of the lower beam as applicable) to $25\% \pm 2\%$ of the output originally measured in the applicable photometric compliance test.

S14.6.6.4.1.2 A headlamp with a single type HB1 or type HB2 light source is tested on the upper beam only.

S14.6.6.4.1.3 Such reduction is determined under the same conditions as that of the original photometric measurement.

S14.6.6.4.1.4 After the photometric output of the lamp has been reduced as specified above, the sample lamp and its mounting hardware must be mounted in an environmental chamber in a manner similar to that indicated in Figure 7 "Dirt/Ambient Test Setup."

S14.6.6.4.1.5 The headlamp is soaked for one hour at a temperature of $35^\circ + 4^\circ - 0^\circ \text{C}$ and then the lamp is energized according to the procedure of this section for one hour in a still air condition, allowing the temperature to rise from the soak temperature.

S14.6.6.4.1.6 At the end of one hour the sample lamp is returned to a room ambient temperature of $23^\circ + 4^\circ - 0^\circ \text{C}$ and a relative humidity of $30\% \pm 10\%$ and allowed to stabilize to the room ambient temperature. The lens is then cleaned.

S14.6.6.4.2 *Performance requirements.* After completion of the temperature cycle test and meeting its requirements, and completion of the internal heat test, the sample headlamp must:

(a) have no lens warpage greater than 3 mm when measured parallel to the optical axis at the point of intersection of the axis of each light source with the exterior surface of the lens, and

(b) meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A $\frac{1}{4}^\circ$ reaim is permitted in any direction at any test point.

S14.6.7 *Humidity test.*

S14.6.7.1 *Procedure.*

S14.6.7.1.1 The test fixture consists of a horizontal steel plate to which three threaded steel or aluminum rods of $\frac{1}{2}$ inch diameter are screwed vertically behind the headlamp.

S14.6.7.1.2 The sample headlamp assembly is clamped to the vertical rods, which are behind the headlamp. All attachments to the headlamp assembly are made behind the lens and vents or openings, and are not within 2 inches laterally of a vent inlet or outlet.

S14.6.7.1.3 The mounted headlamp assembly is oriented in its design operating position, and is placed in a controlled environment at a temperature of $100^\circ + 7^\circ - 0^\circ \text{F}$ ($38^\circ + 4^\circ - 0^\circ \text{C}$) with a relative humidity of not less than 90%. All drain holes, breathing devices, and other openings are set in their normal operation positions for all phases of the humidity test.

S14.6.7.1.4 The headlamp is subjected to 24 consecutive 3-hour test cycles. In each cycle, the headlamp is energized for 1 hour at design voltage with the highest combination of filament wattages that are intended to be used, and then de-energized for 2 hours. If the headlamp incorporates a turn signal then the turn signal

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flashes at 90 flashes per minute with a $75\% \pm 2\%$ current “on-time.”

S14.6.7.1.5 Within 3 minutes after the completion of the 24th cycle, the air flow test will begin. The following procedure shall occur: the mounted assembly is removed, placed in an insulating box and covered with foam material so that there is no visible air space around the assembly; the box is closed, taken to the air flow test chamber, and placed within it. Inside the chamber, the assembly with respect to the air flow, is oriented in its design operating position. The assembly is positioned in the chamber so that the center of the lens is in the center of the opening of the air flow entry duct during the test. The headlamp has at least 3 inches clearance on all sides, and at least 4 inches to the entry and exit ducts at the closest points. If vent tubes are used which extend below the lamp body, the 3 inches are measured from the bottom of the vent tube or its protection. The temperature of the chamber is $73^\circ + 7^\circ - 0^\circ\text{F}$ ($23^\circ + 4^\circ - 0^\circ\text{C}$) with a relative humidity of $30\% + 10\% - 0\%$. The headlamp is not energized.

S14.6.7.1.6 Before the test specified in paragraph S14.6.7.1.7 of this section, the uniformity of the air flow in the empty test chamber at a plane 4 inches downstream of the air entry duct is measured over a 4 inch square grid. The uniformity of air flow at each grid point is $\pm 10\%$ of the average air flow specified in paragraph S14.6.7.1.7 of this section.

S14.6.7.1.7 The mounted assembly in the chamber is exposed, for one hour, to an average air flow of $330 + 0 - 30$ ft/min as measured with an air velocity measuring probe having an accuracy of $\pm 3\%$ in the 330 ft/min range. The average air flow is the average of the velocity recorded at six points around the perimeter of the lens. The six points are determined as follows: At the center of the lens, construct a horizontal plane. The first two points are located in the plane, 1 inch outward from the intersection of the plane and each edge of the lens. Then, trisect the distance between these two points and construct longitudinal vertical planes at the two intermediate locations formed by the trisection. The four remaining points are located in the vertical planes, one inch above the top edge of the lens, and one inch below the bottom edge of the lens.

S14.6.7.1.8 After one hour, the headlamp is removed and inspected for moisture.

S14.6.7.2 *Performance requirements.* After completion of the humidity test, the sample headlamp must show no evidence of interior delamination or moisture, fogging or condensation visible without magnification.

S14.6.8 *Vibration test.*

S14.6.8.1 *Samples.* The mounting bracket with a sample headlamp installed must not have a resonant frequency in the 10-55 Hz. range.

S14.6.8.2 *Procedure.* The mounted sample headlamp is bolted to the anvil end of the table of the vibration test machine of Figure 21 and vibrated 750 cpm through a distance of $\frac{1}{8}$ in. The table is spring mounted at one end and fitted with steel calks on the underside of the other end. The table is of sufficient size to completely contain the test fixture base with no overhang. The

calks are to make contact with the steel anvil once during each cycle at the completion of the fall. The rack is operated under a spring tension of 60 to 70 lb. The vibration is applied in the vertical axis of the headlamp as mounted on the vehicle. Bulb filaments are not energized during the test. The test is continued for 1 hour.

S14.6.8.3 *Performance requirements.* After completion of the vibration test, there must be no evidence of loose or broken parts, other than filaments, visible without magnification.

S14.6.9 *Sealing test.*

S14.6.9.1 *Procedure.*

S14.6.9.1.1 An unfixtured sample headlamp in its design mounting position is placed in water at a temperature of $176^\circ \pm 5^\circ\text{F}$ ($80^\circ \pm 3^\circ\text{C}$) for one hour. The headlamp is energized in its highest wattage mode, with the test voltage at $12.8 \pm 0.1\text{ V}$ during immersion.

S14.6.9.1.2 The lamp is then de-energized and immediately submerged in its design mounting position into water at $32^\circ + 5^\circ - 0^\circ\text{F}$ ($0^\circ + 3^\circ - 0^\circ\text{C}$). The water is in a pressurized vessel, and the pressure is increased to 10 psi (70 kPa), upon placing the lamp in the water. The lamp must remain in the pressurized vessel for a period of thirty minutes.

S14.6.9.1.3 This entire procedure is repeated for four cycles.

S14.6.9.1.4 Then the lamp is inspected for any signs of water on its interior. During the high temperature portion of the cycles, the lamp is observed for signs of air escaping from its interior.

S14.6.9.2 *Performance requirements.* After completion of the sealing test, a sample headlamp confirmed to be sealed need not meet the corrosion test, dust test, or humidity test of this Section. If any water is on the interior or air escapes, the lamp is not a sealed lamp.

S14.6.10 *Chemical resistance test of reflectors of replaceable lens headlamps test.*

S14.6.10.1 *Procedure.*

S14.6.10.1.1 *Test fluids.* The three test fluids used in the chemical resistance test include;

- (a) Tar remover (consisting by volume of 45% xylene and 55% petroleum base mineral spirits);
- (b) Mineral spirits; and
- (c) Fluids other than water contained in the manufacturer's instructions for cleaning the reflector.

S14.6.10.1.2 *Fluid application.* With a sample headlamp in the headlamp test fixture and the lens removed, the entire surface of the reflector that receives light from a headlamp light source is wiped once to the left and once to the right with a 6-inch square soft cotton cloth (with pressure equally applied) which has been saturated once in a container with 2 ounces of one of the test fluids listed in S14.6.10.1.1. The lamp is wiped within 5 seconds after removal of the cloth from the test fluid.

S14.6.10.1.3 *Test duration.* After the headlamp has been wiped with the test fluid, it is stored in its designed operating attitude for 48 hours at a temperature of $73^\circ \pm 7^\circ\text{F}$ ($23^\circ \pm 4^\circ\text{C}$) and a relative humidity of $30\% \pm 10\%$. At the end of the 48-hour period, the headlamp is

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wiped clean with a soft dry cotton cloth and visually inspected.

S14.6.10.2 Performance requirements. After completion of the chemical resistance test, the sample headlamp must have no surface deterioration, coating delamination, fractures, deterioration of bonding or sealing materials, color bleeding or color pickup visible without magnification and the headlamp must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A $\frac{1}{4}^\circ$ re-aim is permitted in any direction at any test point.

S14.6.11 Corrosion resistance test of reflectors of replaceable lens headlamps test.

S14.6.11.1 Procedure.

S14.6.11.1.1 A sample headlamp with the lens removed, unfixtured and in its designed operating attitude with all drain holes, breathing devices or other designed openings in their normal operating positions, must be subjected to a salt spray (fog) test in accordance with ASTM B117-73, *Method of Salt Spray (Fog) Testing* (incorporated by reference, see 571.108 S5.2 of this title), for 24 hours, while mounted in the middle of the chamber.

S14.6.11.1.2 Afterwards, the headlamp must be stored in its designed operating attitude for 48 hours at a temperature of $73^\circ \pm 7^\circ\text{F}$ ($23^\circ \pm 4^\circ\text{C}$) and a relative humidity of $30\% \pm 10\%$ and allowed to dry by natural convection only. At the end of the 48-hour period, the reflector must be cleaned according to the instructions supplied with the headlamp manufacturer's replacement lens, and inspected. The lens and seal must then be attached according to these instructions and the headlamp tested for photometric performance.

S14.6.11.2 Performance requirements. After the completion of the corrosion test, the sample headlamp must show no evidence of corrosion or rust visible without magnification on any part of the headlamp reflector that receives light from a headlamp light source, on any metal light or heat shield assembly, or on a metal reflector of any other lamp. The sample headlamp with the replacement lens installed must meet the requirements of the applicable photometry tests of Table XIX and Table XVIII. A $\frac{1}{4}^\circ$ re-aim is permitted in any direction at any test point.

S14.6.12 Inward force test.

S14.6.12.1 Procedure. A sample headlamp mechanism, including the aiming adjusters, must be subjected to an inward force of 222 N directed normal to the headlamp aiming plane and symmetrically about the center of the headlamp lens face.

S14.6.12.2 Performance requirements. After the completion of the inward force test, a sample headlamp must not permanently recede by more than 2.5 mm. The aim of the headlamp must not permanently deviate by more than 3.2 mm at a distance of 7.6 m. The aim of any headlamp that is capable of being mechanically aimed by externally applied aiming devices must not change by more than 0.30° .

S14.6.13 Torque deflection test.

S14.6.13.1 Procedure.

S14.6.13.1.1 The sample headlamp assembly is mounted in designed vehicle position and set at nominal aim ($H=0$, $V=0$).

S14.6.13.1.2 A sealed beam headlamp, except Type G and Type H, is removed from its mounting and replaced by the applicable deflectometer. (Type C and Type D-Figure 18, Type A and Type E-Figure 16, Type B-Figure 17, and Type F-Figure 14).

S14.6.13.1.3 Sealed beam headlamps Type G and Type H have the adapter of Figure 15 and the deflectometer of Figure 14 attached to the headlamp.

S14.6.13.1.4 A torque of 2.25 Nm must be applied to the headlamp assembly through the deflectometer and a reading on the thumbwheel is taken. The torque must be removed and a second reading on the thumbwheel is taken.

S14.6.13.1.5 Headlamps other than sealed beam headlamps must have the downward force used to create the torque applied parallel to the aiming reference plane, through the aiming pads, and displaced forward using a lever arm such that the force is applied on an axis that is perpendicular to the aiming reference plane and originates at the center of the aiming pad pattern (see Figure 3).

S14.6.13.1.6 For headlamps using the aiming pad locations of Group I, the distance between the point of application of force and the aiming reference plane is not less than 168.3 mm plus the distance from the aiming reference plane to the secondary plane, if used.

S14.6.13.1.7 For headlamps using the aiming pad locations of Group II, the distance between the point of application of force and the aiming reference plane is not less than 167.9 mm plus the distance to the secondary plane, if used.

S14.6.13.1.8 For headlamps using the nonadjustable Headlamp Aiming Device Locating Plates for the 146 mm diameter, the 176 mm diameter, and the 92x150 mm sealed beam, the distance between the point of application of force and the aiming plane is not, respectively, less than 177.4 mm, 176.2 mm, and 193.7 mm.

S14.6.13.2 Performance requirements. The aim of each sample headlamp must not deviate more than 0.30° when the downward torque is removed.

S14.6.14 Retaining ring test.

S14.6.14.1 Procedure. A sample headlamp with the minimum flange thickness of: Type A-31.5 mm, Type B-10.1 mm, Type C-11.8 mm, Type D-11.8 mm, Type E-31.5 mm, and Type F-8.6 mm, is secured between the appropriate mounting ring and retaining ring (mounting ring and aiming ring for Type F).

S14.6.14.2 Performance requirements. The sample headlamp when secured per the procedure must be held tight enough that it will not rattle.

S14.6.15 Headlamp connector test.

S14.6.15.1 Procedure. A sample headlamp connected into the test circuit of Figure 4 has the power supply adjusted until 10 amperes DC are flowing through the circuit. The test is repeated for each filament circuit of the headlamp.

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S14.6.15.2 *Performance requirements.* The voltage drop, as measured in the test circuit of Figure 4, must not exceed 40 mv DC in any applicable filament circuit of the sample headlamp.

S14.6.16 *Headlamp wattage test.*

S14.6.16.1 *Procedure.* A sample headlamp that has been seasoned is energized so as to have $12.8\text{v} \pm 20\text{ mv}$ DC applied across each filament circuit and the current flowing in each circuit is measured.

S14.6.16.2 *Performance requirements.* The wattage of each filament circuit of the sample headlamp must not exceed the applicable value for that type of headlamp as shown in Table II.

S14.6.17 *Aiming adjustment test-laboratory.*

S14.6.17.1 *Procedure.* A sample headlamp is mounted in design position at nominal ($H = 0$, $V = 0$) aim with an accurate measuring device such as a spot projector or other equally accurate means attached. The headlamp is adjusted to the extremes of travel in each horizontal and vertical direction.

S14.6.17.2 *Performance requirements.* Visually aimed lower beam headlamps without a VHAD are required not to have a horizontal adjustment mechanism and horizontal aim range requirements do not apply.

S14.6.17.2.1 A sample sealed beam headlamp, other than a Type F, tested per the procedure must provide a minimum of $\pm 4.0^\circ$ adjustment range in both the vertical and horizontal planes and if equipped with independent vertical and horizontal aiming screws, the adjustment must be such that neither the vertical nor horizontal aim must deviate more than 100 mm from horizontal or vertical planes, respectively, at a distance of 7.6 m through an angle of $\pm 4.0^\circ$.

S14.6.17.2.2 A sample Type F sealed beam, integral beam, replaceable bulb, or combination headlamp tested per the procedure must provide a minimum of $\pm 4.0^\circ$ adjustment range in the vertical plane and $\pm 2.5^\circ$ in the horizontal plane and if equipped with independent vertical and horizontal aiming screws, the adjustment must be such that neither the vertical nor horizontal aim must deviate more than 100 mm from horizontal or vertical planes, respectively, at a distance of 7.6 m through an angle of $\pm 2.5^\circ$ and $\pm 4.0^\circ$, respectively.

S14.6.17.2.3 A sample headlamp that is aimed by moving the reflector relative to the lens and headlamp housing, and vice versa must provide a minimum adjustment range in the vertical plane not less than the full range of the pitch on the vehicle on which it is installed and $\pm 2.5^\circ$ in the horizontal plane.

S14.6.18 *Aiming adjustment test-on vehicle.*

S14.6.18.1 *Procedure.*

S14.6.18.1.1 A sample headlamp is mounted on the vehicle at nominal ($H = 0$, $V = 0$) aim with an accurate measuring device such as a spot projector or other equally accurate means attached.

S14.6.18.1.2 The installed range of static pitch angle is, at a minimum, determined from unloaded vehicle weight to gross vehicle weight rating, and incorporates pitch angle effects from maximum trailer or trunk loadings, the full range of tire intermix sizes and suspen-

sions recommended and/or installed by the vehicle manufacturer, and the anticipated effects of variable passenger loading.

S14.6.18.1.3 The headlamp is adjusted to the extremes of travel in each horizontal and vertical direction.

S14.6.18.2 *Performance requirements.*

S14.6.18.2.1 A sample headlamp tested per the procedure must provide a minimum vertical adjustment range not less than the full range of pitch of the vehicle on which it is installed.

S14.6.18.2.2 The vertical aim mechanism must be continuously variable over the full range.

S14.6.18.2.3 The adjustment of one aim axis through its full on-vehicle range must not cause the aim of the other axis to deviate more than $\pm 0.76^\circ$. If this performance is not achievable, the requirements of S10.18.3.1 apply, except that if the aiming mechanism is not a VHAD, the requirements specific to VHADs are not applicable, and the instruction must be specific to the aiming mechanism installed.

S14.7 *Replaceable light source physical test procedures and performance requirements.*

S14.7.1 *Deflection test for replaceable light sources.*

S14.7.1.1 *Procedure.*

S14.7.1.1.1 With the sample light source rigidly mounted in a fixture in a manner indicated in Figure 8, a force 4.0 ± 0.1 pounds ($17.8 \pm 0.4\text{N}$) is applied at a distance "A" from the reference plane perpendicular to the longitudinal axis of the glass capsule and parallel to the smallest dimension of the pressed glass capsule seal.

S14.7.1.1.2 The force is applied (using a rod with a hard rubber tip with a minimum spherical radius of .039 in [1 mm]) radially to the surface of the glass capsule in four locations in a plane parallel to the reference plane and spaced at a distance "A" from that plane. These force applications are spaced 90° apart starting at the point perpendicular to the smallest dimension of the pressed seal of the glass capsule.

S14.7.1.1.3. The bulb deflection is measured at the glass capsule surface at 180° opposite to the force application. Distance "A" for a replaceable light source other than an HB Type is the dimension provided in accordance with Appendix A of part 564 of this chapter, section I.A.1 if the light source has a lower beam filament, or as specified in section I.B.1 if the light source has only an upper beam filament.

S14.7.1.2 *Performance requirements.* After completion of the deflection test, a sample light source must have no permanent deflection of the glass envelope exceeding 0.13 mm in the direction of applied force.

S14.7.2 *Pressure test for replaceable light sources.*

S14.7.2.1 *Procedure.*

S14.7.2.1.1 The capsule, lead wires and/or terminals, and seal on each sample Type HB1, Type HB3, Type HB4, and Type HB5 light source, and on any other replaceable light source which uses a seal, is installed in a pressure chamber as shown in Figure 10 so as to provide an airtight seal. The diameter of the aperture in

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Figure 10 on a replaceable light source (other than an HB Type) must be that dimension furnished for such light source in compliance with Appendix A or Appendix B of part 564 of this chapter.

S14.7.2.1.2 The light source is immersed in water for one minute while inserted in a cylindrical aperture specified for the light source, and subjected to an air pressure of 70 KPa (10 psig) on the glass capsule side.

S14.7.2.2 *Performance requirements.* After completion of the pressure test, the sample light source with an airtight seal on the low pressure (connector side) must show no evidence of air bubbles on that side.

S14.7.3 *Replaceable light source power and flux measurement procedure.* The measurement of maximum power and luminous flux that is submitted in compliance with section VII of Appendix A of part 564 of this chapter, or section IV of Appendix B of part 564 of this chapter, is made in accordance with this paragraph.

S14.7.3.1 *Seasoning.* The filament or discharge arc is seasoned before measurement of either maximum power and luminous flux.

S14.7.3.1.1 *Resistive filament source.* Seasoning of a light source with a resistive element type filament is made in accordance with this S14.2.5.4 of this standard.

S14.7.3.1.2 *Discharge source.* For a light source using excited gas mixtures as a filament or discharge arc, seasoning of the light source system, including any ballast required for its operation, is made in accordance with section 4.0 of SAE Recommended Practice J2009 (1993) (incorporated by reference, see §571.5).

S14.7.3.2 *Test voltage.* Measurements are made with a direct current test voltage of 12.8 v regulated within one quarter of one percent.

S14.7.3.3 *Luminous flux measurement.* The measurement of luminous flux is made in accordance with IES LM 45 (incorporated by reference, see §571.5).

S14.7.3.3.1 *Resistive filament light source setup.* Luminous flux measurements are made with the black cap installed on Type HB1, Type HB2, Type HB4, and Type HB5, and on any other replaceable light source so designed; and is with the electrical conductor and light source base shrouded with an opaque white cover, except for the portion normally located within the interior of the lamp housing. The measurement of luminous flux for the Types HB3 and HB4 is made with the base covered with a white cover as shown in the drawings for Types HB3 and HB4 filed in Docket No. NHTSA 98-3397. The white covers are used to eliminate the likelihood of incorrect lumen measurement that will occur should the reflectance of the light source base and electrical connector be low.

S14.7.3.3.2 *Discharge light source setup.* With the test voltage applied to the ballast input terminals, the measurement of luminous flux is made with the black cap installed, if so designed, and is made with an opaque white colored cover, except for the portion normally located within the interior of the lamp housing.

S14.8 *Vehicle headlamp aiming devices (VHAD) physical test procedures and performance requirements.*

S14.8.1 *Samples.* The same VHAD and associated headlamp(s) or headlamp assembly must be rigidly

mounted in a headlamp test fixture with the aiming plane horizontal and vertical and with the scale on the device set at 0.

S14.8.2 *Scale graduation test.*

S14.8.2.1 *Procedure.* Check each graduation on the horizontal and vertical aim scales.

S14.8.2.2 *Performance requirements.* Scale graduation from correct aim must not exceed $\pm 0.2^\circ$ horizontally and $\pm 0.1^\circ$ vertically.

S14.8.3 *Cold scale graduation test.*

S14.8.3.1 *Procedure.* The VHAD and an unlighted headlamp assembly must then be stabilized at $-7^\circ \pm 3^\circ\text{C}$ in a circulating air environmental test chamber for a 30 minute temperature soak.

S14.8.3.2 *Performance requirements.* After completion of a 30 minute temperature soak the variation from correct aim shown by the sample VHAD must not exceed $\pm 0.2^\circ$ horizontally and $\pm 0.1^\circ$ vertically.

S14.8.4 *Hot scale graduation test.*

S14.8.4.1 *Procedure.* The VHAD and the headlamp assembly with its highest wattage filament, or combination of filaments intended to be used simultaneously, energized at its design voltage, is then stabilized at $38^\circ \pm 3^\circ\text{C}$ in a circulating air environmental test chamber for a 30 minute temperature soak.

S14.8.4.2 *Performance requirements.* After completion of a 30 minute temperature soak the variation from correct aim shown by the sample VHAD must not exceed $\pm 0.2^\circ$ horizontally and $\pm 0.1^\circ$ vertically.

S14.8.5 *Thermal cycle test.*

S14.8.5.1 *Procedure.* The VHAD and an unlighted headlamp assembly are then placed in a circulating air environmental test chamber and exposed to a temperature of $60^\circ \pm 3^\circ\text{C}$ for 24 hours, followed by a temperature of $-40^\circ \pm 3^\circ\text{C}$ for 24 hours, and are then permitted to return to room temperature.

S14.8.5.2 *Performance requirements.* After completion of the thermal cycle test the variation from correct aim shown by the sample VHAD must not exceed $\pm 0.2^\circ$ horizontally and $\pm 0.1^\circ$ vertically and the VHAD and headlamp assembly must show no damage which would impair its ability to perform as specified in this standard.

S14.8.6 *Corrosion test.*

S14.8.6.1 *Procedure.* The VHAD and headlamp assembly are then tested according to the headlamp corrosion test of S14.6.3.

S14.8.6.2 *Performance requirements.* After completion of the corrosion test the sample VHAD and headlamp must not have any observed corrosion that would result in the failure of any other applicable tests contained in this section.

S14.8.7 *Photometry test.*

S14.8.7.1 *Procedure.* The VHAD and headlamp assembly are then tested for photometric compliance according to the procedure of S14.2.5 and for replacement units per S10.18.8.4.

S14.8.7.2 *Performance requirements.* The sample headlamp must comply with the applicable photometric

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requirements of Table XIX and Table XVIII and with replacement units installed per S10.18.8.4.

S14.9 Associated equipment physical test procedures and performance requirements.

S14.9.1 Turn signal operating unit durability test.

S14.9.1.1 Power supply specifications. During the test, the unit is operated at 6.4 volts for 6 volt systems or 12.8 volts for 12 volt systems from a power supply meeting the following requirements:

- (a) An output current that is at least 10 times the load current;
- (b) Voltage regulation that allows a voltage change of less than 5%;
- (c) Ripple voltage of not more than 5%;
- (d) A response time of not more than 25 milliseconds rise time from 0 to rated current at rated voltage in a pure resistance circuit; and
- (e) An output impedance of not more than 0.005 ohms dc.

S14.9.1.2 Procedure.

S14.9.1.2.1 The sample unit is operated with the maximum bulb load it will experience on the vehicle on which it will be installed. Bulbs that fail during the test are replaced. The turn signal flasher is not to be included in the test circuit. When the unit includes a self-canceling means, the test equipment is arranged so that the unit will be turned “off” in its normal operating manner.

S14.9.1.2.2 The test is conducted at a rate not to exceed 15 complete cycles per minute. One complete cycle consists of the following sequence: Off, left turn, off, right turn, and return to off.

S14.9.1.2.3 The voltage drop from the input terminal of the device to each lamp output terminal, including 3 in of 16 or 18 gage wire, is measured at the start of the test, at intervals of not more than 25,000 cycles during the test, and at the completion of the test.

S14.9.1.3 Performance requirements.

S14.9.1.3.1 A turn signal operating unit is considered to have met the requirements of the durability test if it remains operational after completing at least 100,000 cycles, and the voltage drop between the input contact and any output contact, including required length of wire, does not exceed 0.25 volts.

S14.9.1.3.2 A turn signal operating unit is considered to have met the requirements of the durability test if it remains operational after completing at least 175,000 cycles for a unit installed on a multipurpose passenger vehicle, truck, or bus 2032 mm or more in overall width, and the voltage drop between the input contact and any output contact, including required length of wire, does not exceed 0.25 volts.

S14.9.1.3.3 If stop signals also operate through the turn signal operating unit, the voltage drop of any additional switch contacts must meet the same requirements as the turn signal contacts.

S14.9.2 Vehicular hazard warning signal operating unit durability test.

S14.9.2.1 Procedure.

S14.9.2.1.1 The sample unit is operated at its rated voltage with the maximum bulb load it will experience on the vehicle on which it will be installed. Bulbs that fail during the test are replaced. The hazard warning signal flasher is not to be included in the test circuit.

S14.9.2.1.2 The unit is turned “on” and “off” in its normal operating manner at a rate not to exceed 15 complete cycles per minute. One complete cycle consists of the sequence: Off, on, and return to off. The test consists of 10,000 cycles at an ambient temperature of $75^{\circ} \pm 10^{\circ} \text{F}$ followed by 1 hour constant “on” at the same temperature.

S14.9.2.1.3 The voltage drop from the input terminal of the device to each lamp output terminal, including 3 in of 16 or 18 gage wire, is measured at the start of the test and at the completion of the test.

S14.9.2.2 Performance requirements. A hazard warning signal operating unit is considered to have met the requirements of the durability test if it remains operational after completing 10,000 cycles and the 1 hour constant “on” and the voltage drop between the input contact and any output contact, including required length of wire, does not exceed 0.3 volts for either 6.4 or 12.8 line voltage both at the start and completion of the test.

S14.9.3 Turn signal flasher and vehicular hazard warning signal flasher tests.

S14.9.3.1 Standard test circuit. All turn signal flasher and vehicular hazard warning signal flasher tests use the standard test circuit of Figure 22.

S14.9.3.1.1 Test circuit setup.

S14.9.3.1.1.1 The effective series resistance in the total circuit between the power supply and the bulb sockets (excluding the flasher and bulb load(s) using shorting bars) is 0.10 ± 0.01 ohm.

S14.9.3.1.1.2 The circuit resistance at A-B of Figure 22 is measured with flasher and bulb load(s) each shorted out with an effective shunt resistance not to exceed 0.005 ohms.

S14.9.3.1.1.3 The voltage to the bulbs at C-D of Figure 22 is adjusted to 12.8 volts (or 6.4 volts) with the flasher shorted out by an effective shunt resistance not to exceed 0.005 ohms. The load current is adjusted by simultaneously adjusting trimmer resistors, R.

S14.9.3.1.1.4 For testing fixed-load flashers at other required voltages, adjust the power supply to provide required voltages, at the required temperatures, at C-D of Figure 22, without readjustment of trimming resistors, R.

S14.9.3.1.1.5 For variable-load flashers, the circuit is first adjusted for 12.8 volts (or 6.4 volts) at C-D of Figure 22, with the minimum required load, and the power supply is adjusted to provide other required test voltages, at required temperatures, at C-D of Figure 22, without readjustment of trimming resistors, R (each such required voltage being set with the minimum required load in place). The required voltage tests with the maximum load are conducted without readjusting each corresponding power supply voltage, previously set with minimum bulb load.

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S14.9.3.1.1.6 A suitable high impedance measuring device connected to points X-Y in Figure 22 is used for measuring flash rate, percent current “on” time, and voltage drop across the flasher. The measurement of these quantities does not affect the circuit.

S14.9.3.2 *Power supply specifications.*

S14.9.3.2.1 *Starting time, voltage drop, and flash rate and percent current “on” time tests.* The power supply used in the standard test circuit for conducting the starting time, the voltage drop, and the flash rate and percent current “on” time tests must comply with the following specifications:

(a) Must not generate any adverse transients not present in motor vehicles;

(b) Be capable of supplying 11-16 vdc for 12 volt flashers and 5-9 vdc for 6 volt flashers to the input terminals of the standard test circuit;

(c) Be capable of supplying required design current(s) continuously and inrush currents as required by the design bulb load complement;

(d) Be capable of supplying an output voltage that does not deviate more than 2% with changes in the static load from 0 to maximum (not including inrush current) nor for static input line voltage variations;

(e) Be capable of supplying an output voltage that does not deviate more than 1.0 vdc from 0 to maximum load (including inrush current) and must recover 63% of its maximum excursion within 100 μ sec; and

(f) Have a ripple voltage of 75mv, peak to peak.

S14.9.3.2.2 *Durability tests.* The power supply used in the standard test circuit for conducting durability tests must comply with the following specifications:

(a) Must not generate any adverse transients not present in motor vehicles;

(b) Be capable of supplying 13 vdc and 14 vdc for 12 volt flashers and 6.5 vdc and 7 vdc for 6 volt flashers to the input terminals of the standard test circuit;

(c) Be capable of supplying a continuous output current of the design load for one flasher times the number of flashers and inrush currents as required by the design bulb load complement;

(d) Be capable of supplying an output voltage that does not deviate more than 2% with changes in the static load from 0 to maximum (not including inrush current) and means must be provided to compensate for static input line voltage variations;

(e) Be capable of supplying an output voltage that does not deviate more than 1.0 vdc from 0 to maximum load (including inrush current) and must recover 63% of its maximum excursion within 5 μ sec; and

(f) Have a ripple voltage of 300 mv, peak to peak.

S14.9.3.3 *Turn signal flasher starting time test.*

S14.9.3.3.1 *Samples.* Twenty sample flashers chosen from random from fifty representative samples are subjected to a starting time test using the standard test circuit.

S14.9.3.3.2 *Procedure.*

S14.9.3.3.2.1 The test is conducted in an ambient temperature of 75 ± 10 °F with the design load (variable

load flashers are tested with their minimum and their maximum design load) connected and the power source for the test circuit adjusted to apply design voltage at the bulbs.

S14.9.3.3.2.2 The time measurement starts when the voltage is initially applied. Compliance is based on an average of three starts for each sample separated by a cooling interval of 5 minutes.

S14.9.3.3.3 *Performance requirements.* The requirements of the starting time test are considered to have been met if 17 of 20 samples comply with the following:

(a) A flasher having normally closed contacts must open (turn off) within 1.0 second for a device designed to operate two signal lamps, or within 1.25 seconds for a device designed to operate more than two lamps, or

(b) A flasher having normally open contacts must complete the first cycle (close the contacts and then open the contacts) within 1.5 seconds.

S14.9.3.4 *Turn signal flasher voltage drop test.*

S14.9.3.4.1 *Samples.* The same twenty sample flashers used in the starting time test are subjected to a voltage drop test using the standard test circuit.

S14.9.3.4.2 *Procedure.*

S14.9.3.4.2.1 The test is conducted in an ambient temperature of 75 ± 10 °F with the design load (variable load flashers are tested with their maximum design load) connected and the power source for the standard test circuit adjusted to apply 12.8 volts or 6.4 volts at the bulbs according to the flasher rating.

S14.9.3.4.2.2 The voltage drop is measured between the input and load terminals of the flasher during the “on” period after the flashers have completed at least five consecutive cycles.

S14.9.3.4.3 *Performance requirements.* The requirements of the voltage drop test are considered to have been met if 17 of 20 samples comply with the lowest voltage drop across any flasher not exceeding 0.80 volt.

S14.9.3.5 *Turn signal flasher flash rate and percent current “on” time test.*

S14.9.3.5.1 *Samples.* The same twenty sample flashers used in the voltage drop test are subjected to a flash rate and percent of current “on” time test.

S14.9.3.5.2 *Procedure.*

S14.9.3.5.2.1 The test is conducted using the standard test circuit with the design load (variable load flashers are tested with their minimum and their maximum design load) connected and design voltage applied to the bulbs.

S14.9.3.5.2.2 Compliance is determined using the following combinations of ambient temperature and bulb voltage:

(a) 12.8 volts (or 6.4 volts) and $75^\circ \pm 10$ °F,

(b) 12.0 volts (or 6.0 volts) and $0^\circ \pm 5$ °F,

(c) 15.0 volts (or 7.5 volts) and $0^\circ \pm 5$ °F,

(d) 11.0 volts (or 5.5 volts) and $125^\circ \pm 5$ °F, and

(e) 14.0 volts (or 7.0 volts) and $125^\circ \pm 5$ °F.

S14.9.3.9.2.3 Flash rate and percent current “on” time are measured after the flashers have completed five

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consecutive cycles and are determined by an average of at least three consecutive cycles.

S14.9.3.9.3 Performance requirements. The requirements of the flash rate and percent current “on” time test are considered to have been met if 17 of 20 samples comply with the following:

(a) The performance of a normally closed type flasher must be within the unshaded portion of the polygon shown in Figure 2, or

(b) The performance of a normally open type flasher must be within the entire rectangle including the shaded areas shown in Figure 2.

S14.9.3.10 Vehicular hazard warning signal flasher durability test.

S14.9.3.10.1 Samples. Twenty sample flashers chosen from random from the thirty samples not used in the previous tests are subjected to a durability test.

S14.9.3.10.2 Procedure.

S14.9.3.10.2.1 Conformance of the samples to the starting time, voltage drop, and flash rate and percent of current “on” time tests (limited to the 12.8 volts or 6.4 volts and $75^{\circ} \pm 10^{\circ}\text{F}$ test condition only) is established.

S14.9.3.10.2.2 The test is conducted on each sample with the maximum design load connected and 13.0 volts (or 6.5 volts) applied to the input terminals of the standard test circuit.

S14.9.3.10.2.3 The flasher is subjected to continuous flashing for a total time of 36 hours in an ambient temperature of $75^{\circ} \pm 10^{\circ}\text{F}$.

S14.9.3.10.3 Performance requirements. The requirements of the durability test are considered to have been met if, after completion, 17 of 20 samples comply with the performance requirements of the starting time, voltage drop, and flash rate and percent of current “on” time tests (limited to the 12.8 volts or 6.4 volts and $75^{\circ} \pm 10^{\circ}\text{F}$ test condition only) when tested in the standard test circuit with the power source adjusted to provide design voltage to the bulbs and with a minimum load of two signal lamp bulbs and the maximum design load, including pilot lamps, as specified by the manufacturer at an ambient temperature of $75^{\circ} \pm 10^{\circ}\text{F}$.

S14.9.3.11 Semiautomatic headlamp beam switching device tests.

S14.9.3.11.1 Test conditions. All tests are conducted with 13 volts input to the device unless otherwise specified.

S14.9.3.11.2 Sensitivity test.

S14.9.3.11.2.1 Samples. The sample device is mounted in and operated in the laboratory in the same environment as that encountered on the vehicle, that is tinted glass, grille work, etc.

S14.9.3.11.2.2 Procedure.

S14.9.3.11.2.2.1 The sample device is adjusted for sensitivity in accordance with the manufacturer’s instructions. It is exposed to a light source capable of providing a variable intensity of at least 1.5 cd to 150 cd at 100 feet from the sample device.

S14.9.3.11.2.2.2 The device is switched to the lower beam mode in accordance with the “dim” limits specified and switched back to the upper beam mode in accordance with the “hold” limits specified for the specified test positions.

S14.9.3.11.2.2.3 To provide more complete information on sensitivity throughout the required vertical and horizontal angles, a set of constant footcandle curves are made at “dim” sensitivities of 17, 25, and 100 cd at 100 ft.

S14.9.3.11.2.3 Performance requirements.

S14.9.3.11.2.3.1 Operating limits.

Test position (degrees)	Dim (cd at 100 ft)	Hold (cd at 100 ft)
H V	Adjust to 15	1.5 min to 3.75 max.
H 2L	25 max	1.5 min.
H 4L	40 max	1.5 min.
H 6L	75 max	1.5 min.
H 2R	25 max	1.5 min.
H 5R	150 max to 40 min	1.5 min.
1D V	30 max	1.5 min.
1U V	30 max	1.5 min.

S14.9.3.11.2.3.2 There must be no sensitivity voids shown in the constant footcandle curves within the area limited by the test positions.

S14.9.3.11.3 Voltage regulation test.

S14.9.3.11.3.1 Procedure.

S14.9.3.11.3.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.3.1.2 The “dim” sensitivity is measured at the H-V test position at 11 volts input to the device and at 15 volts input to the device.

S14.9.3.11.3.2 Performance requirements. The device must switch to the lower beam mode at between 8 (cd at 100 ft) and 25 (cd at 100 ft) with the input voltage at 11 volts and at 15 volts.

S14.9.3.11.4 Manual override test.

S14.9.3.11.4.1 Procedure.

S14.9.3.11.4.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.4.1.2 The device is exposed to a test light that causes it to switch to the lower beam mode.

S14.9.3.11.4.1.3 The manufacturer’s instructions are followed to cause the device to override the test light and switch to upper beam.

S14.9.3.11.4.1.4 In a similar manner, the test light is extinguished to cause the device to switch to the upper beam mode.

S14.9.3.11.4.1.5 Again the manufacturer’s instructions are followed to cause the device to switch to lower beam.

S14.9.3.11.4.2 Performance requirements. The device, when operated in accordance with the manufacturer’s instructions, must switch to the opposite beam with the test light energized and with the test light extinguished.

S14.9.3.11.5 Warmup test.

S14.9.3.11.5.1 Procedure.

S14.9.3.11.5.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test and the test lamp extinguished.

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S14.9.3.11.5.1.2 The test lamp will then be energized at a level of 25 (cd at 100 ft) at the H-V position of the device and the time for the device to switch to lower beam is measured.

S14.9.3.11.5.2 *Performance requirements.* If the warm-up time of the device exceeds 10 seconds it shall maintain the headlamps on lower beam during warmup.

S14.9.3.11.6 *Temperature test.*

S14.9.3.11.6.1 *Procedure.*

S14.9.3.11.6.1.1 The sample device is exposed for 1 hour in a temperature corresponding to that at the device mounting location.

S14.9.3.11.6.1.2 For a device mounted in the passenger compartment or the engine compartment, the temperature is 210 °F, mounted elsewhere, the temperature is 150 °F.

S14.9.3.11.6.1.3 After this exposure the H-V “dim” sensitivity of the sample device is measured over the temperature range of -30 °F to +100 °F.

S14.9.3.11.6.2 *Performance requirements.* The device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft) over the temperature range of -30 °F to +100 °F.

S14.9.3.11.7 *Dust test.*

S14.9.3.11.7.1 *Procedure.*

S14.9.3.11.7.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.7.1.2 The device is then subjected to the dust test of S14.5.3.

S14.9.3.11.7.1.3 At the conclusion of the dust exposure the lens of the device must be wiped clean and the H-V “dim” sensitivity of the sample device is measured.

S14.9.3.11.7.2 *Performance requirements.* The device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.8 *Corrosion test.*

S14.9.3.11.8.1 *Procedure.*

S14.9.3.11.8.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.8.1.2 All system components located outside the passenger compartment must be subjected to the corrosion test of S14.5.4 with the device not operating.

S14.9.3.11.8.1.3 Water is not permitted to accumulate on any connector socket.

S14.9.3.11.8.1.4 At the conclusion of the test the H-V “dim” sensitivity of the sample device must be measured.

S14.9.3.11.8.2 *Performance requirements.* The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.9 *Vibration test.*

S14.9.3.11.9.1 *Procedure.*

S14.9.3.11.9.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test and the mechanical aim of the photounit determined.

S14.9.3.11.9.1.2 The sample device must be mounted in proper vehicle position and subjected to vibration of

5g constant acceleration for ½ hour in each of three directions: vertical; horizontal and parallel to the vehicle longitudinal axis; and horizontal and normal to the vehicle longitudinal axis.

S14.9.3.11.9.1.3 The vibration frequency must be varied from 30 to 200 and back to 30 cycles per second over a period of approximately 1 minute.

S14.9.3.11.9.1.4 The device must be operating during the test.

S14.9.3.11.9.1.5 At the conclusion of the test the H-V “dim” sensitivity of the sample device and the mechanical aim of the photounit must be measured.

S14.9.3.11.9.2 *Performance requirements.*

S14.9.3.11.9.2.1 The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.9.2.2 The mechanical aim of the device photounit must not have changed by more than 0.25° from the initial value.

S14.9.3.11.10 *Sunlight test.*

S14.9.3.11.10.1 *Procedure.*

S14.9.3.11.10.1.1 The sample device must be exposed for 1 hour in bright noonday sunlight (5000 fc minimum illumination with a clear sky) with the photounit aimed as it would be in service and facing an unobstructed portion of the horizon in the direction of the sun.

S14.9.3.11.10.1.2 The device must then be rested for 1 hour in normal room light at room temperature and the H-V “dim” sensitivity of the sample device is measured.

S14.9.3.11.10.2 *Performance requirements.* The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.11 *Durability test.*

S14.9.3.11.11.1 *Procedure.*

S14.9.3.11.11.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.11.1.2 The device photounit operated at a 13.0 input voltage on a cycle of 90 minutes on and 30 minutes off must be activated by a 60 cd light source at 100 ft, or equivalent, which is cycled on and off 4 times per minute for a period of 200 hours.

S14.9.3.11.11.1.3 The device must then rest for 2 hours in a lighted area of 50 to 150 fc after which the H-V “dim” sensitivity must be measured.

S14.9.3.11.11.2 *Performance requirements.* The sample device must switch to the lower beam mode between 8 (cd at 100 ft) and 25 (cd at 100 ft).

S14.9.3.11.12 *Return to upper beam test.*

S14.9.3.11.12.1 *Procedure.*

S14.9.3.11.12.1.1 The sensitivity of the sample device is adjusted so that it complies with the sensitivity test.

S14.9.3.11.12.1.2 The lens of the photounit must be exposed to light of 100 fc for 10 seconds.

S14.9.3.11.12.2 *Performance requirements.* The sample device must switch to upper beam mode within 2 seconds after the 100 fc light is extinguished.

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TABLE 1—A—REQUIRED LAMPS AND REFLECTIVE DEVICES

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
All Passenger Cars, Multipurpose passenger Vehicles (MPV), Trucks, and Buses				
Lower Beam Headlamps	White, of a headlighting system listed in Table II.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 22 inches (55.9 cm) nor more than 54 inches (137.2 cm).	The wiring harness or connector assembly of each headlighting system must be designed so that only those light sources intended for meeting lower beam photometrics are energized when the beam selector switch is in the lower beam position, and that only those light sources intended for meeting upper beam photometrics are energized when the beam selector switch is in the upper beam position, except for certain systems listed in Table II. Steady burning, except that may be flashed for signaling purposes.
Upper Beam Headlamps	White, of a headlighting system listed in Table II.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 22 inches (55.9 cm) nor more than 54 inches (137.2 cm).	
Turn Signal Lamps	2 Amber	At or near the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 83 inches.	Flash when the turn signal flasher is actuated by the turn signal operating unit.
	2 Amber or red Truck tractor exception, see S6.1.1.3.	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable.		
Taillamps	2 Red	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 72 inches.	Steady burning. Must be activated when the headlamps are activated in a steady burning state or the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activated. May be activated when the headlamps are activated at less than full intensity as Daytime Running Lamps (DRL).
Stop Lamps	2 Red	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable	Not less than 15 inches, nor more than 72 inches	Steady burning. Must be activated upon application of the service brakes. When optically combined with a turn signal lamp, the circuit must be such that the stop signal cannot be activated if the turn signal lamp is flashing. May also be activated by a device designed to retard the motion of the vehicle.
Side Marker Lamps	2 Amber	On each side as far tot he front as practicable	Not less than 15 inches	Steady burning except may be flashed for signaling purposes. Must be activated when the headlamps are activated in a steady burning state or the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activated.
	2 Red (not required on truck tractor	On each side as far to the rear as practicable		

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TABLE 1–A–REQUIRED LAMPS AND REFLECTIVE DEVICES, Continued

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
Reflex Reflectors	2 Amber	On each side as far to the front as practicable.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
	2 Red (not required on truck tractor)	On each side as far to the rear as practicable.		
	2 Red	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. On a truck tractor may be mounted on the back of the cab not less than 4 inches above the height of the rear tires.		
Backup Lamp	1 White. Additional lamps permitted to meet requirements.	On the rear.	No requirement.	Steady burning. Must be activated when the ignition switch is energized and reverse gear is engaged. Must not be energized when the vehicle is in forward motion.
License Plate Lamp	1 White. Additional lamps permitted to meet requirements.	On the rear to illuminate license plate from top or sides	No requirement.	Steady burning. Must be activated when the headlamps are activated in steady burning state or when the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activated.
Additional Lamps Required on All Passenger Cars, and on Multipurpose Passenger Vehicles (MPV), Trucks, and Buses, Less Than 2032 MM in Overall Width				
Parking lamps	2 Amber or white.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable	Not less than 15 inches, nor more than 72 inches.	Steady burning. Must be activated when the headlamps are activated in a steady burning state.
Additional Lamp(s) Required on All Passenger Cars, and on Multipurpose Passenger Vehicles (MPV), Trucks, and Buses, Less Than 2032 MM in Overall Width and With a GVWR of 10,000 LBS or Less				
High mounted stop lamp	1 Red, or 2 red where exceptions apply. See Section 6.1.1.2.	On the rear including glazing, with the lamp center on the vertical centerline as viewed from the rear.	Not less than 34 inches except for passenger cars. See Section 6.1.4.1.	Steady burning. Must only be activated upon application of the service brakes or by a device designed to retard the motion of the vehicle.

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TABLE 1--A--REQUIRED LAMPS AND REFLECTIVE DEVICES, Continued

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
Additional Lamps and Reflective Devices Required on All Passenger Cars, Multipurpose Passenger Vehicles (MPV), Trucks, and Buses, 30 Feet or Longer				
Intermediate side marker lamps.	2 Amber	On each side located at or near the midpoint between the front and rear side marker lamps	Not less than 15 inches.	Steady burning except may be flashed for signaling purposes. Must be activated when the headlamps are activated in a steady burning state or when the parking lamps on passenger cars and MPVs, trucks, and buses less than 80 inches in overall width are activate.
Intermediate side reflex reflectors.	2 Amber	On each side located at or near the midpoint between the front and rear side reflex reflectors.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
Additional Lamps Required on All Multipurpose Passenger Vehicles (MPV), Truck, and Buses, 2032 MM or More in Overall Width				
Clearance lamps	2 Amber	On the front to indicate the overall width of the vehicle, or width of cab on truck tractor, at the same height, symmetrically about the vertical centerline. May be located at a location other than the front if necessary to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle.	As near the top as practicable	Steady burning.
	2 Red (not required on truck tractor)	On the rear to indicate the overall width of the vehicle, at the same height, symmetrically about the vertical centerline. May be located at a location other than the rear if necessary to indicate the overall width of the vehicle, or for the protection from damage during normal operation of the vehicle.	As near the top as practicable, except where the rear identification lamps are mounted at the extreme height of the vehicle. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors.	Steady burning.
Identification lamps.	3 Amber	On the front, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6 inches or more than 12 inches apart.	As near the top of the vehicle or top of the cab as practicable.	Steady burning.
	3 Red (not required on truck tractor).	On the rear, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6 inches or more than 12 inches apart.	As near the tops as practicable. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors	Steady burning.

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TABLE 1—A—REQUIRED LAMPS AND REFLECTIVE DEVICES, Continued

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
Additional lamps Required on All School Buses Except Multifunction School Activity Buses				
Signal warning lamps	2 Red plus 2 amber optional	On the front of the cab as far apart as practicable, but in no case shall the spacing between lamps be less than 40 inches. Amber lamps, when installed, at the same height as and just inboard of the red lamp.	As high as practicable but at least above the windshield	Flashing alternately between 60 to 120 cycles per minute, with an activation period sufficient to allow the lamp to reach full brightness, when actuated by a manual switch. Amber lamps, when installed, may only be activated by manual or foot operation, and must be automatically deactivated and the red lamps must be automatically deactivated when the bus entrance door is opened.
	2 Red plus 2 amber optional.	On the rear cab as far apart as practicable, but in no case shall the spacing between lamps be less than 40 inches. Amber lamps, when installed, at the same height as and just inboard of the red lamp.	As high as practicable, but at least above the top of any side window opening.	Flashing alternately between 60 to 120 cycles per minute, with an activation period sufficient to allow the lamp to reach full brightness, when actuated by a manual switch. Amber lamps, when installed, may only be activated by manual or foot operation, and must be automatically deactivated and the red lamps must be automatically deactivated when the bus entrance door is opened.
Daytime Running Lamps Permitted but Not Required on Passenger Cars, Multipurpose Passenger Vehicles (MPV), Trucks, and Buses				
Daytime running lamp (DRL).	2 identically colored either white, white to yellow, white to selective yellow, selective yellow, or yellow	On the front, symmetrically disposed about the vertical centerline if not a pair of lamps required by this standard or if not optically combined with a pair of lamps required by this standard.	Not more than 1.067 meters above the road surface if not a pair of lamps required by this standard. See S7.10.13(b) for additional height limitation	Steady burning. Automatically activated as determined by the vehicle manufacturer and automatically deactivated when the headlamp control is in any "on" position. Each DRL optically combined with a turn signal lamp must be automatically deactivated as a DRL when the turn signal lamp or hazard warning lamp is activated, and automatically reactivated as a DRL when the turn signal lamp or hazard warning lamp is deactivated. See S7.10.10.1(c) for additional activation requirements when mounted close to, or combined with, a turn signal lamp.

TABLE 1—B—REQUIRED LAMPS AND REFLECTIVE DEVICES

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
All Trailers				
Turn Signal Lamps	2 Red or amber	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable.	Not less than 15 inches, nor more than 83 inches.	Flash when the turn signal flasher is actuated by the turn signal operating unit.

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TABLE 1-B—REQUIRED LAMPS AND REFLECTIVE DEVICES, Continued

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
Taillamps	2 Red or 1 red on trailers less than 30 inches wide.	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. When a single lamp is installed it must be mounted at or near the vertical centerline.	Not less than 15 inches, nor more than 72 inches.	Steady burning.
Stop Lamps	2 Red, or 1 red on trailers less than 30 inches wide	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. When a single lamp is installed it must be mounted at or near the vertical centerline.	Not less than 15 inches, nor more than 72 inches	Steady burning. Must be activated upon application of the service brakes. When optically combined with a turn signal lamp, the circuit must be such that the stop signal cannot be activated if the turn signal lamp is flashing. May also be activated by a device designed to retard the motion of the vehicle.
Side Marker Lamps	2 Amber. None required on trailers less than 1829 mm [6 ft] in overall length including the trailer tongue.	On each side as far to the front as practicable exclusive of the trailer tongue.	Not less than 15 inches.	Steady burning except may be flashed for signaling purposes.
	2 Red	On each side as far to the rear as practicable.	Not less than 15 inches. Not more than 60 inches on trailers 2032 mm or more in overall width.	
Reflex Reflectors. A trailer equipped with a conspicuity treatment in conformance with S8.2 of this standard need not be equipped with reflex reflectors if the conspicuity material is placed at the locations of the required reflex reflectors.	2 Amber. None required on trailers less than 1829 mm [6 ft] in overall length including the trailer tongue	On each side as far to the front as practicable exclusive of the trailer tongue.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
	2 Red	On each side as far to the rear as practicable		
	2 Red or 1 red on trailers less than 30 inches wide	On the rear, at the same height, symmetrically about the vertical centerline, as far apart as practicable. When a single reflector is installed it must be mounted at or near the vertical centerline.		
License Plate Lamp	1 White Additional lamps permitted to meet requirements.	On the rear to illuminate license plate from top or sides	No requirement.	Steady burning.
Additional Lamps and Reflective Devices Required on all Trailers 30 Feet or Longer				
Intermediate side marker lamps	2 Amber	On each side located at or near the midpoint between the front and rear side marker lamps.	Not less than 15 inches	Steady burning except maybe flashed for signaling purposes.
Intermediate side reflex reflectors. A trailer equipped with a conspicuity treatment in conformance with S8.2 of this standard need not be equipped with reflex reflectors if the conspicuity material is placed at the locations of the required reflex reflectors.	2 Amber	On each side located at or near the midpoint between the front and rear side reflex reflectors	Not less than 15 inches, nor more than 60 inches	Not applicable.

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TABLE 1-B—REQUIRED LAMPS AND REFLECTIVE DEVICES, Continued

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
Additional Lamps Required on all Trailers 2032 MM or More in Overall Width				
Clearance lamps	2 Amber	On the front to indicate the overall width of the vehicle, at the same height, symmetrically about the vertical centerline. May be located at a location other than the front if necessary to indicate the overall width of the vehicle or for protection from damage during normal operation of the vehicle	As near the top as practicable.	Steady burning.
	2 Red	On the rear to indicate the overall width of the vehicle, at the same height, symmetrically about the vertical centerline. May be located at a location other than the front if necessary to indicate the overall width of the vehicle or for protection from damage during normal operation of the vehicle.	As near the top as practicable, except where the rear identification lamps are mounted at the extreme height of the vehicle. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors.	Steady burning.
	2 Amber to front and red to rear	On a boat trailer the requirement for front and rear clearance lamps may be met by installation at or near the midpoint on each side of a dual facing lamps so as to indicate the extreme width. May be located at a location other than the front and the rear if necessary to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle.	As near the top as practicable	Steady burning.
Identification lamps.	3 Red	On the rear, at the same height, as close as practicable to the vertical centerline, with lamp centers spaced not less than 6 inches or more apart than 12 inches apart.	As near the top as practicable. Practicability of locating lamps on the vehicle header is presumed when the header extends at least 25 mm (1 inch) above the rear doors.	Steady burning.

TABLE 1-C—REQUIRED LAMPS AND REFLECTIVE DEVICES

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
All Motorcycles				
Lower Beam Headlamps.	White, of a headlighting system listed in S10.17.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable. See additional requirements in S10.17.1.1, S10.17.1.2, and S10.17.1.3.	Not less than 22 inches (55.9 cm) nor more than 54 inches (137.2 cm).	The wiring harness or connector assembly of each headlighting system must be designed so that only those light sources intended for meeting lower beam photometrics are energized when the beam selector switch is in the lower beam position, and that only those light sources intended for meeting upper beam photometrics are energized when the beam selector switch is in the upper beam position, except for certain systems listed in Table II.

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TABLE 1–C–REQUIRED LAMPS AND REFLECTIVE DEVICES, Continued

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
Upper Beam Headlamps	White, of a headlighting system listed in S10.17.	On the front, at the same height, symmetrically about the vertical centerline, as far apart as practicable. See additional requirements in S10.17.1.1, S10.17.1.2, and S10.17.1.3.	Not less than 22 inches (55.9 cm) nor more than 54 inches (137.2 cm).	Steady burning, except that may be flashed for signaling purposes. The upper beam or the lower beam, but not both, may be wired to modulate from a higher intensity to a lower intensity in accordance with S10.17.5
Turn Signal Lamps	2 Amber. Non required on a motor driven cycle whose speed attainable in 1 mile is 30 mph or less. 2 Amber or red. Non required on a motor driven cycle whose speed attainable in 1 mile is 30 mph or less.	At or near the front, at the same height, symmetrically about the vertical centerline, and having a minimum horizontal separation distance (centerline of lamps) of 16 inches. Minimum edge to edge separation distance between a turn signal lamp and headlamp is 4 inches At or near the rear, at the same height, symmetrically about the vertical centerline, and having a minimum horizontal separation distance (centerline to centerline of lamps) of 9 inches. Minimum edge to edge separation distance the turn signal lamp and the taillamp or stoplamp is 4 inches, when a single stop and taillamp is installed on the vertical centerline and the turn signal lamps are red.	Not less than 15 inches, nor more than 83 inches.	Flash when the turn signal flasher is actuated by the turn signal operating unit.
Taillamps	1 Red	On the rear, on the vertical centerline except that if two are used, they must be symmetrically disposed about the vertical centerline.	Not less than 15 inches, nor more than 72 inches	Steady burning.
				Must be activated when the headlamps are activated in a steady burning state.
Stop Lamps	1 Red	On the rear, on the vertical centerline except that if two are used, they must be symmetrically disposed about the vertical centerline.	Not less than 15 inches, nor more than 72 inches.	Steady burning.
				Must be activated upon application of the service breaks.
				When optically combined with a turn signal lamp, the circuit must be such that the stop signal cannot be activated if the turn signal lamp is flashing. May also be activated by a device designed to retard the motion of the vehicle.
Reflex Reflectors	2 Amber	On each side as far to the front as practicable.	Not less than 15 inches, nor more than 60 inches.	Not applicable.
	2 Red	On each side as far to the rear as practicable.		
	1 Red	On the rear, on the vertical centerline except that, if two are used in the rear, they must be symmetrically disposed about the vertical centerline		

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TABLE 1–C–REQUIRED LAMPS AND REFLECTIVE DEVICES, Continued

Lighting device	Number and color	Mounting location	Mounting Height	Device activation
License Plate Lamp	1 White. Additional lamps permitted to meet requirements.	On the rear to illuminate license plate.	No requirement.	Steady burning. Must be activated when the headlamps are activated in a steady burning state.

TABLE II–A: HEADLIGHTING SYSTEMS–SEALED BEAMS

System Designation	Unit Nominal Size	Number of Headlamps	Headlamp Designation	Beam Composition	Photometry Requirements Reference			Maximum Filament Power at 12.8 V	
					Table XVII	Tables XIX–A, XIX–b, XIX–c		Upper Beam	Lower Beam
					Upper Beam Mechanical and Visual Aim	Lower Beam Mech Aim	Lower Beam Visual Aim		
Type A	100 x 165 mm	2	1A1	1 UB Filament	UB4	N.A.	N.A.	55	N.A.
		2	2A1	1 UB & 1 LB Filaments	UB5	LB4M	LB2V	43	65
Type B	142 x 200 mm	2	2B1	1 UB & 1 LB Filaments	UB3	LB3M	LB3V	70	60
Type C	146 mm DIA.	2	1C1	1 UB Filament	UB4	N.A.	N.A.	55	N.A.
		2	2C1	1 UB & 1 LB Filaments	UB5	LB4M	LB2V	43	65
Type D	178 mm DIA.	2	2D1	1 UB & 1 LB Filaments	UB3	LB3M	LB3V	65	55
Type E	100 x 165 mm	2	2E1	1 UB & 1 LB Filaments	UB3	LB3M	LB3V	70	60
Type F ⁽²⁾	92 x150 mm	2	UF	1 UB Filament	UB1	N.A.	N.A.	70	N.A.
		2	LF	1 UB Filament	N.A. ⁽¹⁾	LB1M ⁽¹⁾	LB1V ⁽¹⁾	N.A.	60
Type G		2	1G1	1 UB Filament	UB4	N.A.	N.A.	55	N.A.
		2	2G1	1 UB & 1 LB Filaments	UB5	LB4M	LB2V	43	65
Type H		2	2H1	1 UB & 1 LB Filaments	UB3	LB3M	LB3V	70	60

⁽¹⁾Headlamps marked “LF” may remain activated when headlamps marked “UF” are activated.

⁽²⁾Type F headlamps may be mounted on common or parallel seating and aiming planes to permit simultaneous aiming with restrictions. See S10.13.2.

TABLE II–B.–HEADLIGHTING SYSTEMS–COMBINATION

System designation	System composition	Photometry requirements reference		
		Table XVIII	Tables XIX–a, XIX–b, XIX–c	
		Upper beam mechanical and visual aim	Lower beam mech aim	Lower beam visual aim
2 LAMP SYSTEM	A COMBINATION OF TWO DIFFERENT HEADLAMPS CHOSEN FROM; TYPE F, AN INTEGRAL BEAM HEADLAMP, OR A REPLACEABLE BULB HEADLAMP.	UB2 ⁽¹⁾	LB2M ⁽¹⁾	LB2V ⁽¹⁾
4 LAMP SYSTEM	ANY COMBINATION OF FOUR DIFFERENT HEADLAMPS CHOSEN FROM ; TYPE F, AN INTEGRAL BEAM HEADLAMP ⁽³⁾ OR A REPLACEABLE BULB HEADLAMP.	UB1	LB1M ⁽²⁾	LB1V ⁽²⁾

⁽¹⁾ Headlamps designed to conform to the photometry requirements of UB2 and LB2M or LB2V may allow the lower beam light source(s) to remain activated when an upper beam light source is activated if the lower beam light source(s) contribute to upper beam photometric compliance.

⁽²⁾Lower beams may remain activated when upper beams are activated.

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Table II-b.—Headlighting systems—combination, Continued

(3) Beam contributor photometric allocation formula of S14.2.5.9 may apply.

TABLE II-C.—HEADLIGHTING SYSTEMS—INTEGRAL BEAMS

System designation	System composition	Photometry requirements reference		
		Table XVIII	Tables XIX-a, XIX-b, XIX-c	
		Upper beam mechanical and visual aim	Lower beam mech aim	Lower beam visual aim
2 LAMP SYSTEM	UPPER BEAM & LOWER BEAM	UB2 ⁽¹⁾ OR UB3	LB2M(1) OR LB3M.....	LB1V(1) OR LB3V
4 LAMP SYSTEM	UPPER BEAM	UB4	N.A.	N.A.
	UPPER BEAM & LOWER BEAM	UB5	LB4M.....	LB2V
4 LAMP SYSTEM	UPPER BEAM (U)	UB1	N.A.	N.A.
	LOWER BEAM (L)	N.A. ⁽²⁾	LB1M ⁽²⁾	LB1V ⁽²⁾
4 LAMP SYSTEM	UPPER BEAM	UB6	N.A.	N.A.
	LOWER BEAM	N.A. ⁽³⁾	LB5M ⁽³⁾	LB4V ⁽³⁾
BEAM CONTRIBUTOR	UPPER BEAM & LOWER BEAM	UB1 ⁽⁴⁾	LB1M ⁽²⁾⁽⁴⁾	LB1V ⁽²⁾⁽⁴⁾

(1) Headlamps designed to conform to the photometry requirements of UB2 and LB2M or LB2V may allow the lower beam light source(s) to remain activated when an upper beam light source is activated if the lower beam light source(s) contribute to upper beam photometric compliance.

(2) Lower beams may remain activated when upper beams are activated.

(3) Lower beams must remain activated when upper beams are activated.

(4) Beam contributor photometric allocation formula of S14.2.5.9 applies.

TABLE II-D.—HEADLIGHTING SYSTEMS—REPLACEABLE BULB

System designation	System composition	Photometry requirements reference		
		Table XVIII	Tables XIX-a, XIX-b, XIX-c	
		Upper beam mechanical and visual aim	Lower beam mech aim	Lower beam visual aim
2 LAMP SYSTEM	ANY DUAL FILAMENT TYPE, OTHER THAN HB2, USED ALONE OR WITH ANOTHER DUAL FILAMENT TYPE OTHER THAN HB2	UB2 ⁽¹⁾ OR UB3	LB2M ⁽¹⁾ OR LB3M	LB2V ⁽¹⁾ OR LB3V
2 LAMP SYSTEM	HB2 OR ANY SINGLE FILAMENT TYPE USED ALONE OR WITH ANY OTHER SINGLE OR DUAL FILAMENT TYPE.	UB2 ⁽¹⁾ OR UB3	LB2M ⁽¹⁾	LB2V ⁽¹⁾
4 LAMP SYSTEM	ANY DUAL FILAMENT TYPE, OTHER THAN HB2, USED ALONE OR WITH ANOTHER DUAL FILAMENT TYPE OTHER THAN HB2.	UB2 ⁽²⁾ OR UB3	LB1M ⁽²⁾ OR LB3M	LB1V ⁽²⁾ OR LB3V
4 LAMP SYSTEM	HB2 OR ANY SINGLE FILAMENT TYPE USED ALONE OR WITH ANY OTHER SINGLE OR DUAL FILAMENT TYPE. (U & L).	UB1 ⁽²⁾	LB1M ⁽²⁾	LB1V ⁽²⁾

(1) Headlamps designed to conform to the photometry requirements of UB2 and LB2M or LB2V may allow the lower beam light source(s) to remain activated when an upper beam light source is activated if the lower beam light source(s) contribute to upper beam photometric compliance.

(2) Lower beams may remain activated when upper beams are activated.

TABLE III.—MARKING REQUIREMENTS LOCATION

Lamp, reflective device, or other component	Marking	Marking location	Requirement
Headlamp, Beam Contributors, or Headlamp Replaceable Lens	"DOT"	Lens	S6.5.1
	Optical axis marking	See requirement	S10.18.5

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TABLE III.—MARKING REQUIREMENTS LOCATION, Continued

Lamp, reflective device, or other component	Marking	Marking location	Requirement
	Manufacturer name and/or trade-mark	Lens	S6.5.3
	Voltage	See requirement	S6.5.3
	Part number or trade number	See requirement	S6.5.3
Headlamp Replaceable Lens	Manufacturer identification	Lens	S13.3
	Headlamp identification		
Replaceable Bulb Headlamps	“U” or “L” (4 lamp system)	Lens	S10.15.4
	Replaceable bulb type	Lens	S6.5.3.4
Sealed Beam Headlamps	“sealed beam”	Lens	S6.5.3.3
	Type designation	See requirements	S6.5.3.3
Integral Beam Headlamps	“U” or “L” (4 lamp system)	Lens	S10.14.4
Motorcycle Replaceable Bulb Headlamps	“motorcycle”	Lens	S10.17.2
Visually/Optically Aimed Headlamps	“VoR” or “VOL” or “VO”	Lens	S10.18.9.6
Externally Aimed Headlamps	Aim pad location & “H” or “V”	Lens	S10.18.7.1
Vehicle Headlamp Aiming Devices (VHAD)	Aiming scale(s)	See requirement	S10.18.8
(Headlamps) Replaceable Light Sources	“DOT”	See requirement	S11.1
	Replaceable light source designation	See requirement	
	Manufacturer name and/or trade-mark	See requirement	
Replaceable Light Source Ballasts	Manufacturer name or logo	See requirement	S11.2
	Part number		
	Light source identification		
	Rated laboratory life.		
	High voltage warning		
	Output in watts and volts		
	“DOT”		
Lamps (Other than Headlamps), Reflective Devices, and Associated Equipment.	“DOT”	See requirement	S6.5.1.2
Daytime Running Lamps (DRL)	“DRL”	Lens	S6.5.2
Conspicuity Reflex Reflectors	“DOT-C”	Exposed surface	S8.2.2.1
Retroreflective Sheeting	“DOT-C2” or “DOT-C3” or “DOT-C4”	Exposed surface	S8.2.1.3

TABLE IV—A—EFFECTIVE PROJECTED LUMINOUS LENS AREA REQUIREMENT

Lighting Device	Passenger cars, multipurpose passenger vehicles, trucks, trailers, and buses of less than 2032 MM in overall width—Minimum effective projected luminous lens area (sq mm)			Multipurpose passenger vehicles, trucks, trailers, and buses 2032 MM or more in overall width—Minimum effective projected luminous lens area each lamp (sp mm)	Motorcycles—Minimum effective projected luminous lens area (sq mm)	
	Single compartment lamp	Multiple compartment lamp or multiple lamps			Multiple compartment lamp or multiple lamps	
		Each compartment or lamp	Combined compartments or lamps		Each compartment or lamp	Single or combined compartments or lamps
Front turn signal lamp	2200		2200	7500	2200	2258
Rear turn signal lamp	5000	2200	5000	7500	2200	2258
Stop lamp	5000	2200	5000	7500	2200	(¹)5000

(¹)A motor driven cycle whose speed attainable in 1 mile is 30 mph or less may be equipped with a stop lamp whose minimum effective projected luminous lens area is not less than 2258 sq. mm.

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TABLE IV–B–EFFECTIVE PROJECTED LUMINOUS LENS AREA REQUIREMENT

Lighting device	Passenger cars, multipurpose passenger vehicles, trucks, and buses of less than 2032 mm in overall width and with a GVWR of 10,000 lbs or less using a single lamp minimum effective projected luminous lens area (sq mm)	Multipurpose passenger vehicles, trucks, and buses of less than 2032 mm in overall width and with a GVWR of 10,000 lbs or less using dual lamps of identical size and shape minimum effective projected luminous lens area each lamp (sq mm)
High-mounted stop lamp	2903	1452

TABLE IV–C–EFFECTIVE PROJECTED LUMINOUS LENS AREA REQUIREMENT

Lighting device	School bus minimum effective projected luminous lens area each lamp (sq mm)
School bus signal lamp	12,258

TABLE V–A–VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES

Lighting Device	Required visibility
Backup lamp	Lamps must be mounted so that the optical center of at least one lamp is visible from any eye point elevation from at least 1828 mm (6 ft) to 610 mm (2 ft) above the horizontal plane on which the vehicle is standing; and from any position in the area, rearward of a vertical plane perpendicular to the longitudinal axis of the vehicle, 914 mm (3 ft), to the rear of the vehicle and extending 914 mm (3 ft) beyond each side of the vehicle.
High-mounted stop lamp	Signal must be visible to the rear through a horizontal angle from 45° to the left to 45° to the right of the longitudinal axis of the vehicle. (Single lamp or two lamps together where required by S6.1.1.2 of this standard).
School bus signal lamp	Signal of front lamps to the front and rear lamps to the rear must be unobstructed within area bounded by 5° up to 10° down and 30° left to 30° right.

TABLE V–B.–VISIBILITY REQUIREMENTS INSTALLED LIGHTING DEVICES–LENS AREA VISIBILITY OPTION

Lighting Device	Corner points ⁽¹⁾⁽²⁾		Required visibility
Turn signal lamp ⁽³⁾	15°UP–45°IB	15°UP–45°OB	Unobstructed minimum effective projected luminous lens area of 1250 sq mm in any direction throughout the pattern defined by the specified corner points.
Stop lamp	15°DOWN–45°IB	15°DOWN–45°OB	
Taillamp	15°UP–45°IB	15°UP–45°OB	
Parking lamp	15°DOWN–45°IB	15°DOWN–45°OB	
	15°UP–45°IB	15°UP–45°OB	
	15°DOWN–45°IB	15°DOWN–45°OB	
	15°UP–45°IB	15°UP–45°OB	
	15°DOWN–45°IB	15°DOWN–45°OB	

⁽¹⁾IB indicates an inboard direction (toward the vehicle's longitudinal centerline) and OB indicates an outboard direction.

⁽²⁾Where a lamp is mounted with its axis of reference less than 750 mm above the road surface, the vertical test point angles located below the horizontal plane subject to visibility requirements may be reduced to 5° down.

⁽³⁾Where more than one lamp or optical area is lighted at the front on each side of a multipurpose passenger vehicle, truck, trailer, or bus, of 2032 mm or more overall width, only one such area need comply.

TABLE V–C.–VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES–LUMINOUS INTENSITY VISIBILITY OPTION

Lighting Device	Corner points ⁽¹⁾⁽²⁾		Required visibility–Minimum luminous intensity in any direction throughout the pattern defined by the specified corner points. Candela.
Turn signal lamp ⁽³⁾	15°UP–45°IB	15°UP–80°OB	0.3
	15°DOWN–45°IB	15°DOWN–45°OB	
Stop lamp	15°UP–45°IB	15°UP–45°OB	0.3
	15°DOWN–45°IB	15°DOWN–45°OB	
Taillamp	15°UP–45°IB	15°UP–80°OB	0.05
	15°DOWN–45°IB	15°DOWN–45°OB	
Parking lamp	15°UP–45°IB	15°UP–80°OB	0.05
	15°DOWN–45°IB	15°DOWN–45°OB	

⁽¹⁾IB indicates an inboard direction (toward the vehicle's longitudinal centerline) and OB indicates an outboard direction.

⁽²⁾Where a lamp is mounted with its axis of reference less than 750 mm above the road surface, the vertical test point angles located below the horizontal plane subject to visibility requirements may be reduced to 5° down.

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Table V-c.–Visibility requirements of installed lighting devices–luminous intensity visibility option, Continued

(3)Inboard and outboard corner points are 80° for a single taillamp installed on a motorcycle.

TABLE V–D–VISIBILITY REQUIREMENTS OF INSTALLED LIGHTING DEVICES (LEGACY VISIBILITY ALTERNATIVE)

Lighting device		Required visibility ¹
Turn signal lamp:	All passenger cars, multipurpose passenger vehicles, trucks, buses, motorcycles, and trailers of less than 2032 mm overall width. All multipurpose passenger vehicles, trucks, buses, and trailers of 2032 mm or more overall width.	Unobstructed minimum effective projected luminous lens area of 1250 sq mm through horizontal angle of H–V to H–45° OB. Unobstructed minimum effective projected luminous lens area of 1300 sq mm through horizontal angle of H–V to H–45° OB. Where more than one lamp or optical area is lighted on each side of the vehicle, only one such area on each side need comply.
Stop lamp		Unobstructed minimum effective projected luminous lens area of 1250 sq mm through horizontal angle of H–45° IB to H–45° OB. Where more than one lamp or optical area is lighted on each side of the vehicle, only one such area on each side need comply.
Taillamp		Unobstructed minimum effective projected luminous lens area of 2 sq in through horizontal angle of H–45° IB to H–45° OB. Where more than one lamp or optical area is lighted on each side of the vehicle, only one such area on each side need comply.

(1)IB indicates an inboard direction (toward the vehicle's longitudinal centerline) and OB indicates an outboard direction.

TABLE VI–A: FRONT TURN SIGNAL LAMP PHOTOMETRY REQUIREMENTS

					Base Requirements						2.5X Base Requirements					
Group Number	Test Point (degrees)		Minimum photometric Intensity Ratio Where Combined with A: Parking Lamp Clearance Lamp ⁽⁴⁾		Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)			Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)		
					Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
					1	2	3	1	2	3	1	2	3	1	2	3
1	20L	5U	3	3	25	30	35	130	155	180	62.5	75	87.5	325	387.5	450
		5D		3	25	30	35				62.5	75	87.5			
	5L	10U	3	3	40	48	55				100	120	137.5			
		10D ⁽³⁾		3	40	48	55				100	120	137.5			
2	10L	5U	3	3	75	88	100	250	295	340	187.5	220	250	625	737.5	850
		H	3	3	100	120	140				250	300	350			
		5D		3	75	88	100				187.5	220	250			
3	V	5U	5	5	175	205	235	950	1130	1295	437.5	512.5	587.5	2375	2825	3237.5
	5L	H	5	5	200	240	275				500	600	687.5			
	V		5	5	200	240	275				500	600	687.5			
	5R		5	5	200	240	275				500	600	687.5			
	V	5D		3	175	205	235				437.5	512.5	587.5			
4	10R	5U	3	3	75	88	100	250	295	340	187.5	220	250	625	737.5	850
		H	3	3	100	120	140				250	300	350			
		5D		3	75	88	100				187.5	220	250			
5	5R	10U	3	3	40	48	55	130	155	180	100	120	137.5	325	387.5	450
		10D ⁽³⁾		3	40	48	55				100	120	137.5			
	20R	5U	3	3	25	30	35				62.5	75	87.5			
		5D		3	25	30	35				62.5	75	87.5			

(1)The measured values at each test point must not be less than 60% of the minimum value.

(2)The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

(3)Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

(4)When a clearance lamp on a vehicle 2032 mm or more in overall width is combined with a front turn signal lamp and the maximum luminous

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Table VI-a: Front turn signal lamp photometry requirements, Continued
intensity of the clearance lamp is located below horizontal and within a 1.0° radius around the test point, the ration for the test point may be computed by using the lowest value of the clearance lamp luminous intensity within the generated area.

TABLE VI-B: FRONT TURN SIGNAL LAMP PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Minimum photometric Intensity Ration Where Combined with A:		2 X Base Requirements						1.5X Base Requirements					
					Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)			Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)		
					Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
					1	2	3	1	2	3	1	2	3	1	2	3
1	20L	5U	3	3	50	60	70	260	310	360	37.5	45	52.5	195	232.5	270
		5D		3	50	60	70				37.5	45	52.5			
	5L	10U	3	3	80	96	110				60	72	82.5			
		10D ⁽³⁾		3	80	96	110				60	72	82.5			
2	10L	5U	3	3	150	176	200	500	590	680	112.5	132	150	375	442.5	510
		H	3	3	200	240	280				150	180	210			
		5D		3	150	176	200				112.5	132	150			
3	V	5U	5	5	350	410	470	1900	2260	2590	262.5	307.5	352.5	1425	1695	1942.5
	5L	H	5	5	400	480	550				300	360	412.5			
	V		5	5	400	480	550				300	360	412.5			
	5R		5	5	400	480	550				300	360	412.5			
	V	5D		3	350	410	470				262.5	307.5	352.5			
4	10R	5U	3	3	150	176	200	500	590	680	112.5	132	150	375	442.5	510
		H	3	3	200	240	280				150	180	210			
		5D		3	150	176	200				112.5	132	150			
5	5R	10U	3	3	80	96	110	260	310	360	60	72	82.5	195	232.5	270
		10D ⁽³⁾		3	80	96	110				60	72	82.5			
	20R	5U	3	3	50	60	70				37.5	45	52.5			
		5D		3	50	60	70				37.5	45	52.5			

⁽¹⁾The measured values at each test point must not be less than 60% of the minimum value.

⁽²⁾The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽³⁾Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

⁽⁴⁾When a clearance lamp on a vehicle 2032 mm or more in overall width is combined with a front turn signal lamp and the maximum luminous intensity of the clearance lamp is located below horizontal and within a 1.0° radius around the test point, the ration for the test point may be computed by using the lowest value of the clearance lamp luminous intensity within the generated area.

TABLE VII: REAR TURN SIGNAL LAMP PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Test Points Applicable to Double Faced Lamps ⁽⁶⁾		Minimum Photometric Intensity Ration Where Combined with a Tail Lamp or Clearance Lamp ⁽⁷⁾⁽⁸⁾	Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)			Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)		
						Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
						1	2	3	1	2	3	1 ⁽⁵⁾	2	3	1 ⁽⁵⁾	2	3
			Left Side Lamp	Right Side Lamp													
1	20L	5U	No	Yes	3	10	12	15	50	60	70	15	20	25	80/84	100	120
		5D	No	Yes	3	10	12	15				15	20	25			
	5L	10U	No	Yes	3	16	19	22				26/27	30	25			
		10D ⁽³⁾	No	Yes	3	16	19	22				26/27	30	35			
2	10L	5U	No	Yes	3	30	35	40	100	115	135	50	55	65	165	185	220
		H	No	Yes	3	40	47	55				65	75	90			
		5D	No	Yes	3	30	35	40				50	55	65			

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TABLE VII: REAR TURN SIGNAL LAMP PHOTOMETRY REQUIREMENTS, Continued

Group Number	Test Point (degrees)		Test Points Applicable to Double Faced Lamps ⁽⁶⁾		Minimum Photometric Intensity Ratio Where Combined with a Tail Lamp or Clearance Lamp ⁽⁷⁾⁽⁸⁾	Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)			Minimum Photometric Intensity ^{(1)(2)(cd)}			Group Minimum Photometric Intensity (cd)		
			Left Side Lamp	Right Side Lamp		Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
						1	2	3	1	2	3	1 ⁽⁵⁾	2	3	1 ⁽⁵⁾	2	3
	3	V	5U	Yes		Yes	5	70	82	95	380	445	520	110	130	150	610/590	710	825
	5L	H <td>No</td> <td>Yes</td> <td>5</td> <td>80</td> <td>95</td> <td>110</td> <td>130/120</td> <td>150</td> <td>175</td>	No	Yes	5	80	95	110	130/120	150				175			
	V		Yes	Yes	5	80	95	110	130	150				175			
	5R <td></td> <td>Yes</td> <td>No</td> <td>5</td> <td>80</td> <td>95</td> <td>110</td> <td>130/120</td> <td>150</td> <td>175</td>		Yes	No	5	80	95	110	130/120	150				175			
	V	5D <td>Yes</td> <td>Yes</td> <td>3</td> <td>70</td> <td>82</td> <td>95</td> <td>110</td> <td>130</td> <td>150</td>	Yes	Yes	3	70	82	95	110	130				150			
4	10R	5U	Yes	No	3	30	35	40	100	115	135	50	55	65	165	185	220
		H	Yes	No	3	40	47	55				65	75	90			
		5D	Yes	No	3	30	35	40				50	55	65			
5	5R	10U	Yes	No	3	16	19	22	50	60	70	26/27	30	35	80/84	100	120
		10D ⁽³⁾	Yes	No	3	16	19	22				26/27	30	35			
	20R	5U	Yes	No	3	10	12	15				15	20	25			
		5D	Yes	No	3	10	12	15				15	20	25			
Maximum Photometric Intensity ⁽⁴⁾						300	360	420				750	900	900			

⁽¹⁾The measured values at each test point must not be less than 60% of the minimum value.

⁽²⁾The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽³⁾Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

⁽⁴⁾The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range

⁽⁵⁾Values preceded by a slash (/) apply only to multipurpose passenger vehicles, trucks, trailers, and buses of 2032 mm or more in overall width.

⁽⁶⁾A double faced turn signal lamp installed as described in S6.1.1.3 on a truck tractor need only meet the photometric requirements for a left side lamp where the lamp is mounted on the left side of the vehicle, and for a right side lamp where the lamp is mounted on the right side of the vehicle.

⁽⁷⁾Required only when combined turn signal lamp and clearance lamp is installed on a vehicle 2032 mm or more in overall width.

⁽⁸⁾When a taillamp (or clearance lamp on a vehicle 2032 mm or more in overall width) is combined with a rear turn signal lamp and the maximum luminous intensity of the taillamp (or clearance lamp) is located below horizontal and within an area generated by a 0.5° radius around a test point (1.0° radius on lamps installed on a vehicle 2032 mm or more in overall width), the ratio for the test point may be computed by using the lowest value of the taillamp (or clearance lamp) luminous intensity within the generated area.

TABLE VIII: TAILLAMP PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Photometric Intensity ⁽¹⁾⁽²⁾⁽⁴⁾ (cd)						Group Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)		
			Lighted Sections						Lighted Sections		
			1		2		3		1	2	3
			Minimum	Maximum	Minimum	Maximum	Minimum	Maximum			
1	20L	5U	0.3	18	0.5	20	0.7	25	1.4	2.4	3.5
		5D	0.3	-	0.5	-	0.7	-			
	5L	10U	0.4	18	0.7	20	1.0	25			
		10D ⁽³⁾	0.4	-	0.7	-	1.0	-			
2	10L	5U	0.8	18	1.4	20	2.0	25	2.4	4.2	6.0
		H	0.8	18	1.4	20	2.0	25			
		5D	0.8	-	1.4	-	2.0	-			
3	V	5U	1.8	18	3.1	20	4.5	25	9.6	16.8	24.0
	5L	H	2.0	18	3.5	20	5.0	25			
	V		2.0	18	3.5	20	5.0	25			
	5R		2.0	18	3.5	20	5.0	25			
	V	5D	1.8	-	3.1	-	4.5	-			
4	10R	5U	0.8	18	1.4	20	2.0	25	2.4	4.2	6.0
		H	0.8	18	1.4	20	2.0	25			
		5D	0.8	-	1.4	-	2.0	-			

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TABLE VIII: TAILLAMP PHOTOMETRY REQUIREMENTS, Continued

Group Number	Test Point (degrees)		Photometric Intensity ⁽¹⁾⁽²⁾⁽⁴⁾ (cd)						Group Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)		
			Lighted Sections						Lighted Sections		
			1		2		3		1	2	3
			Minimum	Maximum	Minimum	Maximum	Minimum	Maximum			
5	5R	10U	0.4	18	0.7	20	1.0	25	1.4	2.4	3.5
		10D ⁽³⁾	0.4	-	0.7	-	1.0	-			
	20R	5U	0.3	18	0.5	20	0.7	25			
		5D	0.3	-	0.5	-	0.7	-			

⁽¹⁾The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽²⁾If the sum of intensity values for all points in the group is not less than the specified total value for the group, the measured intensity value for each individual test point is not required to meet the minimum value.

⁽³⁾Where taillamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

⁽⁴⁾A taillamp shall not exceed the maximum intensity of H above.

TABLE IX: STOP LAMP PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Minimum Photometric Intensity Ratio Where Combined with a Tail Lamp ⁽⁵⁾	Minimum Photometric intensity ⁽¹⁾⁽²⁾ (cd)			Group Minimum Photometric Intensity (cd)		
				Lighted Sections			Lighted Sections		
				1	2	3	1	2	3
1	20L	5U	3	10	12	15	50	60	70
		5D	3	10	12	15			
	5L	10U	3	16	19	22			
		10D ⁽⁴⁾	3	16	19	22			
2	10L	5U	3	30	35	40	100	115	135
		H	3	40	47	55			
		5D	3	30	35	40			
3	V	5U	5	70	82	95	380	445	520
	5L	H	3/5 ⁽⁶⁾	80	95	110			
	V		5	80	95	110			
	5R		5	80	95	110			
	V		5D	3	70	82				95
4	10R	5U	3	30	35	40	100	115	135
		H	3	40	47	55			
		5D	3	30	35	40			
5	5R	10U	3	16	19	22	50	60	70
		10D ⁽⁴⁾	3	16	19	22			
	20R	5U	3	10	12	15			
		5D	3	10	12	15			
Maximum Photometric Intensity ⁽³⁾				300	360	420			

⁽¹⁾The measured values at each test point must not be less than 60% of the minimum value.

⁽²⁾The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽³⁾The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range.

⁽⁴⁾Were stop lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

⁽⁵⁾When a taillamp is combined with a stop lamp and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5° radius around a test point (1.0° radius on lamps installed on a vehicle 2032 mm or more in overall width), the ratio for the test point may be computed by using the lowest value of the taillamp luminous intensity within the generated area.

⁽⁶⁾Values preceded by a slash (/) apply only to lamps installed on multipurpose passenger vehicles, trucks, trailers, and buses of 2032 mm or more in overall width.

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TABLE X.—SIDE MARKER LAMP PHOTOMETRY REQUIREMENTS

Test Point (degrees)	Minimum photometric intensity (cd) ⁽²⁾ red lamps	Minimum photometric intensity (cd) ⁽²⁾ amber lamps
10U:		
45L ⁽¹⁾	0.25	0.62
V	0.25	0.62
45R ⁽¹⁾	0.25	0.62
H:		
45L ⁽¹⁾	0.25	0.62
V	0.25	0.62
45R ⁽¹⁾	0.25	0.62
10D: ⁽³⁾		
45L ⁽¹⁾	0.25	0.62
V	0.25	0.62
45R ⁽¹⁾	0.25	0.62

⁽¹⁾ Where a side marker lamp installed on a motor vehicle less than 30 feet in overall length and less than 80 inches (2 m) in overall width has the lateral angle nearest the other required side marker lamp on the same side of the vehicle reduced from 45° by design as specified by S7.4.13.2, the photometric intensity measurement may be met at the lesser angle.

⁽²⁾ The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽³⁾ Where side marker lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

TABLE XI.—CLEARANCE AND IDENTIFICATION LAMPS PHOTOMETRY REQUIREMENTS

Test Point (degrees)	Minimum photometric intensity (cd) ⁽²⁾ red lamps	Minimum photometric intensity (cd) ⁽²⁾ amber lamps
10U:		
45L ⁽¹⁾	0.25	0.62
V	0.25	0.62
45R ⁽¹⁾	0.25	0.62
H:		
45L ⁽¹⁾	0.25	0.62
V	0.25	0.62
45R ⁽¹⁾	0.25	0.62
10D: ⁽³⁾		
45L ⁽¹⁾	0.25	0.62
V	0.25	0.62
45R ⁽¹⁾	0.25	0.62
Maximum photometric intensity ⁽³⁾ (cd) red lamps	15	

⁽¹⁾ Where clearance lamps or identification lamps are mounted with their axis of reference less than 750mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

⁽²⁾ The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽³⁾ When optically combined with a stop lamp or turn signal lamp, this maximum applies on or above the horizontal.

⁽⁴⁾ Where clearance lamps are installed at locations other than on the front and rear due to the necessity to indicate the overall width of the vehicle, or for protection from damage during normal operation of the vehicle, they need not meet the photometric intensity requirement at any test point that is 45° inboard.

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TABLE XII: BACKUP LAMP PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Maximum Photometric Intensity (cd) Any Single Lamp	Two Lamp Systems—Each Lamp		Single Lamp System	
				Minimum Photometric Intensity (cd) ⁽¹⁾⁽⁴⁾	Group Minimum Photometric Intensity (cd)	Minimum Photometric Intensity (cd) ⁽¹⁾⁽⁴⁾	Group Minimum Photometric Intensity (cd)
1 ⁽²⁾⁽³⁾	45L	5U	300/600 ⁽⁵⁾	15	45	30	90
		H	300/600 ⁽⁵⁾	15		30	
		5D	-	15		30	
2 ⁽²⁾⁽³⁾	30L	H	300/600 ⁽⁵⁾	25	50	50	100
		5D	-	25		50	
3	10L	10U	300/600 ⁽⁵⁾	10	100	20	200
		5U	300/600 ⁽⁵⁾	20		40	
		V	10U	15		30	
	10R	5U	300/600 ⁽⁵⁾	25		50	
		10U	300/600 ⁽⁵⁾	10		20	
		5U	300/600 ⁽⁵⁾	20		40	
		5U	300/600 ⁽⁵⁾	20		40	
4	10L	H	300/600 ⁽⁵⁾	50	360	100	720
		5D	-	50		100	
	V	H	300/600 ⁽⁵⁾	80		160	
		5D	-	80		160	
	10R	H	300/600 ⁽⁵⁾	50		100	
		5D	-	50		100	
		5D	-	50		100	
5 ⁽²⁾⁽³⁾	30R	H	300/600 ⁽⁵⁾	25	50	50	100
		5D	-	25		50	
6 ⁽²⁾⁽³⁾	45R	5U	300/600 ⁽⁵⁾	15	45	30	90
		H	300/600 ⁽⁵⁾	15		30	
		5D	-	15		30	

⁽¹⁾ The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽²⁾ When two lamps of the same or symmetrically opposite design are used, the tested photometric values along the vertical axis and the averages of the tested photometric values for the same horizontal test point left and right of vertical for one lamp must be used to determine compliance with the requirements.

⁽³⁾ When two lamps of differing designs are used, they must be tested individually and the tested photometric values added to determine the combined units compliance with twice the stated requirements.

⁽⁴⁾ If the sum of intensity values for all points in the group is not less than the specified total value for the group, the measured intensity value for each individual test point is not required to meet the minimum value.

⁽⁵⁾ The value before the slash applies to each lamp in a multiple lamp system; the value after the slash applies to a single lamp system.

TABLE XIII—A: MOTORCYCLE TURN SIGNAL LAMP ALTERNATIVE PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Minimum Photometric Intensity Ratio Where Combined with A:		Minimum Photometric Intensity ^{(1)(2)(cd)} Front Turn Signal Lamp			Group Minimum Photometric Intensity (cd) Front Turn Signal Lamp			Minimum Photometric Intensity ^{(1)(2)(cd)} Red Rear Turn Signal Lamp			Group Minimum Photometric Intensity ^{(1)(2)(cd)} Red Rear Turn Signal Lamp			Minimum Photometric Intensity ^{(1)(2)(cd)} Amber Rear Turn Signal Lamp			Group Minimum Photometric Intensity ^{(1)(2)(cd)} Amber Rear Turn Signal Lamp		
					Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
1	20L	5U	3	3	12.5	15	17.5	65	77.5	90	5	6	7.5	25	30	35	7.5	10	12.5	40	50	60
		5D		3	12.5	15	17.5				5	6	7.5				7.5	10	12.5			
	5L	10U	3	3	20	24	27.5				8	9.5	11				13	15	17.5			
		10D ⁽⁴⁾		3	20	24	27.5				8	9.5	11				13	15	17.5			
2	10L	5U	3	3	37.5	44	50	125	147.5	170	15	17.5	20	50	57.5	67.5	25	27.5	32.5	82.5	92.5	110
		H	3	3	50	60	70				20	23.5	27.5				32.5	37.5	45			
		5D		3	37.5	44	50				15	17.5	20				25	27.5	32.5			

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TABLE XIII-A: MOTORCYCLE TURN SIGNAL LAMP ALTERNATIVE PHOTOMETRY REQUIREMENTS, Continued

Group Number	Test Point (degrees)		Minimum Photometric Intensity Ratio Where Combined with A:		Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd) Front Turn Signal Lamp			Group Minimum Photometric Intensity (cd) Front Turn Signal Lamp			Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd) Red Rear Turn Signal Lamp			Group Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd) Red Rear Turn Signal Lamp			Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd) Amber Rear Turn Signal Lamp			Group Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd) Amber Rear Turn Signal Lamp		
			Parking lamp	Tail Lamp ⁽⁵⁾	Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections			Lighted Sections		
					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
3	V	5U	5	5	87.5	102.5	117.5	475	565	647.5	35	41	47.5	190	222.5	260	55	65	75	305	355	412.5
	5L	H	5	5	100	120	137.5				40	47.5	55				65	75	87.5			
	V		5	5	100	120	137.5				40	47.5	55				65	75	87.5			
	5R		5	5	100	120	137.5				40	47.5	55				65	75	87.5			
	V	5D		3	87.5	102.5	117.5				35	41	47.5				55	65	75			
4	10R	5U	3	3	37.5	44	50	125	147.5	170	15	17.5	20	50	57.5	67.5	25	27.5	32.5	82.5	92.5	110
		H	3	3	50	60	70				20	23.5	27.5				32.5	37.5	45			
		5D		3	37.5	44	50				15	17.5	20				25	27.5	32.5			
5	5R	10U	3	3	20	24	27.5	65	77.5	90	8	9.5	11	25	30	35	13	15	17.5	40	50	60
		10D ⁽⁴⁾		3	20	24	27.5				8	9.5	11				13	15	17.5			
	20R	5U	3	3	12.5	15	17.5				5	6	7.5				7.5	10	12.5			
		5D		3	12.5	15	17.5				5	6	7.5				7.5	10	12.5			
Maximum Photometric Intensity ⁽³⁾											300	360	420				750	900	900			

⁽¹⁾The measured values at each test point must not be less than 60% of the minimum value.

⁽²⁾The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽³⁾The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range.

⁽⁴⁾Where turn signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

⁽⁵⁾When a taillamp is combined with a rear turn signal lamp and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5° radius around a test point the ratio for the test point may be computed by using the lowest value of the taillamp luminous intensity within the generated area.

TABLE XIII-B: MOTORCYCLE DRIVEN CYCLE STOP LAMP ⁽³⁾ ALTERNATIVE PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Minimum Photometric Intensity Ratio Where a Motor Driven Cycle Stop Lamp is Combined with a Tail Lamp ⁽⁴⁾	Group Minimum Photometric Intensity (cd) Motor Driven Cycle Stop Lamp		
				Lighted Sections		
				1	2	3
1	20L	5U	3	26	31	36
		5D	3			
	5L	10U	3			
		10D ⁽⁴⁾	3			
2	10L	5U	3	50	59	69
		H	3			
		5D	3			
3	V	5U	5	190	226	261
	5L	H	5			
	V		5			
	5R		5			
	V	5D	3			
4	10R	5U	3	50	59	69
		H	3			
		5D	3			

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TABLE XIII-B: MOTORCYCLE DRIVEN CYCLE STOP LAMP ⁽³⁾ ALTERNATIVE PHOTOMETRY REQUIREMENTS, Continued

Group Number	Test Point (degrees)		Minimum Photometric Intensity Ratio Where a Motor Driven Cycle Stop Lamp is Combined with a Tail Lamp ⁽⁴⁾	Group Minimum Photometric Intensity (cd) Motor Driven Cycle Stop Lamp		
				Lighted Sections		
				1	2	3
5	5R	10U	3	26	31	36
		10D ⁽⁴⁾	3			
	20R	5U	3			
		5D	3			
		Maximum Photometric Intensity ⁽¹⁾				

⁽¹⁾The maximum photometric intensity must not occur over any area larger than that generated by a 0.5° radius within a solid angle defined by the test point range.

⁽²⁾Where stop lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at ° down rather than at the specified required downward angle.

⁽³⁾Requirements for a motor-driven cycle whose speed attainable in 1 mile is 30 mph or less

⁽⁴⁾When a taillamp is combined with a stop lamp and the maximum luminous intensity of the taillamp is located below horizontal and within an area generated by a 0.5° radius around a test point the ratio for the test point may be computed by using the lowest value of the taillamp luminous intensity within the generated area.

TABLE XIV: PARKING LAMP PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Minimum Photometric Intensity ⁽¹⁾⁽²⁾ (cd)	Maximum Photometric Intensity (cd)	Group Minimum Photometric Intensity (cd)
1	20L	5U	0.4	125	2.4
		5D	0.4	250	
	5L	10U	0.8	125	
		10D ⁽³⁾	0.8	250	
2	10L	5U	0.8	125	3.0
		H	1.4	125	
		5D	0.8	250	
3	V	5U	2.8	125	16.8
	5L	H	3.6	125	
	V		4.0	125	
	5R		3.6	125	
	V	5D	2.8	250	
4	10R	5U	0.8	125	3.0
		H	1.4	125	
		5D	0.8	250	
5	5R	10U	0.8	125	2.4
		10D ⁽³⁾	0.8	250	
	20R	5U	0.4	125	
		5D	0.4	250	

⁽¹⁾The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽²⁾If the sum of intensity values for all points in the group is not less than the specified total value for the group, the measured intensity value for each individual test point is not required to meet the minimum value

⁽³⁾Where parking lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

TABLE XV: HIGH-MOUNTED STOP LAMP PHOTOMETRY REQUIREMENTS

Group Number	Test Point (degrees)		Minimum Photometric Intensity ⁽¹⁾⁽²⁾⁽³⁾ (cd)	Group Minimum Photometric Intensity ⁽³⁾ (cd)
1	V	5U	25	125
	5L	H	25	
	V	H	25	
	5R	H	25	
	V	5D	25	

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TABLE XV: HIGH-MOUNTED STOP LAMP PHOTOMETRY REQUIREMENTS, Continued

Group Number	Test Point (degrees)		Minimum Photometric Intensity ⁽¹⁾⁽²⁾⁽³⁾ (cd)	Group Minimum Photometric Intensity ⁽³⁾ (cd)
2	5R	5U	25	98
	10R	5U	16	
	10R	H	16	
	10R	5D	16	
	5R	5D	25	
3	5L	5U	25	98
	10L	5U	16	
	10L	H	16	
	10L	5D	16	
	5L	5D	25	
4	10L	10U	8	32
	V	10U	16	
	10R	10U	8	
Maximum Photometric Intensity ⁽⁴⁾			160	

⁽¹⁾The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

⁽²⁾The photometric intensity at each test point must not be less than 60% of the specified minimum value when considering overall group or zone photometry tables.

⁽³⁾Where a pair of lamps identical in size and shape are used due to vehicle construction, they together must meet photometric requirements.

⁽⁴⁾The maximum photometric intensity must not occur over any area larger than that generated by a 0.25° radius within a solid cone angle within the rectangle bounded by test points 10U–10L, 10U–10R, 5D–10L, and 5D–10R.

TABLE XVI-A. — REFLEX REFLECTOR PHOTOMETRY REQUIREMENTS

Observation angle (degrees)	Entrance angle (degrees)	Minimum performance					
		Red reflectors		Amber reflectors		White reflectors	
		(cd/incident ft–c)	(mcd/lux)	(cd/incident ft–c)	(mcd/lux)	(cd/incident ft–c)	(mcd/lux)
0.2	0	4.5	420	11.25	1050	18	1680
	10U	3.0	280	7.5	700	12	1120
	10D ⁽¹⁾	3.0	280	7.5	700	12	1120
	20L	1.5	140	3.75	350	6	560
	20R	1.5	140	3.75	350	6	560
1.5	0	0.07	6	0.175	15	0.28	24
	10U	0.05	5	0.125	12.5	0.2	20
	10D ⁽¹⁾	0.05	5	0.125	12.5	0.2	20
	20L	0.03	3	0.075	7.5	0.12	12
	20R	0.03	3	0.075	7.5	0.12	12

⁽¹⁾Where reflex reflectors are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the required specified downward angle.

TABLE XVI-B. — ADDITIONAL PHOTOMETRY REQUIREMENTS FOR CONSPICUITY REFLEX REFLECTORS

Observation angle (degrees)	Entrance angle (degrees)	Minimum performance		
		Red reflectors (mcd/lux)	White horizontal orientation (mcd/lux)	White vertical orientation (mcd/lux)
0.2	0	300	1250	1680
	20L TO 20R			560
	30L TO 30R	300	1250	
	45L TO 45R	75	300	
	10U TO 10D			1120

Regulations

TABLE XVI-C. — RETROREFLECTIVE SHEETING PHOTOMETRY REQUIREMENTS

Observation angle (degrees)	Entrance angle (degrees)	Minimum performance					
		Grade dot-C2		Grade dot-C3		Grade dot-C4	
		White (cd/lux/sq m)	Red (cd/lux/sq m)	White (cd/lux/sq m)	Red (cd/lux/sq m)	White (cd/lux/sq m)	Red (cd/lux/sq m)
0.2	–4	250	60	165	40	125	30
	30	250	60	165	40	125	30
	45	60	15	40	10	30	8
0.5	–4	65	15	43	10	33	8
	30	65	15	43	10	33	8
	45	15	4	10	3	8	2

TABLE XVII — SCHOOL BUS SIGNAL LAMP PHOTOMETRY REQUIREMENTS

Test point (degrees)	Minimum photometric intensity (cd) ⁽²⁾ red lamps	Minimum photometric intensity (cd) amber lamps
5U:		
20L	150	375
10L	300	750
5L	300	750
V	300	750
5R	300	750
10R	300	750
20R	150	375
H:		
30L	30	75
20L	180	450
10L	400	1000
5L	500	1250
V	600	1500
5R	500	1250
10R	400	1000
20R	180	450
30R	30	75
5D:		
30L	30	75
20L	200	500
10L	300	750
5L	450	1125
V	450	1125
5R	450	1125
10R	300	750
20R	200	500
30R	30	75
10D: ⁽¹⁾		
5L	40	100
V	40	100
5R	40	100

⁽¹⁾ Where school bus signal lamps are mounted with their axis of reference less than 750 mm above the road surface, photometry requirements below 5° down may be met at 5° down rather than at the specified required downward angle.

⁽²⁾ The photometric intensity values between test points must not be less than the lower specified minimum value of the two closest adjacent test points on a horizontal or vertical line.

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TABLE XVIII: HEADLAMP UPPER BEAM PHOTOMETRY REQUIREMENTS

Test Point (degrees)		Upper Beam #1 (UB1)		Upper Beam #2 (UB2)		Upper Beam #3 (UB3)	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
2U	V		1,500		1,500		1,000
1U	3L & 3R		5,000		5,000		2,000
H	V	70,000	40,000	75,000	40,000	75,000	20,000
H	3L & 3R		15,000		15,000		10,000
H	6L & 6R		5,000		5,000		3,250
H	9L & 9R		3,000		3,000		1,500
H	12L & 12R		1,500		1,500		750
1.5D	V		5,000		5,000		5,000
1.5D	9L & 9R		2,000		2,000		1,500
2.5D	V		2,500		2,500		2,500
2.5D	12L & 12R		1,000		1,000		750
4D	V	5,000		12,000		5,000	
Test Point (degrees)		Upper Beam #4 (UB4)		Upper Beam #5 (UB5)		Upper Beam #6 (UB6)	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
2U	V		750		1,500		1,000
1U	3L & 3R		3,000		5,000		2,000
H	V	60,000	18,000	75,000	40,000	75,000	20,000
H	3L & 3R		12,000		15,000		10,000
H	6L & 6R		3,000		5,000		3,250
H	9L & 9R		2,000		3,000		1,500
H	12L & 12R		750		1,500		750
1.5D	V		3,000		5,000		7,000
1.5D	9L & 9R		1,250		2,000		1,500
2.5D	V		1,500		2,500		2,500
2.5D	12L & 12R		600		1,000		750
4D	V	5,000		12,000		5,000	

TABLE XIX-A: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS

Test Point (degrees)		Lower Beam #1M (LB1M)		Lower Beam #1V(LB1V)		Lower Beam #2M(LB2M)		Lower Beam #2V(LB2V)	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
⁽¹⁾ 10U to 90U	⁽¹⁾ 90L TO 90R	125	-	125	-	125	-	125	-
4U	8L & 8R	-	64	-	64	-	64	-	64
2U	4L	-	135	-	135	-	135	-	135
1.5U	1R to 3R	-	200	-	200	-	200	-	200
1.5U	1R to R	1,400	-	1,400	-	1,400	-	1,400	-
1U	1.5L to L	700	-	700	-	700	-	700	-
0.5U	1.5L to L	1,000	-	1,000	-	1,000	-	1,000	-
0.5U	1R to 3R	2,700	500	2,700	500	2,700	500	2,700	500
H	V	5,000	-	5,000	-	-	-	-	-
H	4L	-	135	-	135	-	135	-	135
H	8L	-	64	-	64	-	64	-	64
0.5D	1.5L to L	3,000	-	-	3,000	-	-	-	-
0.5D	1.5R	20,000	10,000	-	-	20,000	10,000	-	-
0.6D	1.3R	-	-	-	10,000	-	-	-	10,000
0.86D	V	-	-	-	4,500	-	-	-	4,500
0.86D	3.5L	-	-	12,000	1,800	-	-	12,000	1,800
1D	6L	-	1,000	-	-	-	1,000	-	-
1.5D	2R	-	15,000	-	15,000	-	15,000	-	15,000

Regulations

TABLE XIX-A: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS, Continued

Test Point (degrees)		Lower Beam #1M (LB1M)		Lower Beam #1V(LB1V)		Lower Beam #2M(LB2M)		Lower Beam #2V(LB2V)	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
1.5D	9L & 9R	-	1,000	-	-	-	1,000	-	-
2D	9L & 9R	-	-	-	1,250	-	-	-	1,250
2D	15L & 15R	-	850	-	1,000	-	850	-	1,000
2.5D	V	-	-	-	-	-	-	-	-
2.5D	12L & 12R	-	-	-	-	-	-	-	-
4D	V	7,000	-	10,000	-	-	-	-	-
4D	4R	12,500	-	12,500	-	12,500	-	12,500	-
4D	20L & 20R	-	-	-	-	-	-	-	300

⁽¹⁾These test points are boundaries, all test points that fall into the area defined by these points must meet the listed photometry requirement.

TABLE XIX-B: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS

Test Point (degrees)		Lower Beam #3 M (LB3M)		Lower Beam # 3V(LB3V)		Lower Beam # 4M(LB4M)		Lower Beam # 5M(LB5M)	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
⁽¹⁾ 10U to 90U	⁽¹⁾ 90L TO 90R	125	-	125	-	125	-	125	-
4U	8L & 8R	-	64	-	64	-	64	-	64
2U	4L	-	135	-	135	-	135	-	135
1.5U	1R to 3R	-	200	-	200	-	200	-	200
1.5U	1R to R	1,400	-	1,400	-	1,400	-	1,400	-
1U	1.5L to L	700	-	700	-	700	-	700	-
0.5U	1.5L to L	1,000	-	1,000	-	1,000	-	1,000	-
0.5U	1R to 3R	2,700	500	2,700	500	2,700	500	2,700	500
H	V	-	-	-	-	-	-	5,000	-
H	4L	-	135	-	135	-	135	-	135
H	8L	-	64	-	64	-	64	-	64
0.5D	1.5L to L	2,500	-	-	-	2,500	-	3,000	-
0.5D	1.5R	20,000	8,000	-	-	20,000	8,000	20,000	10,000
0.6D	1.3R	-	-	-	10,000	-	-	-	-
0.86D	V	-	-	-	4,500	-	-	-	-
0.86D	3.5L	-	-	12,000	1,800	-	-	-	-
1D	6L	-	750	-	-	-	750	-	1,000
1.5D	2R	-	15,000	-	15,000	-	15,000	-	15,000
1.5D	9L & 9R	-	750	-	-	-	750	-	1,000
2D	9L & 9R	-	-	-	1,250	-	-	-	-
2D	15L & 15R	-	700	-	1,000	-	700	-	850
2.5D	V	-	-	-	-	-	-	-	2,500
2.5D	12L & 12R	-	-	-	-	-	-	-	1,000
4D	V	-	-	-	-	-	-	7,000	-
4D	4R	12,500	-	12,500	-	12,500	-	12,500	-
4D	20L & 20R	-	-	-	300	-	-	-	-

⁽¹⁾These test points are boundaries, all test points that fall into the area defined by these points must meet the listed photometry requirement.

TABLE XIX-C: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS

Test Point (degrees)		Lower Beam # 4V (LB4V)	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
⁽¹⁾ 10U to 90U	⁽¹⁾ 90L TO 90R	125	-
4U	8L & 8R	-	64
2U	4L	-	135
1.5U	1R to 3R	-	200
1.5U	1R to R	1,400	-
1U	1.5L to L	700	-
0.5U	1.5L to L	1,000	-

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TABLE XIX–C: HEADLAMP LOWER BEAM PHOTOMETRY REQUIREMENTS, Continued

Test Point (degrees)		Lower Beam # 4V (LB4V)	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
0.5U	1R to 3R	2,700	500
H	V	5,000	-
H	4L	-	135
H	8L	-	64
0.5D	1.5L to L	-	-
0.5D	1.5R	-	-
0.6D	1.3R	-	10,000
0.86D	V	-	4,500
0.86D	3.5L	12,000	1,800
1D	6L	-	-
1.5D	2R	-	15,000
1.5D	9L & 9R	-	-
2D	9L & 9R	-	1,250
2D	15L & 15R	-	1,000
2.5D	V	-	2,500
2.5D	12L & 12R	-	1,000
4D	V	10,000	-
4D	4R	12,500	-
4D	20L & 20R	-	300

⁽¹⁾These test points are boundaries, all test points that fall into the area defined by these points must meet the listed photometry requirement.

TABLE XX: MOTORCYCLE AND MOTOR DRIVEN CYCLE HEADLAMP PHOTOMETRY REQUIREMENTS

Lower Beam							
Test Point (degrees)		Motorcycle		Motor Driven Cycle		Motor Driven Cycle With Single Lamp System	
		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
1.5U	1R to r	1,400		1,400			
1.5U	1R to 3R					1,400	
1U	1.5L to L	700		700		700	
0.5U	1.5L to L	1,000		1,000		1,000	
0.5U	1R to 3R	2,700		2,700		2,700	
1.5D	9L and 9R		700				
2D	V		7,000		5,000		4,000
2D	3L and 3R		4,000		3,000		3,000
2D	6L and 6R		1,500		1,500		1,500
2D	12L and 12R		700				
3D	6L and 6R		800		800		
4D	V		2,000		2,000		
4D	4R	12,500		12,500		12,500	

Regulations

TABLE XX: MOTORCYCLE AND MOTOR DRIVEN CYCLE HEADLAMP PHOTOMETRY REQUIREMENTS

		Upper Beam			
		Motorcycle		Motor Driven Cycle	
Test Point (degrees)		Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)	Maximum Photometric Intensity (cd)	Minimum Photometric Intensity (cd)
2U	V		1,000		
1U	3L and 3R		2,000		2,000
H	V		12,500		10,000
0.5D	V		20,000		20,000
0.5D	3L and 3R		10,000		5,000
0.5D	6L and 6R		3,300		2,000
0.5D	9L and 9R		1,500		
0.5D	12L and 12R		800		
1D	V		17,500		15,000
2D	V		5,000		5,000
3D	V		2,500		2,500
3D	6L and 6R				800
3D	9L and 9R		1,500		
3D	12L and 12R		300		
4D	V		1,500		
4D	V	7,500		7,500	
Anywhere in Beam		75,000		75,000	

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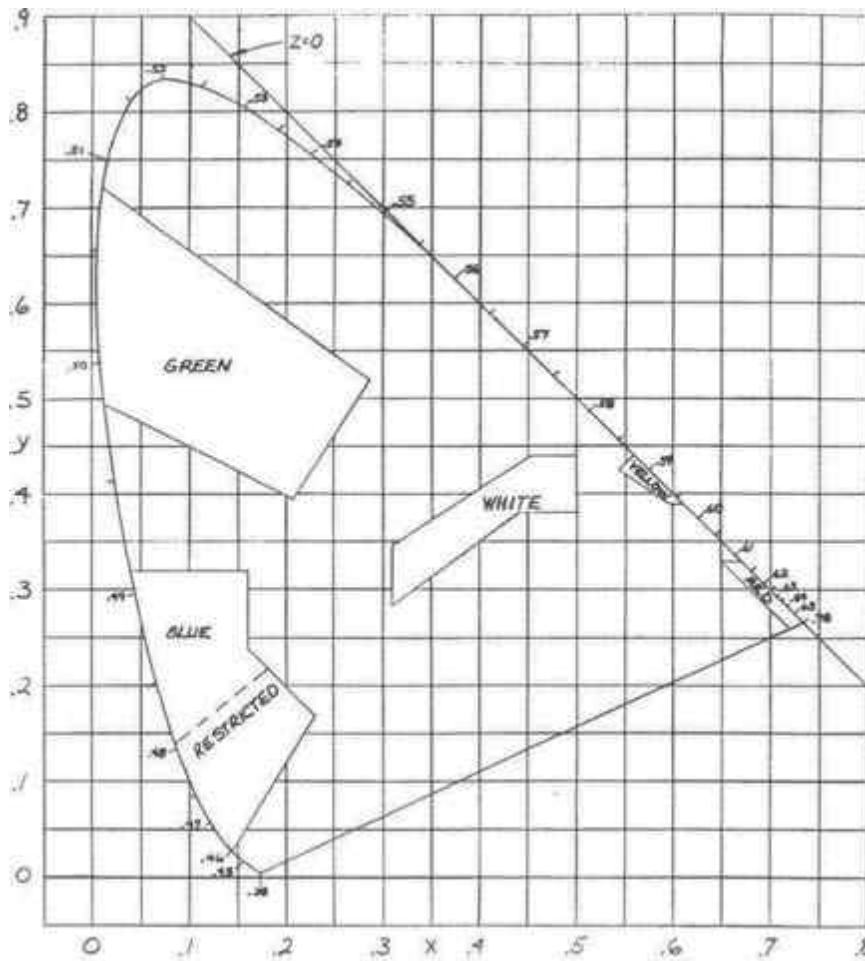


Figure 1: Chromaticity Diagram

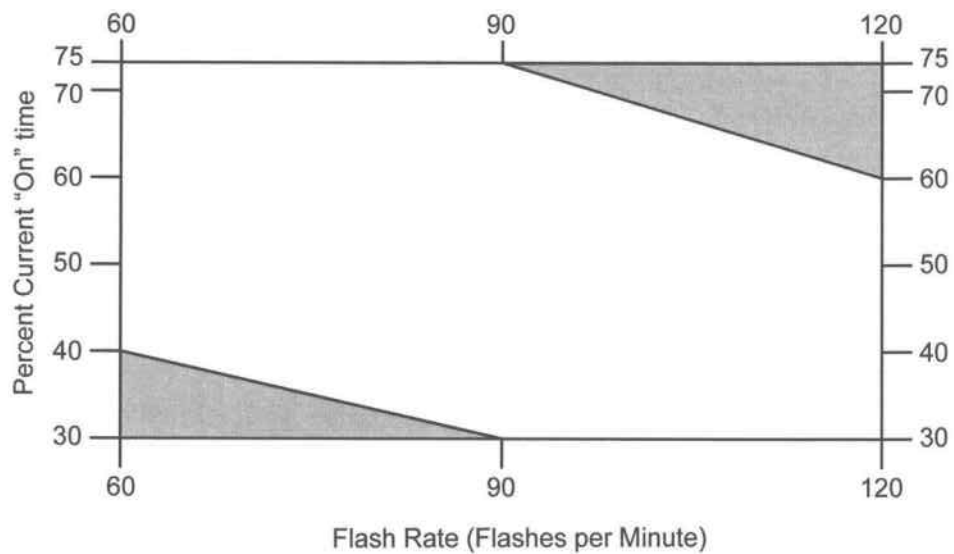


Figure 2: Flasher Performance Chart

Regulations

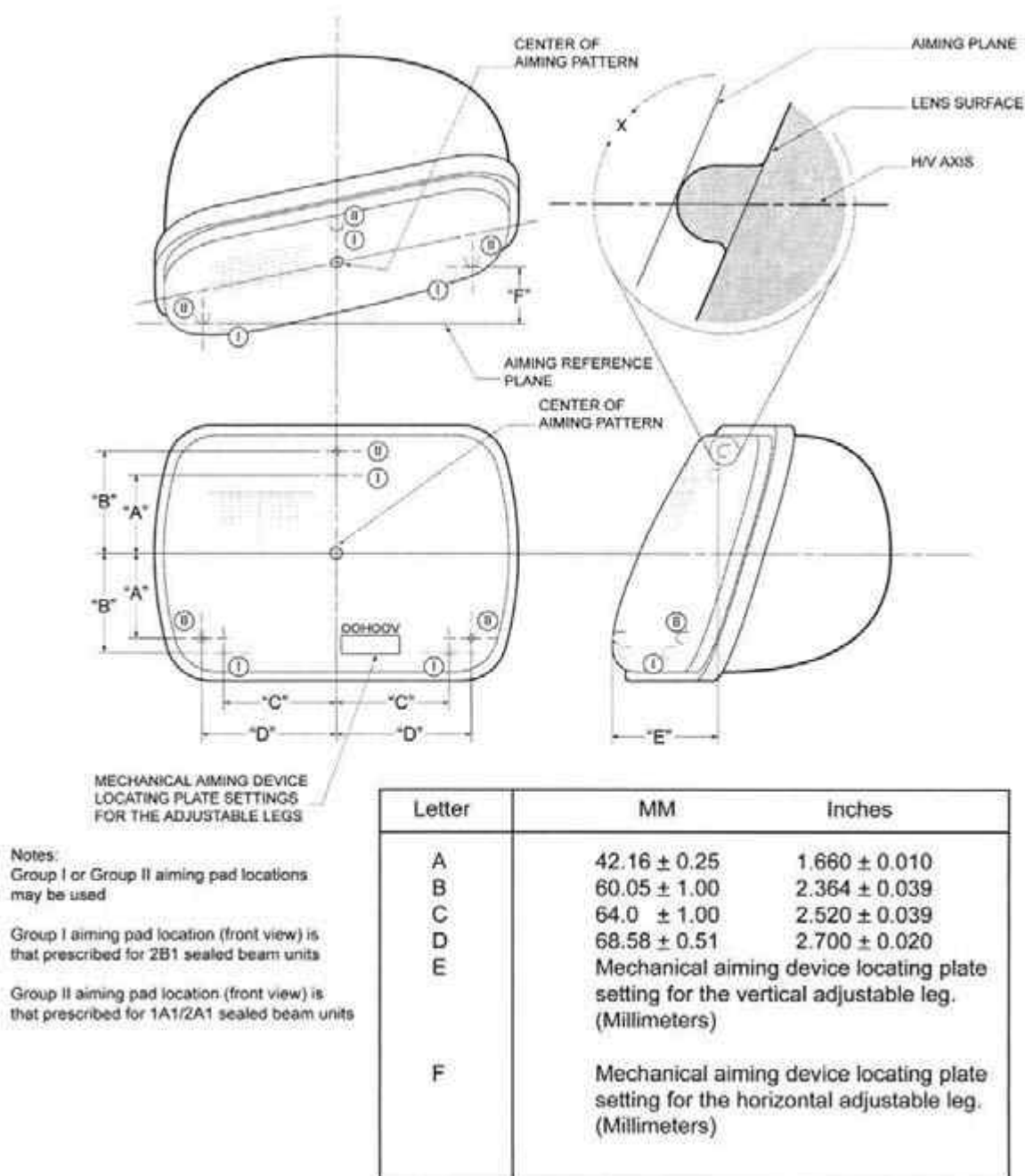


Figure 3: Replaceable Bulb Aiming Pads

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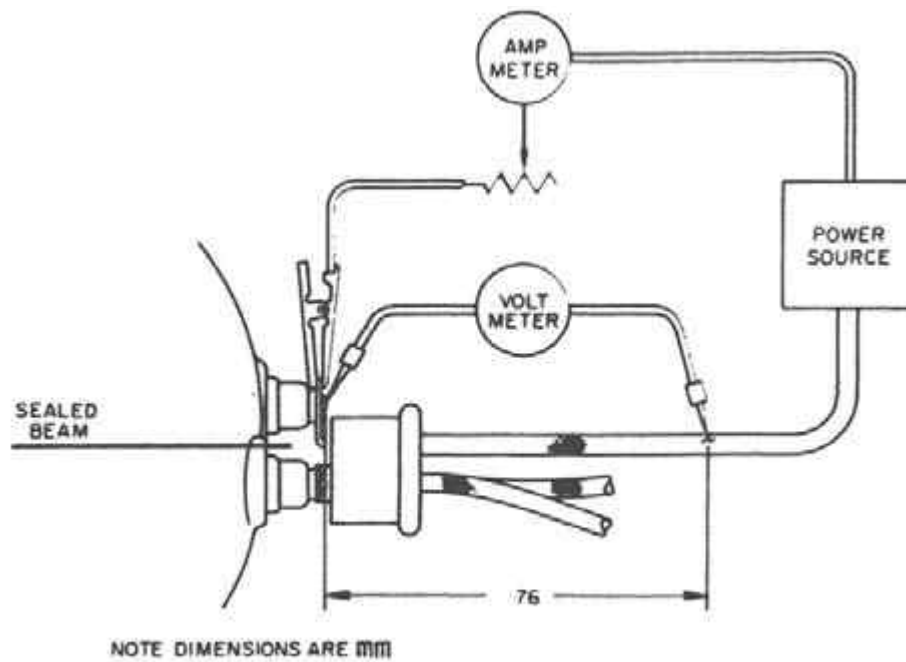


Figure 4: Headlamp Connector Test Setup

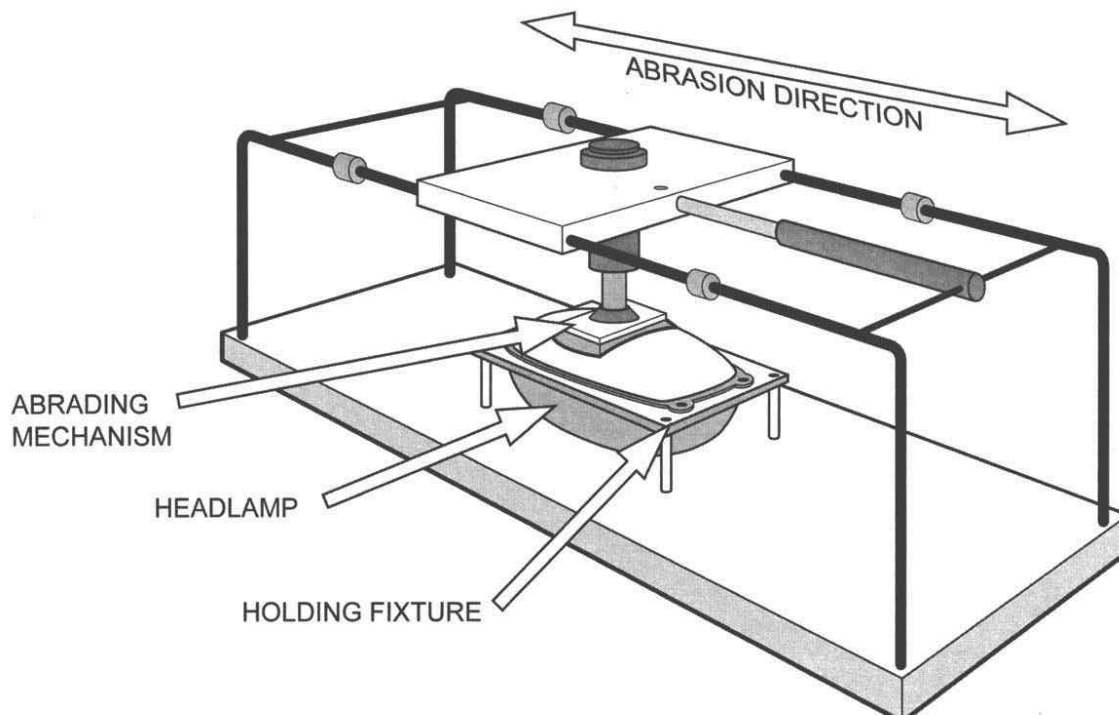


Figure 5: Headlamp Abrasion Test Fixture

Regulations

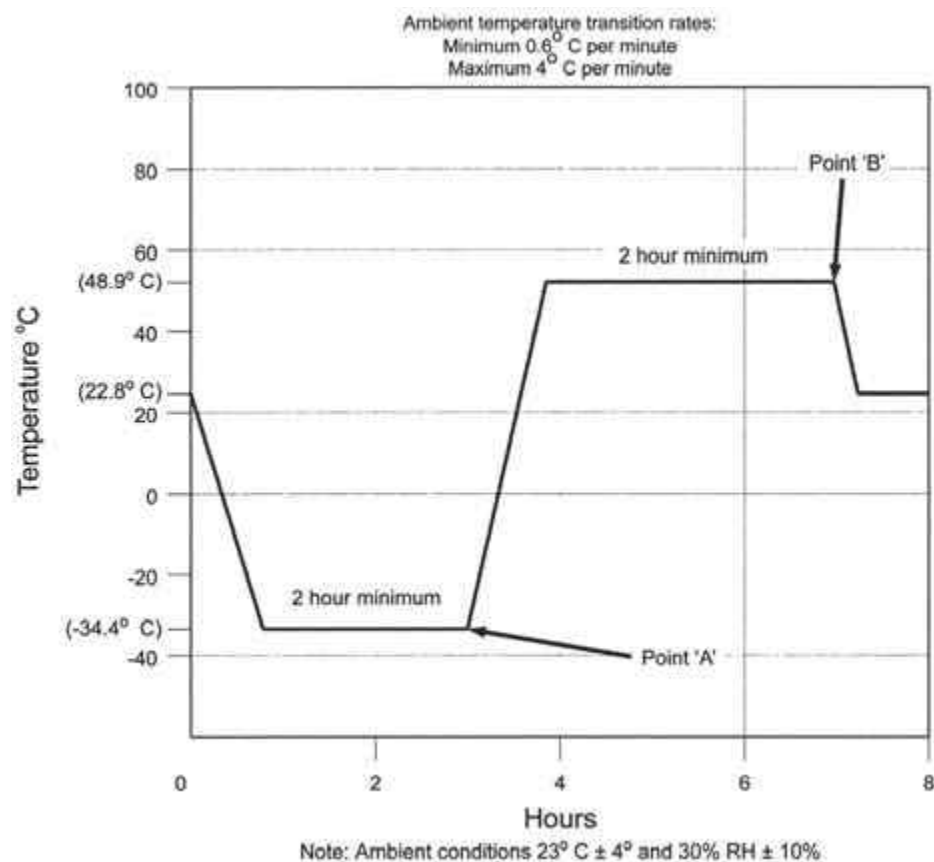


Figure 6: Thermal Cycle Profile

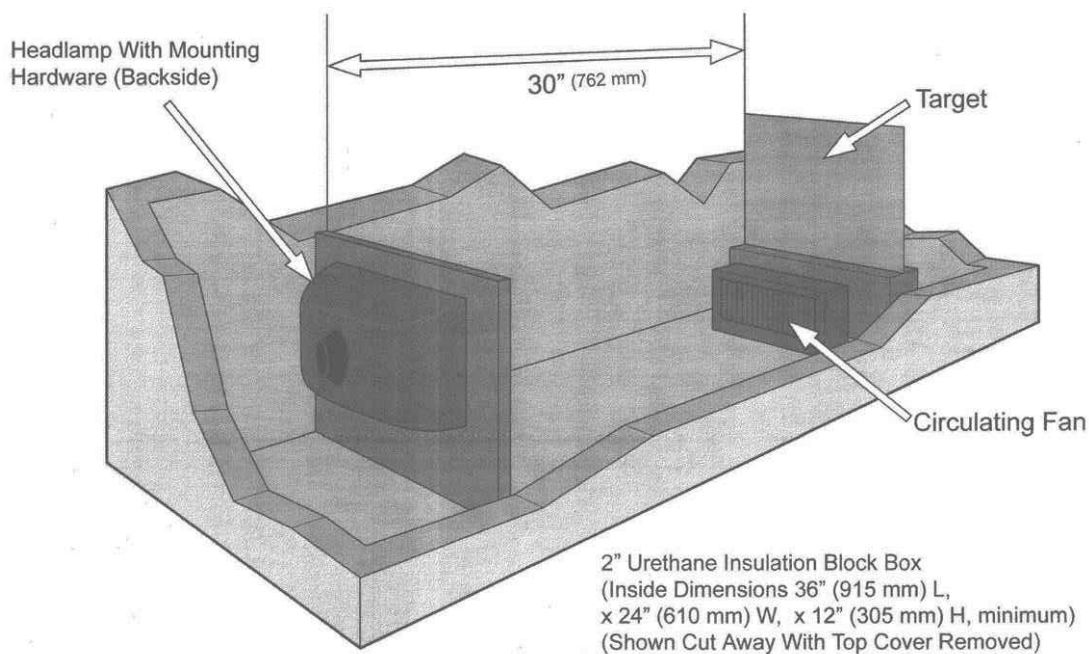


Figure 7: Dirt/Ambient Test Setup

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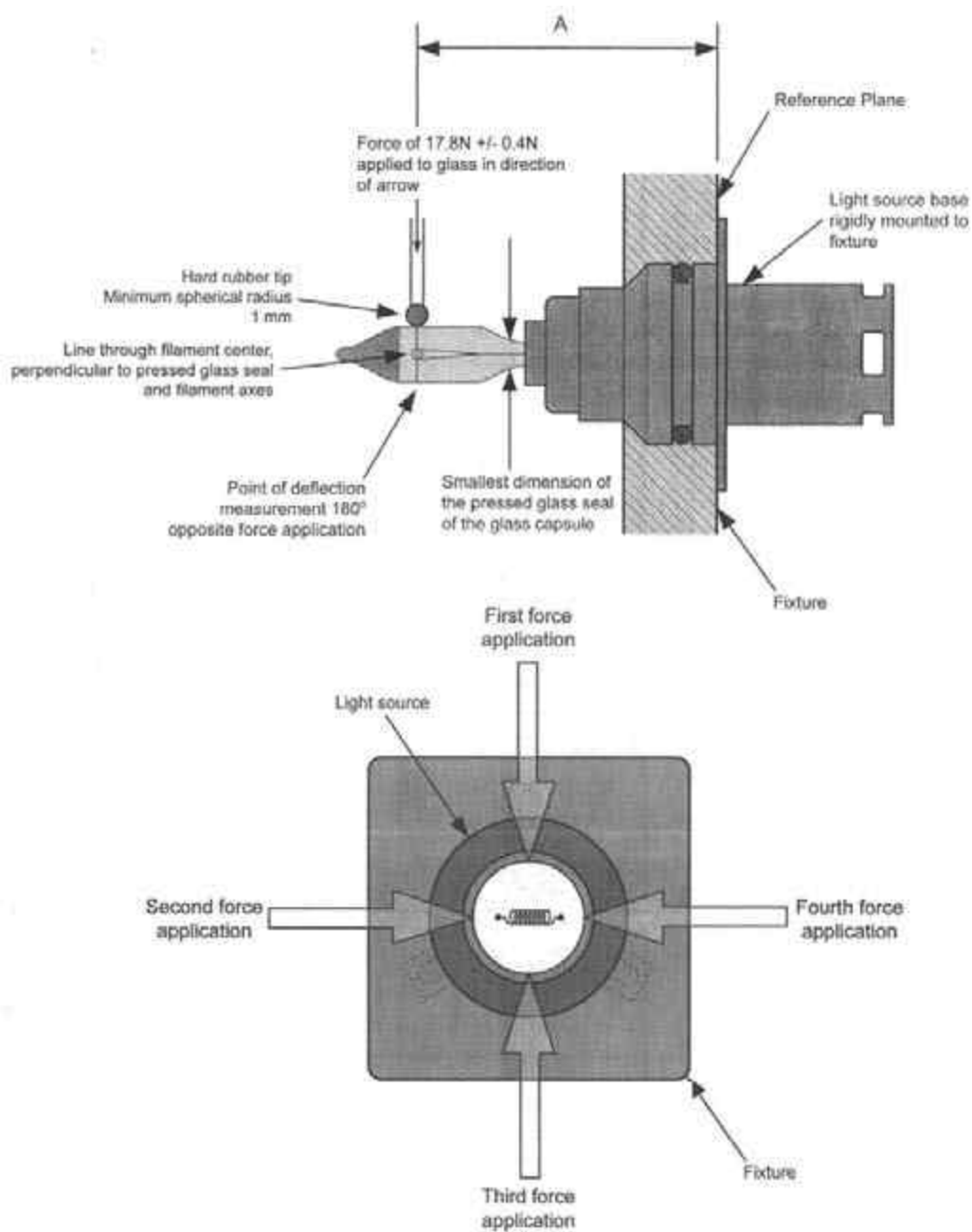


Figure 8: Replaceable Light Source Deflection Test Setup

Regulations

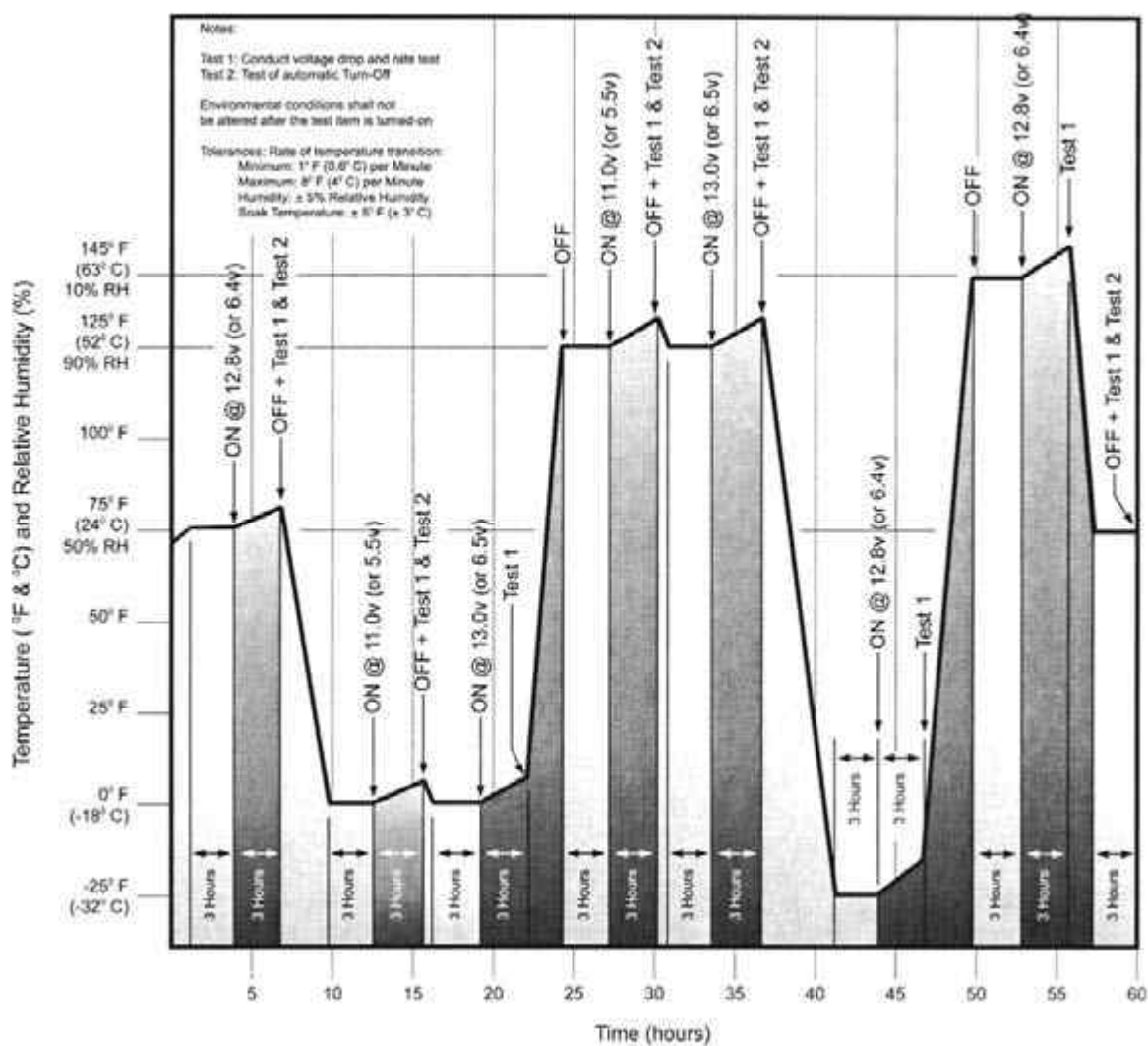


Figure 9: Environmental Test Profile

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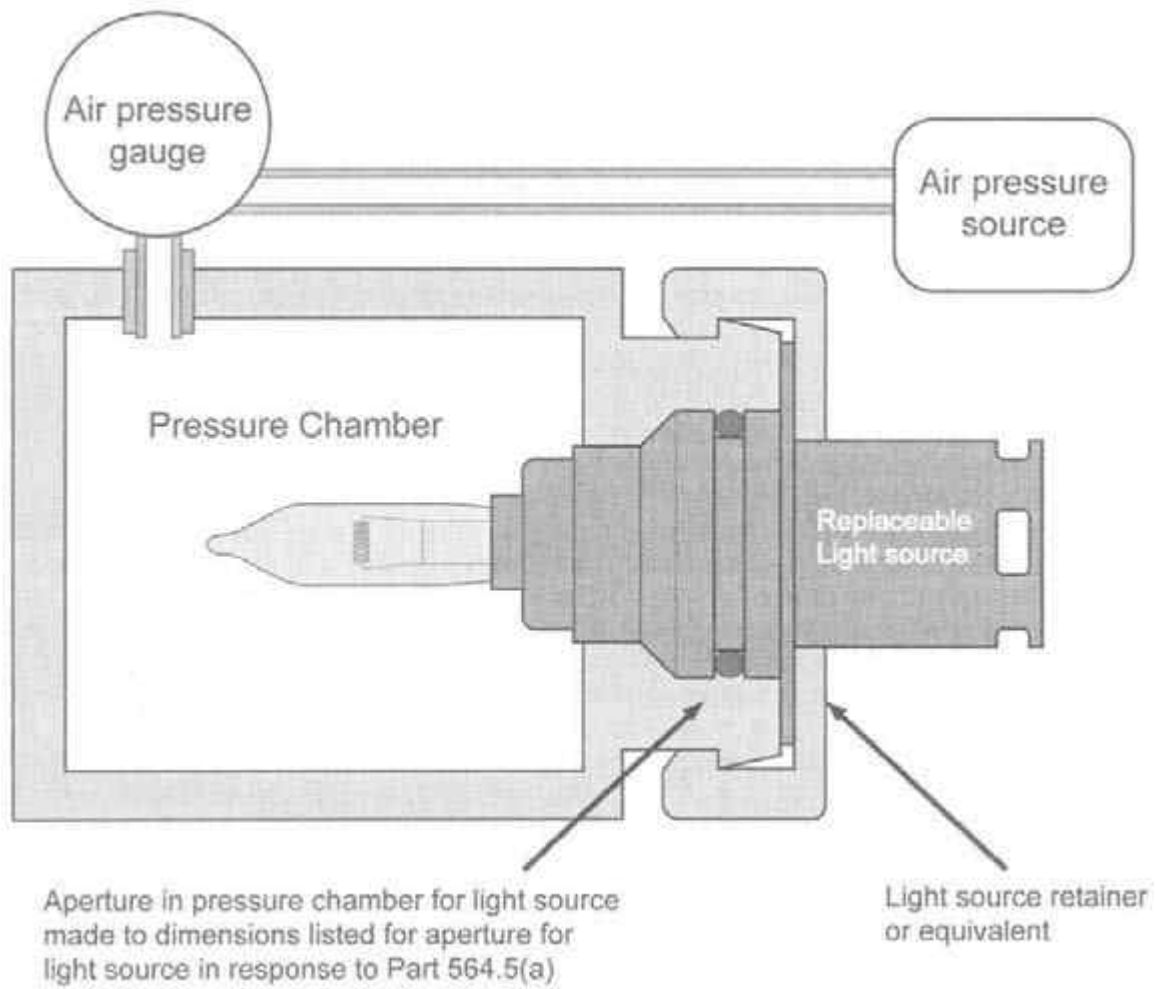


Figure 10: Replaceable Light Source Pressure Test Setup

Regulations

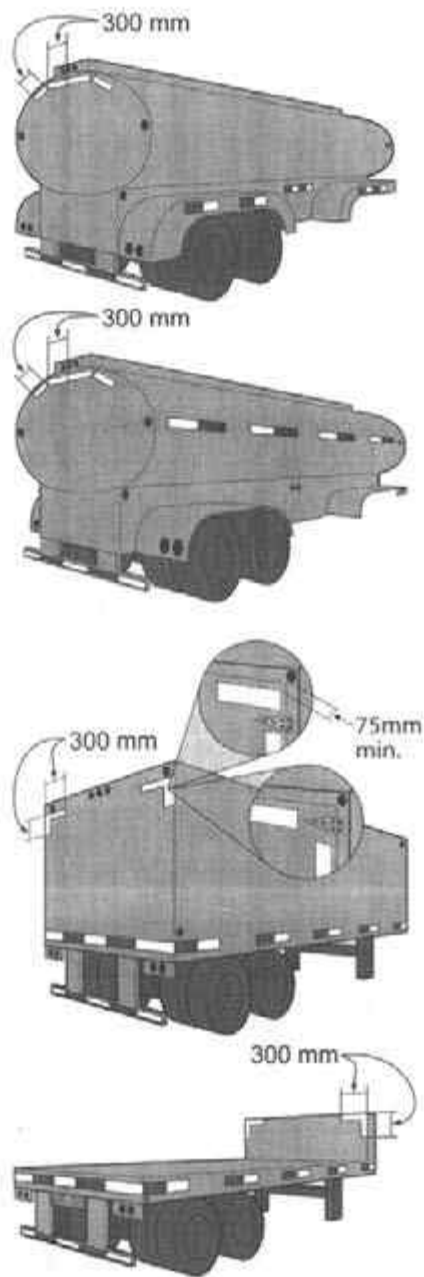


Figure 11: Trailer Conspicuity Treatment Examples

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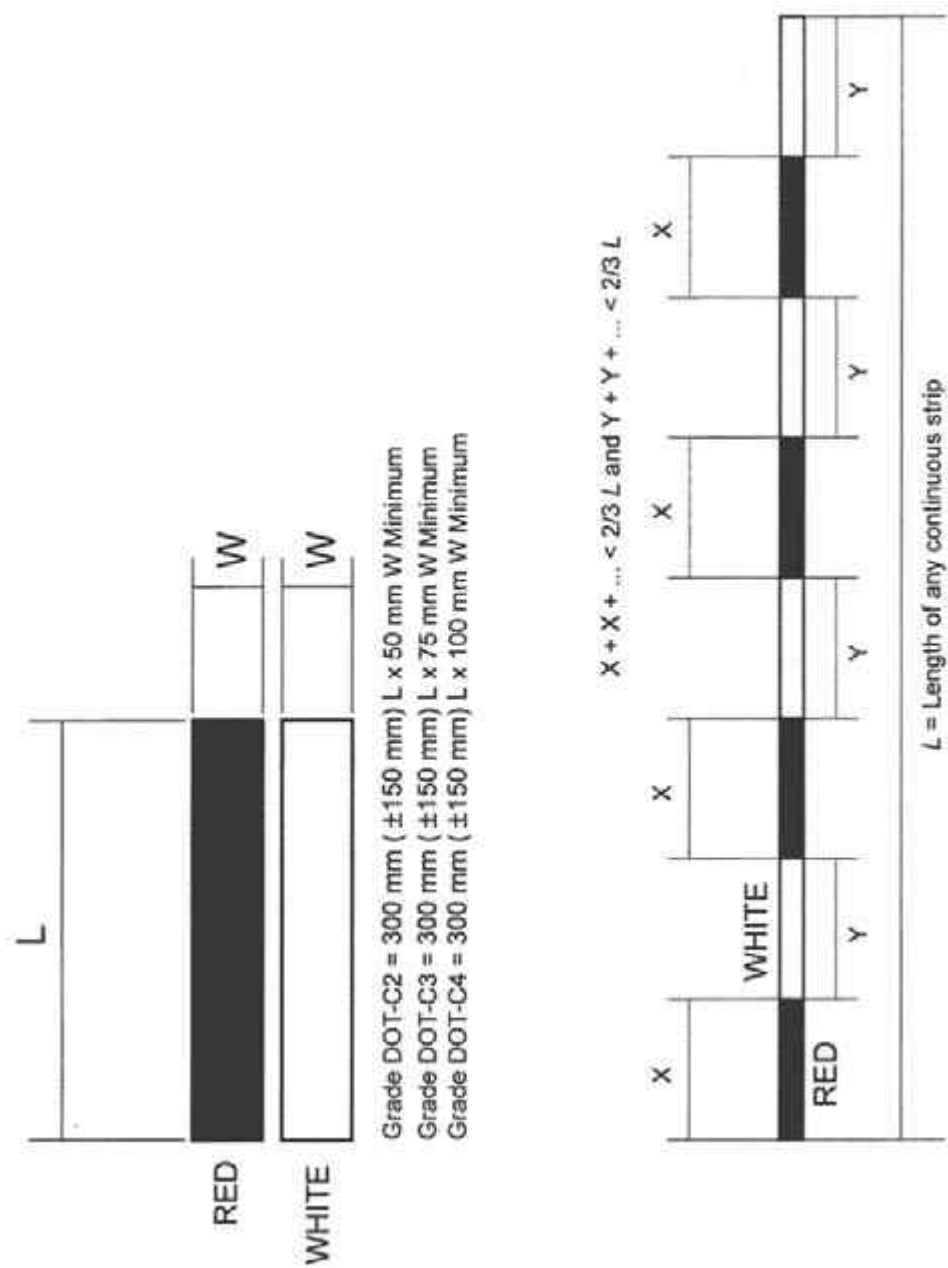


Figure 12a: Trailer Conspicuity Detail I

Regulations

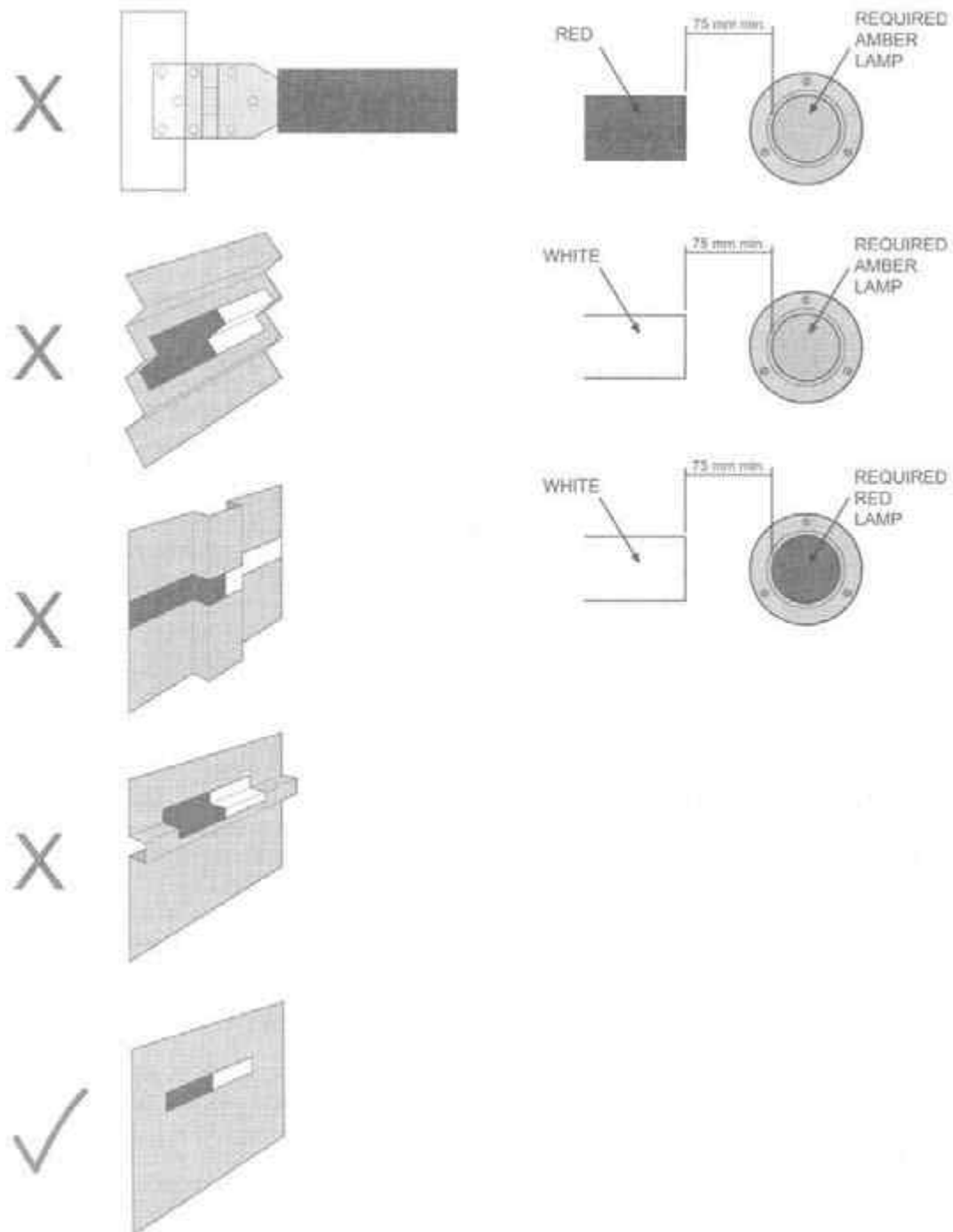


Figure 12b: Trailer Conspicuity Detail II

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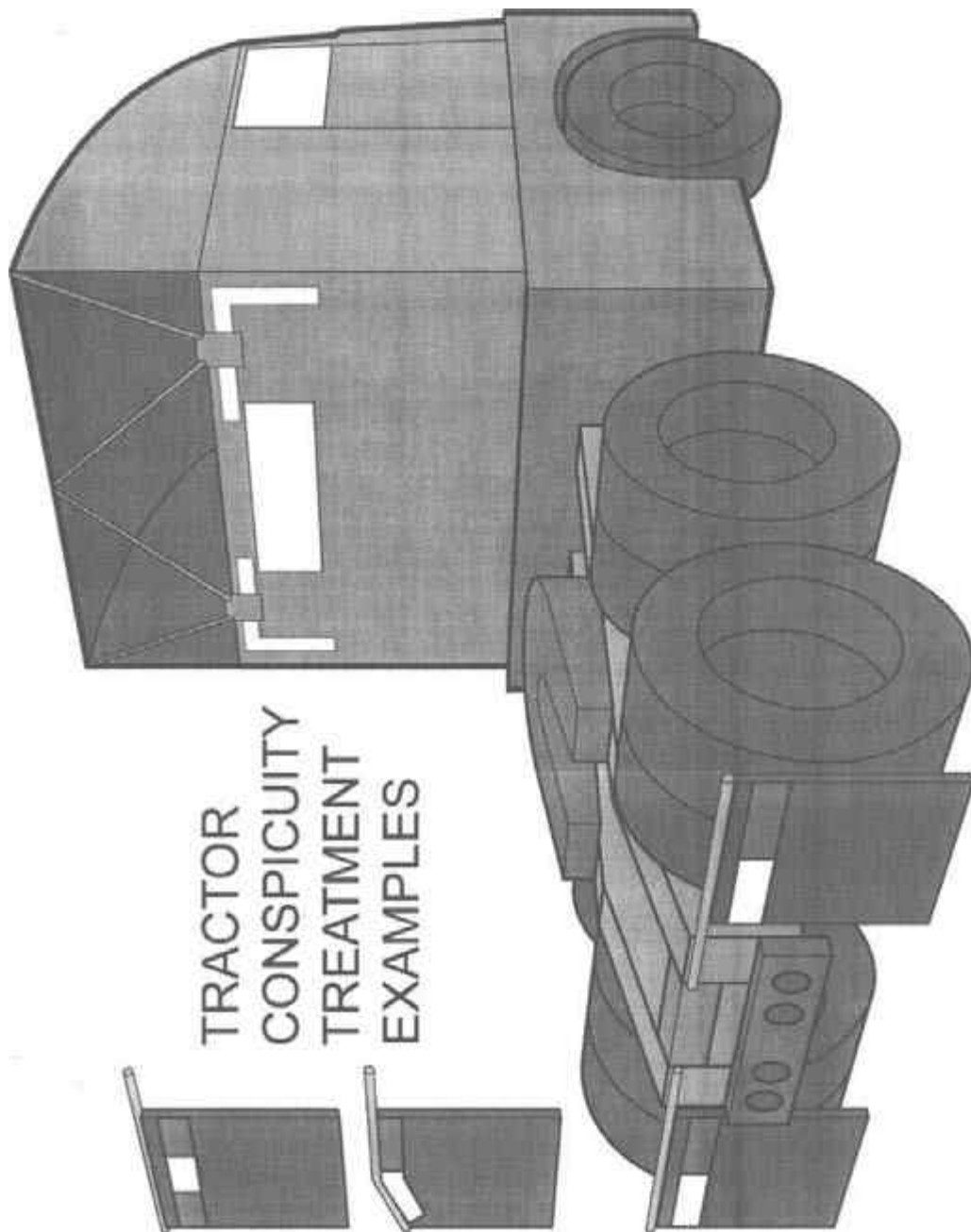


Figure 13: Tractor Conspicuity Treatment Examples

Regulations

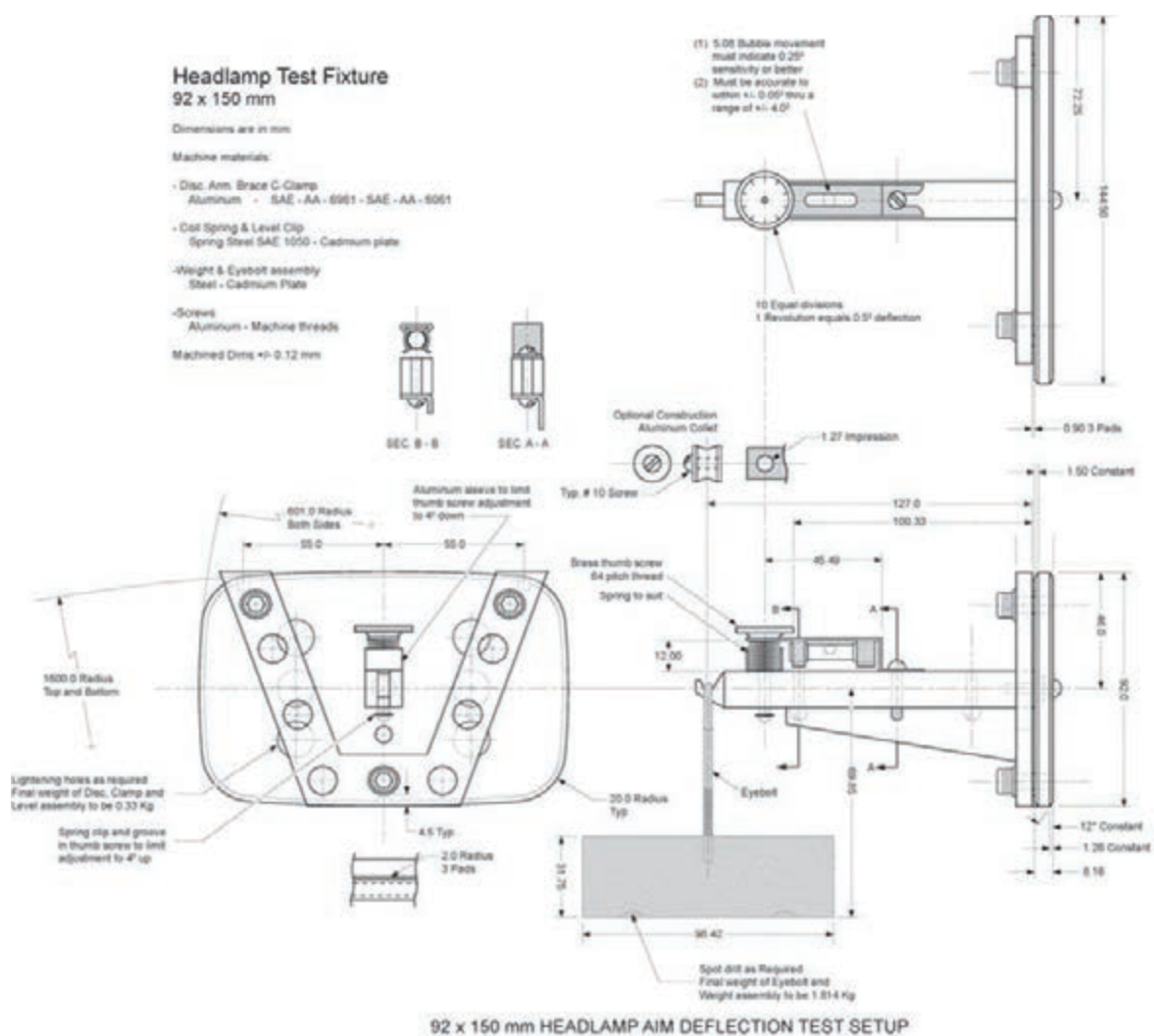


Figure 14

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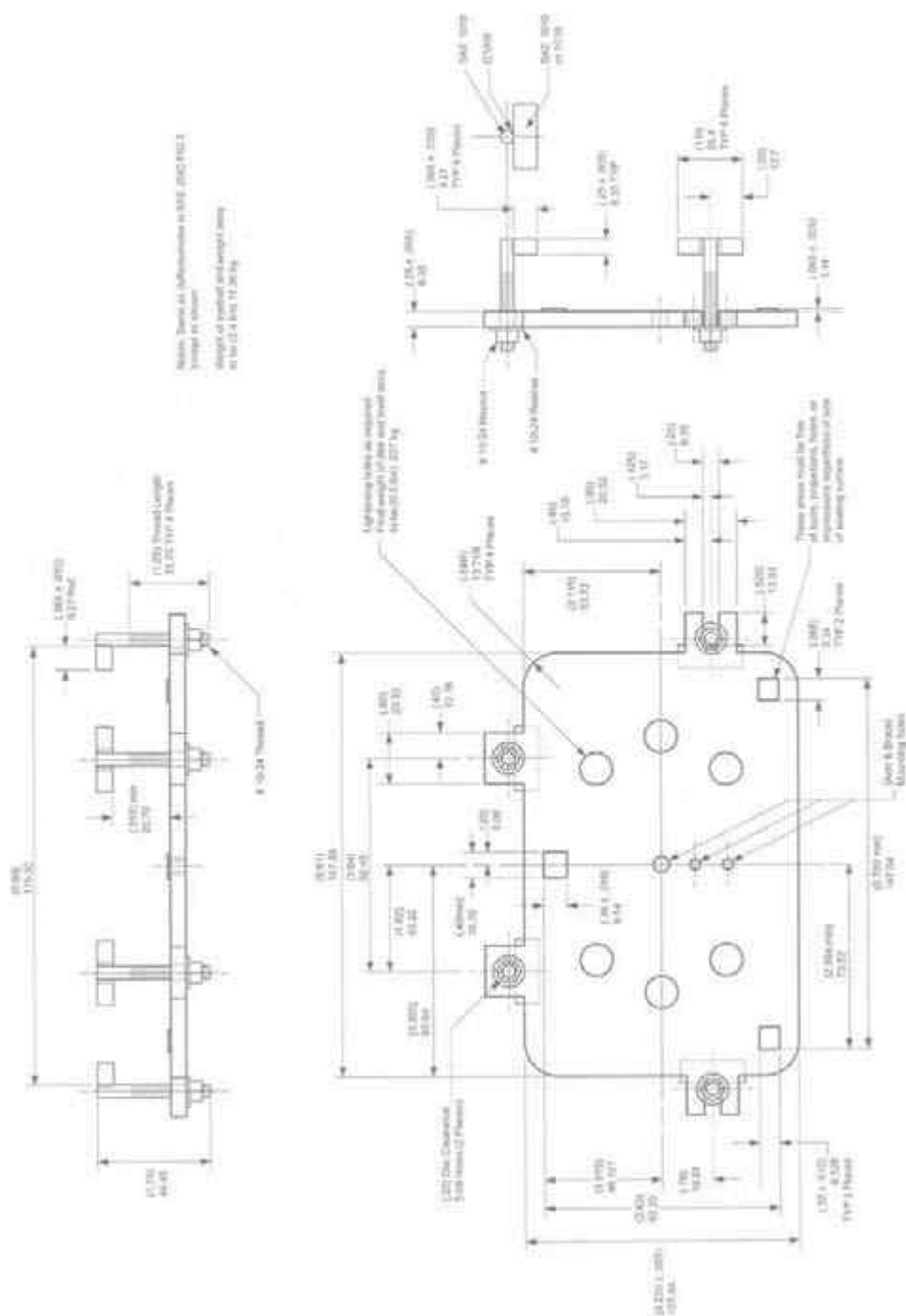


Figure 15: Types G and H Headlamp Aim Deflection Test Setup

Regulations

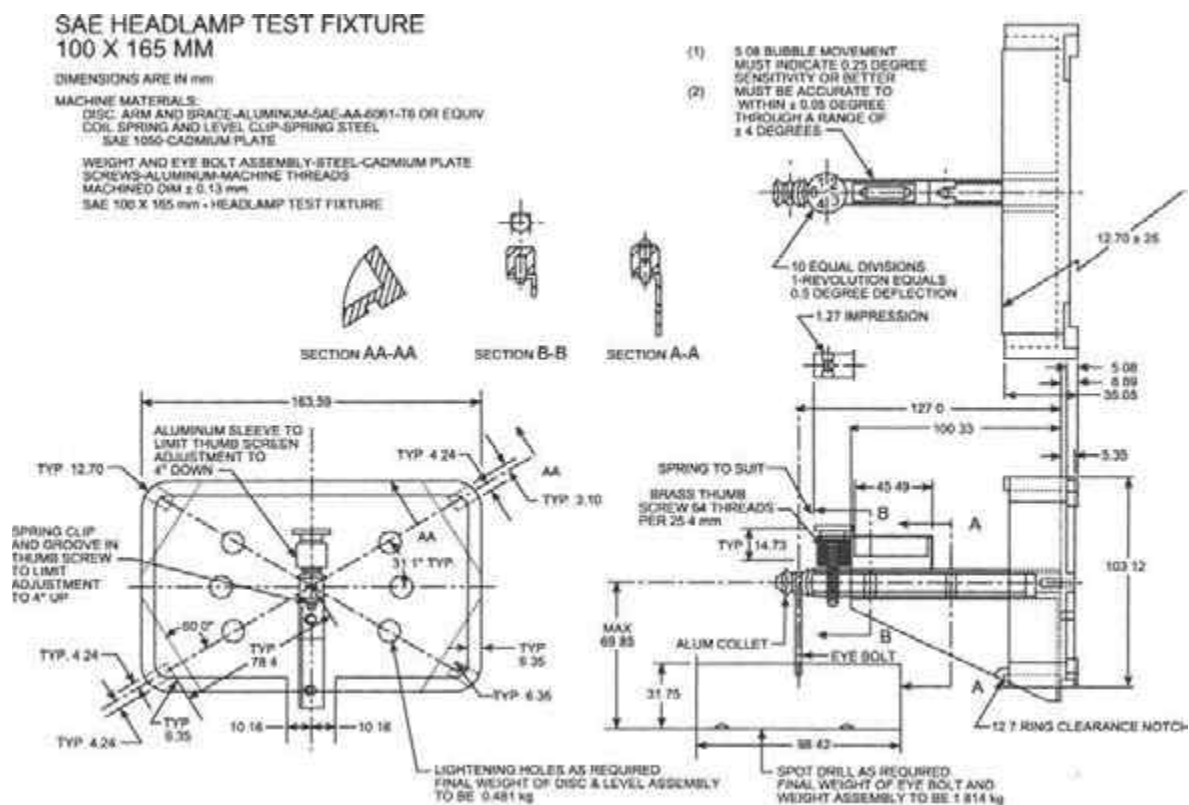


Figure 16: Types A and E Headlamp Aim Deflection Test Setup

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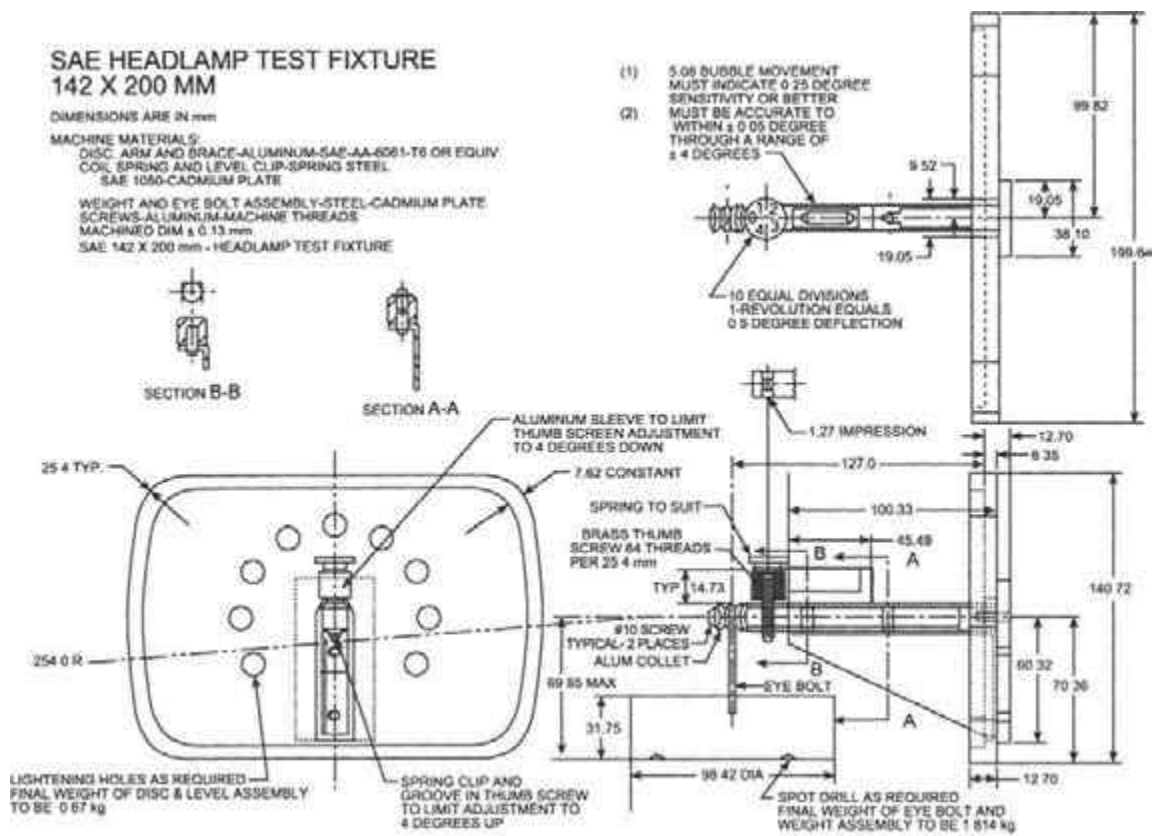


Figure 17: Type B Headlamp Aim Deflection Test Setup

Regulations

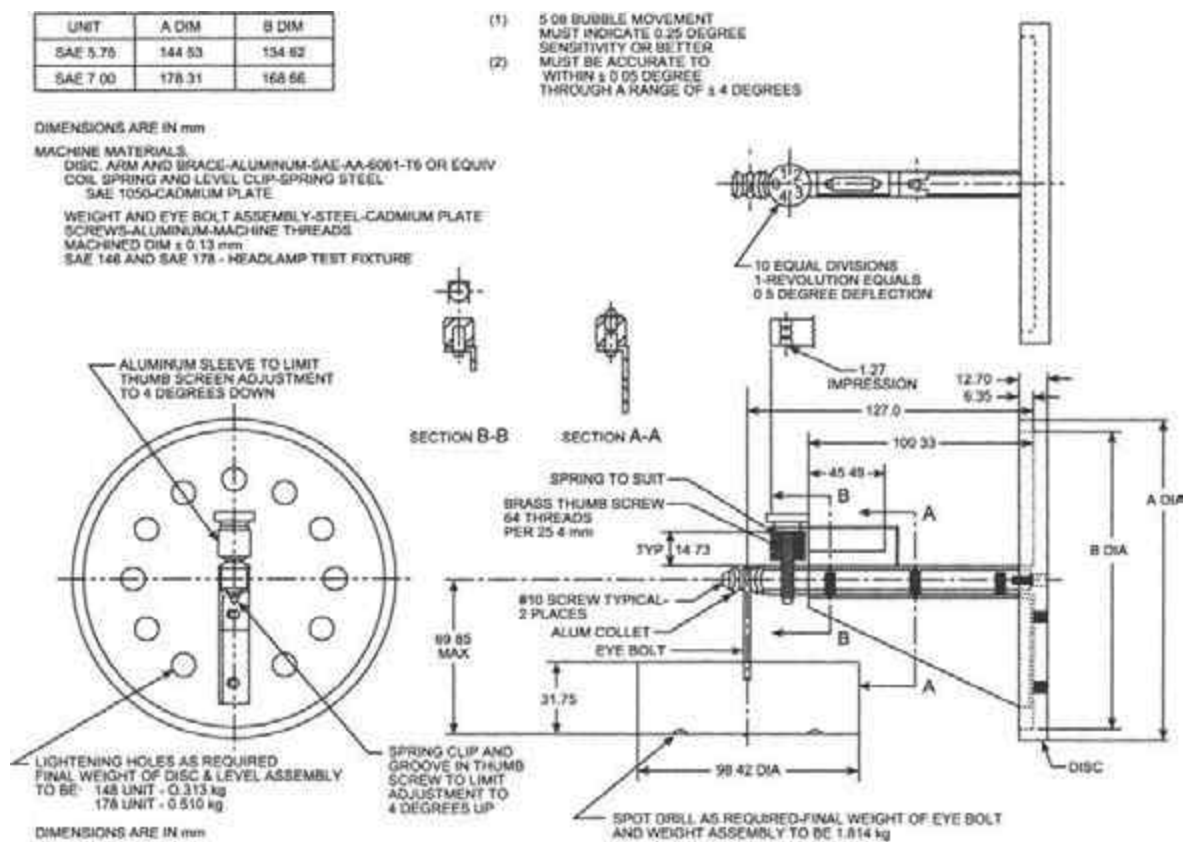


Figure 18: Types C and D Headlamp Aim Deflection Test Setup

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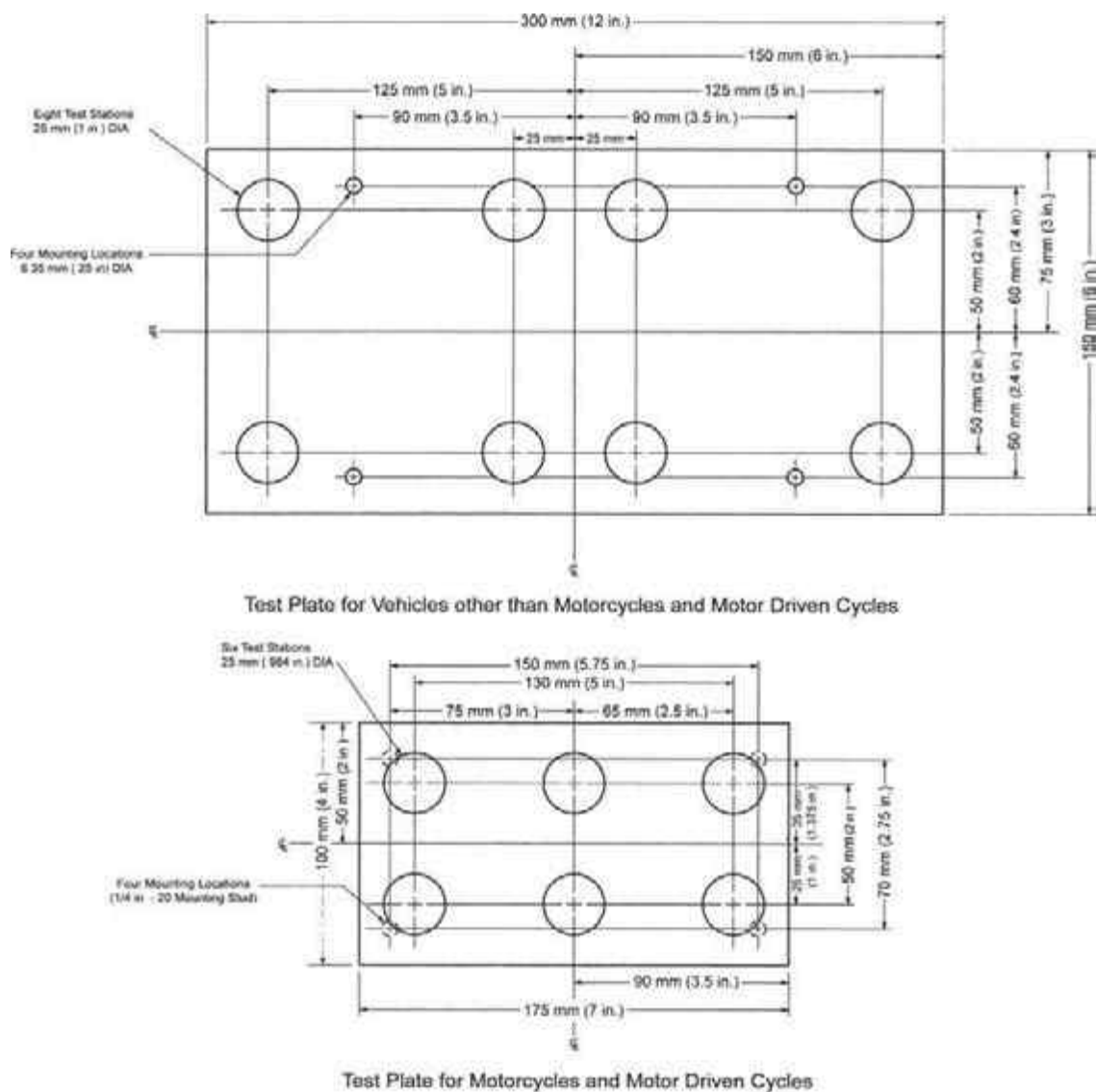


Figure 19: License Plate Lamp Target Locations

Regulations

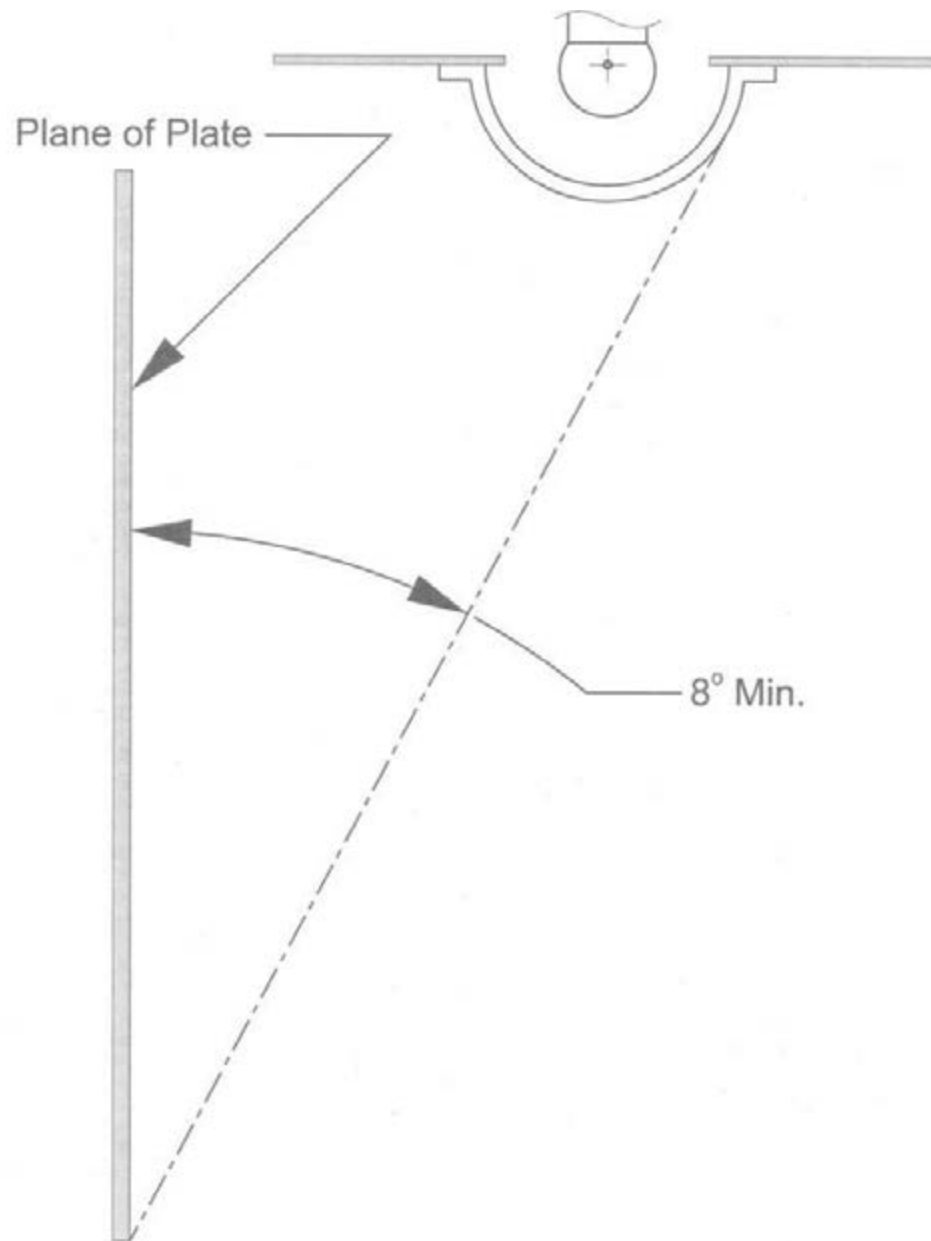


Figure 20: License Plate Lamp Measurement of Incident Light Angle

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Point	Radius, in.	Point	Radius, in.	Point	Radius, in.	Point	Radius, in.
1	0.5000	6	0.5504	11	0.6284	16	0.7064
2	0.5000	7	0.5660	12	0.6440	17	0.7220
3	0.5086	8	0.5816	13	0.6596	18	0.7376
4	0.5192	9	0.5972	14	0.6752	19	0.7466
5	0.5348	10	0.6128	15	0.6908	20	0.7500

* The cam width is between 1/2 and 1 in.

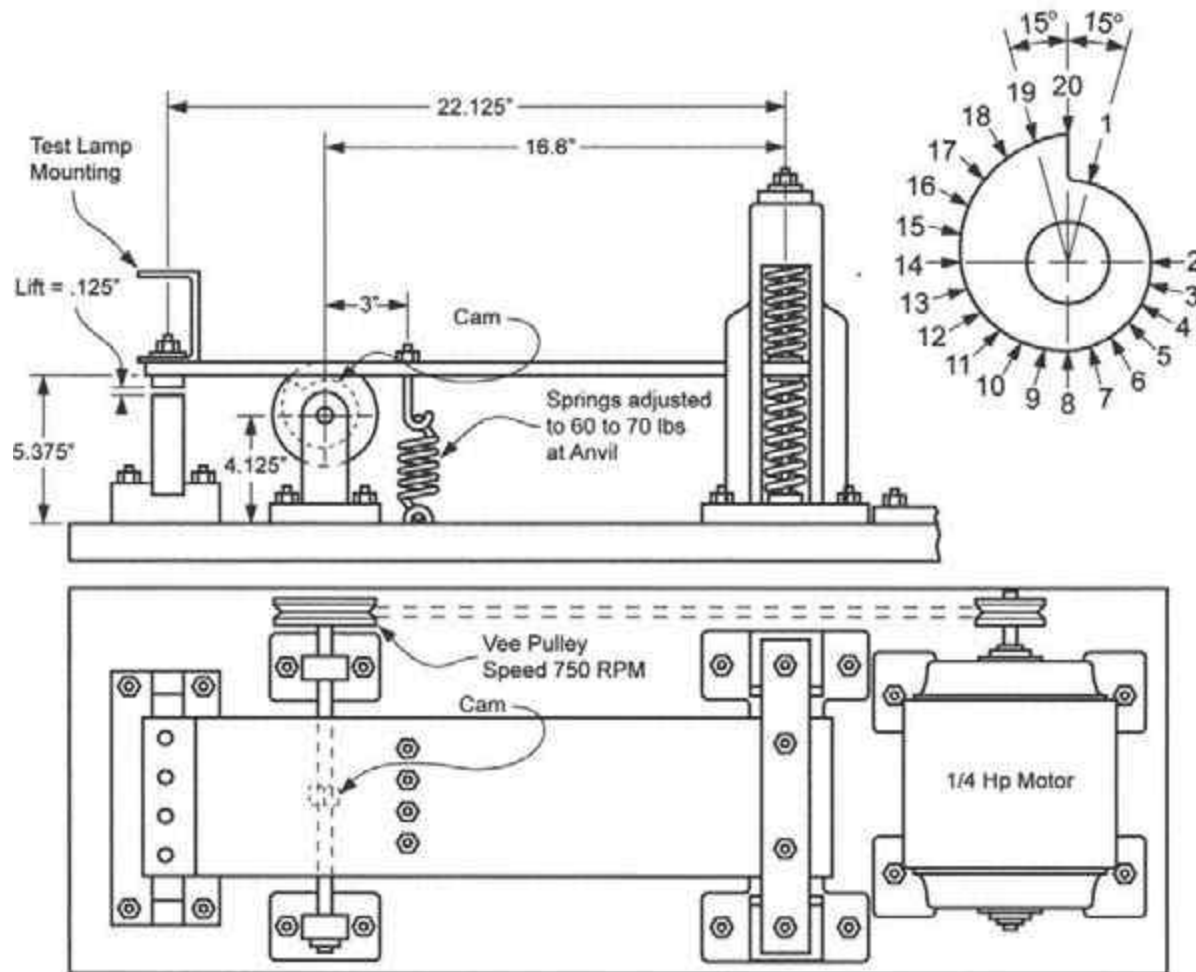


Figure 21: Vibration Test Machine

Regulations

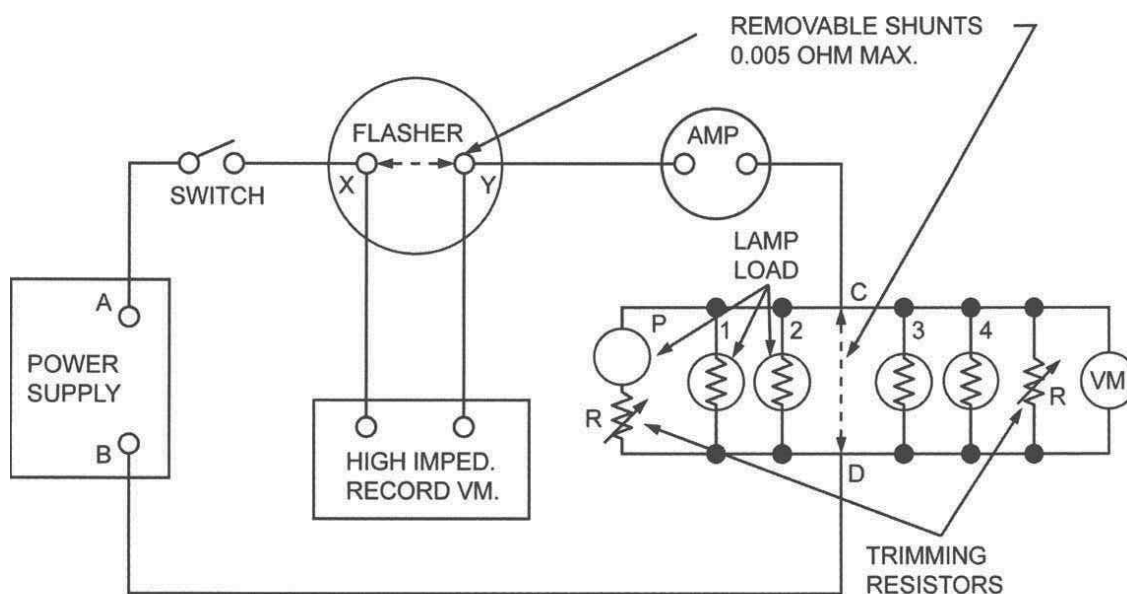


Figure 22: Flasher Standard Test Circuit

Appendix to §571.108: Table of Contents

Sec. 571.10 8 Standard No. 108; Lamps, reflective devices, and associated equipment.

S1 Scope.

S2 Purpose.

S3 Application.

S4 Definitions.

S5 References to SAE publications.

S5.2 Incorporation by reference.

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§571.111 Standard No. 111; Rear visibility.

S1. Scope. This standard specifies requirements for rear visibility devices and systems.

S2. Purpose. The purpose of this standard is to reduce the number of deaths and injuries that occur when the driver of a motor vehicle does not have a clear and reasonably unobstructed view to the rear.

S3. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, buses, school buses, motorcycles and low-speed vehicles.

S4. Definitions.

Backing event means an amount of time which starts when the vehicle's direction selector is placed in reverse, and ends at the manufacturer's choosing, when the vehicle forward motion reaches:

- (a) a speed of 10 mph,
- (b) a distance of 10 meters traveled, or
- (c) a continuous duration of 10 seconds.

Convex mirror means a mirror having a curved reflective surface whose shape is the same as that of the exterior surface of a section of a sphere.

Effective mirror surface means the portions of a mirror that reflect images, excluding the mirror rim or mounting brackets.

Environmental test fixture means a device designed to support the external components of the rear visibility system for testing purposes, using any factory seal which would be used during normal vehicle operation, in a manner that simulates the on-vehicle component orientation during normal vehicle operation, and prevents the exposure of any test conditions to portions

of the external component which are not exposed to the outside of the motor vehicle.

External component means any part of the rear visibility system which is exposed to the outside of the motor vehicle.

Key means a physical device or an electronic code which, when inserted into the starting system (by physical or electronic means), enables the vehicle operator to activate the engine or motor.

Limited line manufacturer means a manufacturer that sells three or fewer carlines, as that term is defined in 49 CFR 583.4, in the United States during a production year, as that term is defined in S15.

Rearview image means a visual image, detected by means of a single source, of the area directly behind a vehicle that is provided in a single location to the vehicle operator and by means of indirect vision.

Rear visibility system means the set of devices or components which together perform the function of producing the rearview image as required under this standard.

Small manufacturer means an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States.

Starting system means the vehicle system used in conjunction with the key to activate the engine or motor.

Unit magnification mirror means a plane or flat mirror with a reflective surface through which the angular height and width of the image of an object is equal to the angular height and width of the object when viewed directly at the same distance except for flaws that do not exceed normal manufacturing tolerances. For the purposes of this regulation a prismatic day-night adjustment rearview mirror one of whose positions provides unit magnification is considered a unit magnification mirror.

S5. Requirements for passenger cars.

S5.1 Inside rearview mirror. Each passenger car shall have an inside rearview mirror of unit magnification.

S5.1.1 Field of view. Except as provided in S5.3, the mirror shall provide a field of view with an included horizontal angle measured from the projected eye point of at least 20 degrees, and a sufficient vertical angle to provide a view of a level road surface extending to the horizon beginning at a point not greater than 61 m to the rear of the vehicle when the vehicle is occupied by the driver and four passengers or the designated occupant capacity, if less, based on an average occupant weight of 68 kg. The line of sight may be partially obscured by seated occupants or by head restraints. The location of the driver's eye reference points shall be those established in Motor Vehicle Safety Standard No. 104 (§571.104) or a nominal location appropriate for any 95th percentile male driver.

S5.1.2 Mounting. The mirror mounting shall provide a stable support for the mirror, and shall provide for mirror adjustment by tilting in both the horizontal and vertical directions. If the mirror is in the head impact area, the mounting shall deflect, collapse or break away without leaving sharp edges when the reflective surface

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of the mirror is subjected to a force of 400 N in any forward direction that is not more than 45° from the forward longitudinal direction.

S5.2 Outside rearview mirror—driver's side.

S5.2.1 Field of view. Each passenger car shall have an outside mirror of unit magnification. The mirror shall provide the driver a view of a level road surface extending to the horizon from a line, perpendicular to a longitudinal plane tangent to the driver's side of the vehicle at the widest point, extending 2.4 m out from the tangent plane 10.7 m behind the driver's eyes, with the seat in the rearmost position. The line of sight may be partially obscured by rear body or fender contours. The location of the driver's eye reference points shall be those established in Motor Vehicle Safety Standard No. 104 (§571.104) or a nominal location appropriate for any 95th percentile male driver.

S5.2.2 Mounting. The mirror mounting shall provide a stable support for the mirror, and neither the mirror nor the mounting shall protrude farther than the widest part of the vehicle body except to the extent necessary to produce a field of view meeting or exceeding the requirements of S5.2.1. The mirror shall not be obscured by the unwiped portion of the windshield, and shall be adjustable by tilting in both horizontal and vertical directions from the driver's seated position. The mirror and mounting shall be free of sharp points or edges that could contribute to pedestrian injury.

S5.3 Outside rearview mirror passenger's side. Each passenger car whose inside rearview mirror does not meet the field of view requirements of S5.1.1 shall have an outside mirror of unit magnification or a convex mirror installed on the passenger's side. The mirror mounting shall provide a stable support and be free of sharp points or edges that could contribute to pedestrian injury. The mirror need not be adjustable from the driver's seat but shall be capable of adjustment by tilting in both horizontal and vertical directions.

S5.4 Convex mirror requirements. Each motor vehicle using a convex mirror to meet the requirements of S5.3 shall comply with the following requirements:

S5.4.1 When each convex mirror is tested in accordance with the procedures specified in S12. of this standard, none of the radii of curvature readings shall deviate from the average radius of curvature by more than plus or minus 12.5 percent.

S5.4.2 Each convex mirror shall have permanently and indelibly marked at the lower edge of the mirror's reflective surface, in letters not less than 4.8 mm nor more than 6.4 mm high the words "Objects in Mirror Are Closer Than They Appear."

S5.4.3 The average radius of curvature of each such mirror, as determined by using the procedure in S12., shall be not less than 889 mm and not more than 1,651 mm.

S5.5 Rear visibility.

(a) **Phase-in period requirements.** For passenger cars with a GVWR of 4,536 kg or less manufactured on or after May 1, 2016, but not later than April 30, 2018, a percentage of each manufacturer's production, as speci-

fied in S15, shall display a rearview image meeting the requirements of S5.5.1.

(b) **Final requirements.** Each passenger car with a GVWR of 4,536 kg or less manufactured on or after May 1, 2018, shall display a rearview image meeting the requirements of S5.5.1 through S5.5.7.

S5.5.1 Field of view. When tested in accordance with the procedures in S14.1, the rearview image shall include:

(a) A minimum of a 150-mm wide portion along the circumference of each test object located at positions F and G specified in S14.1.4; and

(b) The full width and height of each test object located at positions A through E specified in S14.1.4.

S5.5.2 Size. When the rearview image is measured in accordance with the procedures in S14.1, the calculated visual angle subtended by the horizontal width of

(a) All three test objects located at positions A, B, and C specified in S14.1.4 shall average not less than 5 minutes of arc; and

(b) Each individual test object (A, B, and C) shall not be less than 3 minutes of arc.

S5.5.3 Response time. The rearview image meeting the requirements of S5.5.1 and S5.5.2, when tested in accordance with S14.2, shall be displayed within 2.0 seconds of the start of a backing event.

S5.5.4 Linger time. The rearview image meeting the requirements of S5.5.1 and S5.5.2 shall not be displayed after the backing event has ended.

S5.5.5 Deactivation. The rearview image meeting the requirements of S5.5.1 and S5.5.2 shall remain visible during the backing event until either, the driver modifies the view, or the vehicle direction selector is removed from the reverse position.

S5.5.6 Default view. The rear visibility system must default to the rearview image meeting the requirements of S5.5.1 and S5.5.2 at the beginning of each backing event regardless of any modifications to the field of view the driver has previously selected.

S5.5.7 Durability. The rear visibility system shall meet the field of view and image size requirements of S5.5.1 and S5.5.2 after each durability test specified in S14.3.1, S14.3.2, and S14.3.3.

S6. Requirements for multipurpose passenger vehicles, low-speed vehicles, trucks, buses, and school buses with GVWR of 4,536 kg or less.

S6.1 Each multipurpose passenger vehicle, truck and bus, other than a school bus, with a GVWR of 4,536 kg or less shall have either—

(a) Mirrors that conform to the requirements of S5.; or

(b) Outside mirrors of unit magnification, each with not less than 126 cm² of reflective surface, installed with stable supports on both sides of the vehicle, located so as to provide the driver a view to the rear along both sides of the vehicle, and adjustable in both the horizontal and vertical directions to view the rearward scene.

S6.2 Rear visibility.

(a) **Phase-in period requirements.** For multipurpose passenger vehicles, low-speed vehicles, trucks, buses,

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and school buses with a GVWR of 4,536 kg or less manufactured on or after May 1, 2016, but not later than April 30, 2018, a percentage of each manufacturer's production, as specified in S15, shall display a rearview image meeting the requirements of S6.2.1.

(b) **Final requirements.** Each multipurpose passenger vehicle, low-speed vehicle, truck, bus, and school bus with a GVWR of 4,536 kg or less manufactured on or after May 1, 2018, shall display a rearview image meeting the requirements of S6.2.1 through S6.2.7.

S6.2.1 Field of view. When tested in accordance with the procedures in S14.1, the rearview image shall include:

(a) A minimum of a 150-mm wide portion along the circumference of each test object located at positions F and G specified in S14.1.4; and

(b) The full width and height of each test object located at positions A through E specified in S14.1.4.

S6.2.2 Size. When the rearview image is measured in accordance with the procedures in S14.1, the calculated visual angle subtended by the horizontal width of

(a) All three test objects located at positions A, B, and C specified in S14.1.4 shall average not less than 5 minutes of arc; and

(b) Each individual test object (A, B, and C) shall not be less than 3 minutes of arc.

S6.2.3 Response time. The rearview image meeting the requirements of S6.2.1 and S6.2.2, when tested in accordance with S14.2, shall be displayed within 2.0 seconds of the start of a backing event.

S6.2.4 Linger time. The rearview image meeting the requirements of S6.2.1 and S6.2.2 shall not be displayed after the backing event has ended.

S6.2.5 Deactivation. The rearview image meeting the requirements of S6.2.1 and S6.2.2 shall remain visible during the backing event until either, the driver modifies the view, or the vehicle direction selector is removed from the reverse position.

S6.2.6 Default view. The rear visibility system must default to the rearview image meeting the requirements of S6.2.1 and S6.2.2 at the beginning of each backing event regardless of any modifications to the field of view the driver has previously selected.

S6.2.7 Durability. The rear visibility system shall meet the field of view and image size requirements of S6.2.1 and S6.2.2 after each durability test specified in S14.3.1, S14.3.2, and S14.3.3.

S7. Requirements for multipurpose passenger vehicles and trucks with a GVWR of more than 4,536 kg and less than 11,340 kg and buses, other than school buses, with a GVWR of more than 4,536 kg.

S7.1 Each multipurpose passenger vehicle and truck with a GVWR of more than 4,536 kg and less than 11,340 kg and each bus, other than a school bus, with a GVWR of more than 4,536 kg shall have outside mirrors of unit magnification, each with not less than 323 cm² of reflective surface, installed with stable supports on both sides of the vehicle. The mirrors shall be located so as to provide the driver a view to the rear along both sides of

the vehicle and shall be adjustable both in the horizontal and vertical directions to view the rearward scene.

S8. Requirements for multipurpose passenger vehicles and trucks with a GVWR of 11,340 kg or more.

S8.1 Each multipurpose passenger vehicle and truck with a GVWR of 11,340 kg or more shall have outside mirrors of unit magnification, each with not less than 323 cm² of reflective surface, installed with stable supports on both sides of the vehicle. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the vehicle and shall be adjustable both in the horizontal and vertical directions to view the rearward scene.

S9. Requirements for School Buses. When a school bus is tested in accordance with the procedures of S13, it shall meet the requirements of S9.1 through S9.4.

S9.1 Outside Rearview Mirrors. Each school bus shall have two outside rearview mirror systems: System A and System B.

S9.2. System A shall be located with stable supports so that the portion of the system on the bus's left side, and the portion on its right side, each:

(a) Includes at least one mirror of unit magnification with not less than 323 cm² of reflective surface; and

(b) Includes one or more mirrors which together provide, at the driver's eye location, a view of:

(1) For the mirror system on the right side of the bus, the entire top surface of cylinder N in Figure 2, and that area of the ground which extends rearward from cylinder N to a point not less than 61 meters from the mirror surface.

(2) For the mirror system on the left side of the bus, the entire top surface of cylinder M in Figure 2, and that area of the ground which extends rearward from cylinder M to a point not less than 61 meters from the mirror surface.

S9.3(a) For each of the cylinders A through P whose entire top surface is not directly visible from the driver's eye location, System B shall provide, at that location:

(1) A view of the entire top surface of that cylinder.

(2) A view of the ground that overlaps with the view of the ground provided by System A.

(b) Each mirror installed in compliance with S9.3(a) shall meet the following requirements:

(1) Each mirror shall have a projected area of at least 258 cm², as measured on a plane at a right angle to the mirror's axis.

(2) Each mirror shall be located such that the distance from the center point of the eye location of a 25th percentile adult female seated in the driver's seat to the center of the mirror shall be at least 95 cm.

(3) Each mirror shall have no discontinuities in the slope of the surface of the mirror.

(4) Each mirror shall be installed with a stable support.

(c) Each school bus which has a mirror installed in compliance with S9.3(a) that has an average radius of curvature of less than 889 mm, as determined under

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S12, shall have a label visible to the seated driver. The label shall be printed in a type face and color that are clear and conspicuous. The label shall state the following:

“USE CROSS VIEW MIRRORS TO VIEW PEDESTRIANS WHILE BUS IS STOPPED. DO NOT USE THESE MIRRORS TO VIEW TRAFFIC WHILE BUS IS MOVING. IMAGES IN SUCH MIRRORS DO NOT ACCURATELY SHOW ANOTHER VEHICLE'S LOCATION.”

S9.4(a) Each image required by S9.3(a)(1) to be visible at the driver's eye location shall be separated from the edge of the effective mirror surface of the mirror providing that image by a distance of not less than 3 minutes of arc.

(b) The image required by S9.3(a)(1) of cylinder P shall meet the following requirements:

(1) The angular size of the shortest dimension of that cylinder's image shall be not less than 3 minutes of arc; and

(2) The angular size of the longest dimension of that cylinder's image shall be not less than 9 minutes of arc.

S10. Requirements for motorcycles.

S10.1 Each motorcycle shall have either a mirror of unit magnification with not less than 8065 mm² of reflective surface, or a convex mirror with not less than 6450 mm² of reflective surface and an average radius of curvature not less than 508 mm and not greater than 1524 mm, installed with a stable support, and mounted so that the horizontal center of the reflective surface is at least 279 mm outward of the longitudinal centerline of the motorcycle. The mirror shall be adjustable by tilting in both the horizontal and vertical directions.

S11. **Mirror construction.** The average reflectance of any mirror required by this standard shall be determined in accordance with SAE Standard J964 OCT84 (incorporated by reference, see §571.5). All single reflectance mirrors shall have an average reflectance of at least 35%. If a mirror is capable of multiple reflectance levels, the minimum reflectance level in the day mode shall be at least 35% and the minimum reflectance level in the night mode shall be at least 4%. A multiple reflectance mirror shall either be equipped with a means for

the driver to adjust the mirror to a reflectance level of at least 35% in the event of electrical failure, or achieve such reflectance level automatically in the event of electrical failure.

S12. Determination of radius of curvature.

S12.1 To determine the average radius of curvature of a convex mirror, use a 3-point linear spherometer, which meets the requirements of S12.2, at the 10 test positions shown in Figure 1 and record the readings for each position.

S12.2 The 3-point linear spherometer has two outer fixed legs 38 mm apart and one inner movable leg at the midpoint. The spherometer has a dial indicator with a scale that can be read accurately to .0025 mm, with the zero reading being a flat surface.

S12.3 The 10 test positions on the image display consist of two positions at right angles to each other at each of five locations as shown in Figure 1. The locations are at the center of the mirror, at the left and right ends of a horizontal line that bisects the mirror and at the top and bottom ends of a vertical line that bisects the mirror. None of the readings are within a 6.4 mm border on the edge of the image display.

S12.4 At each position, the spherometer is held perpendicular to the convex mirror-surface and a record is made of the reading on the dial indicator to the nearest .0025 mm.

S12.5 Convert the dial reading data for each of the 10 test positions to radius of curvature calculations using Table I. Consider the change as linear for dial readings that fall between two numbers in Table I.

S12.6 Calculate the average radius of curvature by adding all 10 radius of curvature calculations and dividing by ten.

S12.7 Determine the numerical difference between the average radius of curvature and each of the 10 individual radius of curvature calculations determined in S12.5.

S12.8 Calculate the greatest percentage deviation by dividing the greatest numerical difference determined in S12.7 by the average radius of curvature and multiply by 100.

Regulations

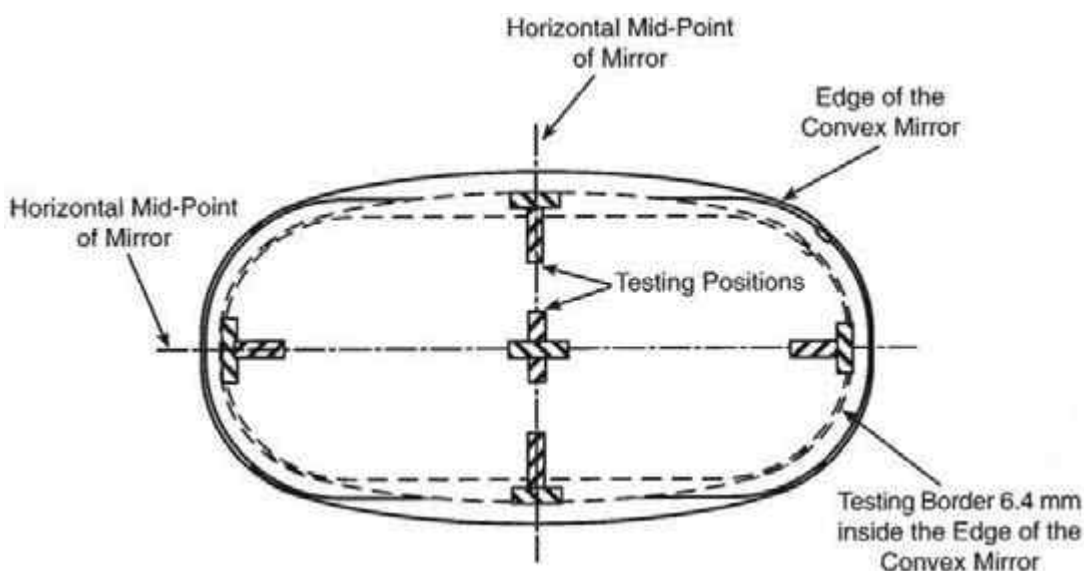


Figure 1-LOCATION OF TEN CONVEX MIRROR TESTING POSITIONS
All dimensions in millimeter (mm)

TABLE I—CONVERSION TABLE FROM SPHEROMETER
DIAL READING TO RADIUS OF CURVATURE

Dial reading	Radius of curvature (inches)	Radius of curvature (mm)
.00330.....	85.2	2164.1
.00350.....	80.4	2042.92
.00374.....	75.2	1910.1
.00402.....	70.0	1778.0
.00416.....	67.6	1717.0
.00432.....	65.1	1653.5
.00450.....	62.5	1587.5
.00468.....	60.1	1526.5
.00476.....	59.1	1501.1
.00484.....	58.1	1475.7
.00492.....	57.2	1452.9
.00502.....	56.0	1422.4
.00512.....	54.9	1394.5
.00522.....	53.9	1369.1
.00536.....	52.5	1333.5
.00544.....	51.7	1313.2
.00554.....	50.8	1290.3
.00566.....	49.7	1262.4
.00580.....	48.5	1231.9
.00592.....	47.5	1206.5
.00606.....	46.4	1178.6
.00622.....	45.2	1148.1
.00636.....	44.2	1122.7
.00654.....	43.0	1092.2
.00668.....	42.1	1069.3
.00686.....	41.0	1041.4
.00694.....	40.5	1028.7
.00720.....	39.1	993.1
.00740.....	38.0	965.2
.00760.....	37.0	939.8
.00780.....	36.1	916.9
.00802.....	35.1	891.5
.00822.....	34.2	868.7
.00850.....	33.1	840.7
.00878.....	32.0	812.8
.00906.....	31.0	787.4
.00922.....	30.5	774.7

TABLE I—CONVERSION TABLE FROM SPHEROMETER DIAL
READING TO RADIUS OF CURVATURE, Continued

Dial reading	Radius of curvature (inches)	Radius of curvature (mm)
.00938.....	30.0	762.0
.00960.....	29.3	744.2
.00980.....	28.7	729.0
.01004.....	28.0	711.2
.01022.....	27.5	698.5
.01042.....	27.0	685.8
.01060.....	26.5	673.1
.01080.....	26.0	660.4
.01110.....	25.3	642.6
.01130.....	24.9	632.5
.01170.....	24.0	609.6
.01200.....	23.4	594.4
.01240.....	22.7	576.6
.01280.....	22.0	558.8
.01310.....	21.5	546.1
.01360.....	20.7	525.8
.01400.....	20.1	510.5
.01430.....	19.7	500.4
.01480.....	19.0	482.6
.01540.....	18.3	464.8
.01570.....	17.9	454.7
.01610.....	17.5	444.5
.01650.....	17.1	434.3
.01700.....	16.6	421.6
.01750.....	16.1	408.9
.01800.....	15.6	396.2
.01860.....	15.1	383.5
.01910.....	14.7	373.4
.01980.....	14.2	360.7
.02040.....	13.8	350.5
.02100.....	13.4	340.4
.02160.....	13.0	330.2
.02250.....	12.5	317.5
.02340.....	12.0	304.8
.02450.....	11.5	292.1
.02560.....	11.0	279.4

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TABLE I—CONVERSION TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE, Continued

Dial reading	Radius of curvature (inches)	Radius of curvature (mm)
.02680.....	10.5	266.7
.02810.....	10.0	254.0
.02960.....	9.5	241.3
.03130.....	9.0	228.6
.033.....	8.5	215.9

S13. School bus mirror test procedures. The requirements of S9.1 through S9.4 shall be met when the vehicle is tested in accordance with the following conditions.

S13.1 The cylinders shall be a color which provides a high contrast with the surface on which the bus is parked.

S13.2 The cylinders are 0.3048 m high and 0.3048 m in diameter, except for cylinder P which is 0.9144 m high and 0.3048 m in diameter.

S13.3 Place cylinders at locations as specified in S13.3(a) through S13.3(g) and illustrated in Figure 2. Measure the distances shown in Figure 2 from a cylinder to another object from the center of the cylinder as viewed from above.

(a) Place cylinders G, H, and I so that they are tangent to a transverse vertical plane tangent to the forward-most surface of the bus's front bumper. Place cylinders D, E, F so that their centers are located in a transverse vertical plane that is 1.8288 meters (6 feet) forward of a transverse vertical plane passing through the centers of cylinders G, H, and I. Place cylinders A, B, and C so that their centers are located in a transverse vertical plane that is 3.6576 meters (12 feet) forward of the transverse vertical plane passing through the centers of cylinders G, H, and I.

(b) Place cylinders B, E, and H so that their centers are in a longitudinal vertical plane that passes through the bus's longitudinal centerline.

(c) Place cylinders A, D, and G so that their centers are in a longitudinal vertical plane that is tangent to the most outboard edge of the left side of the bus's front bumper.

(d) Place cylinders C, F, and I so that their centers are in a longitudinal vertical plane that is tangent to the most outboard edge of the right side of the bus's front bumper.

(e) Place cylinder J so that its center is in a longitudinal vertical plane 0.3048 meters (1 foot) to the left of the longitudinal vertical plane passing through the centers of cylinders A, D, and G, and is in the transverse vertical plane that passes through the centerline of the bus's front axle.

(f) Place cylinder K so that its center is in a longitudinal vertical plane 0.3048 meters (1 foot) to the right of the longitudinal vertical plane passing through the centers of cylinders C, F, and I, and is in the transverse vertical plane that passes through the center-line of the bus's front axle.

(g) Place cylinders L, M, N, O, and P so that their centers are in the transverse vertical plane that passes through the centerline of the bus's rear axle. Place cylinder L so that its center is in a longitudinal vertical plane that is 1.8288 meters (6 feet) to the left of the longitudinal vertical plane tangent to the bus's most outboard left surface (excluding the mirror system). Place cylinder M so that its center is in a longitudinal vertical plane that is 0.3048 meters (1 foot) to the left of the longitudinal vertical plane tangent to the left side of the bus. Place cylinder N so that its center is in a longitudinal vertical plane that is 0.3048 meters (1 foot) to the right of the longitudinal vertical plane tangent to the right side of the bus. Place cylinder O so that its center is in a longitudinal vertical plane that is 1.8288 meters (6 feet) to the right of the longitudinal vertical plane tangent to the right side of the bus. Place cylinder P so that its center is in a longitudinal vertical plane that is 3.6576 meters (12 feet) to the right of the longitudinal vertical plane tangent to the right side of the bus.

Regulations

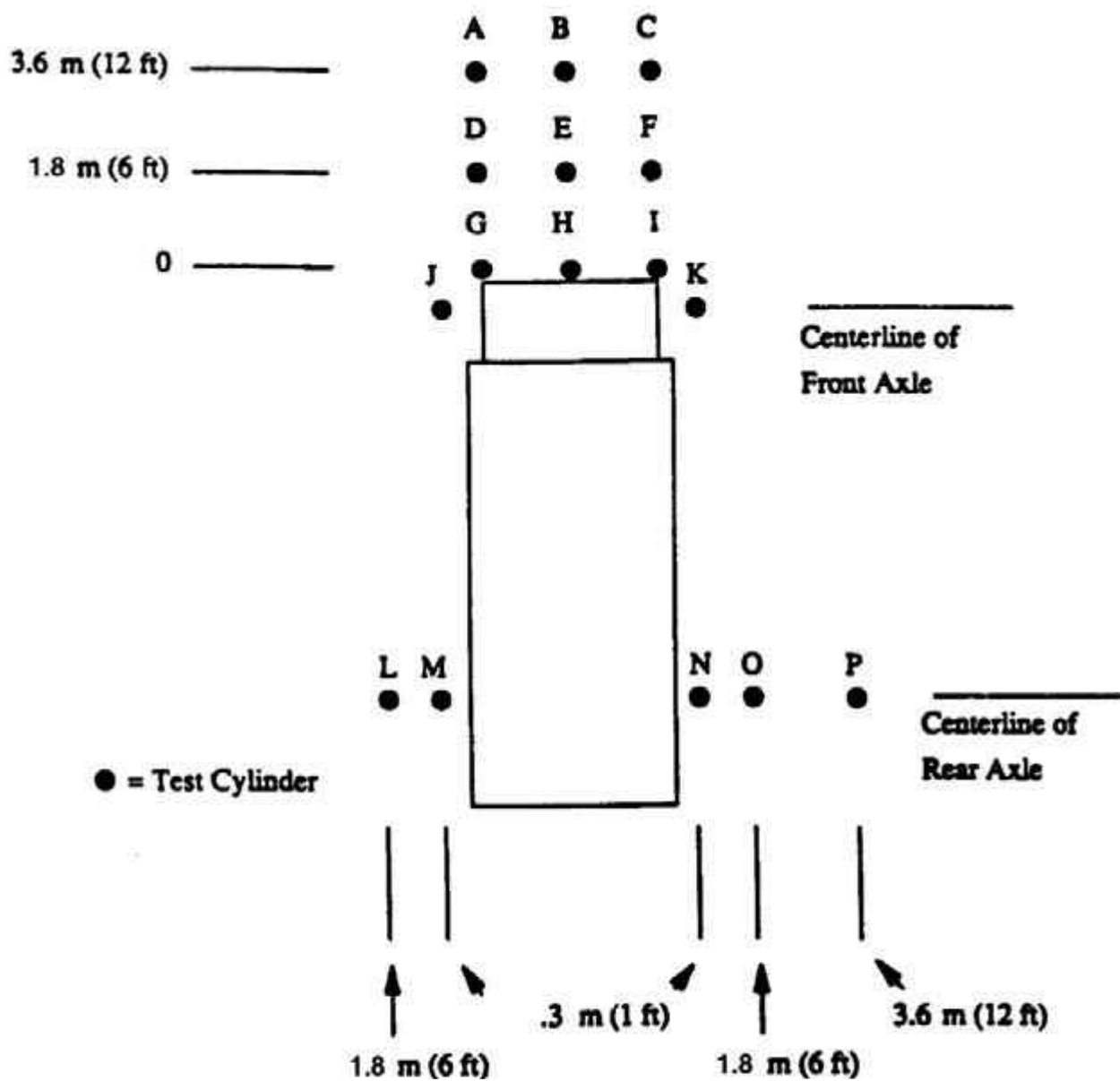


Figure 2.—Location of Test Cylinder for School Bus Field-of -View Test
All Dimensions in Meter s (m)

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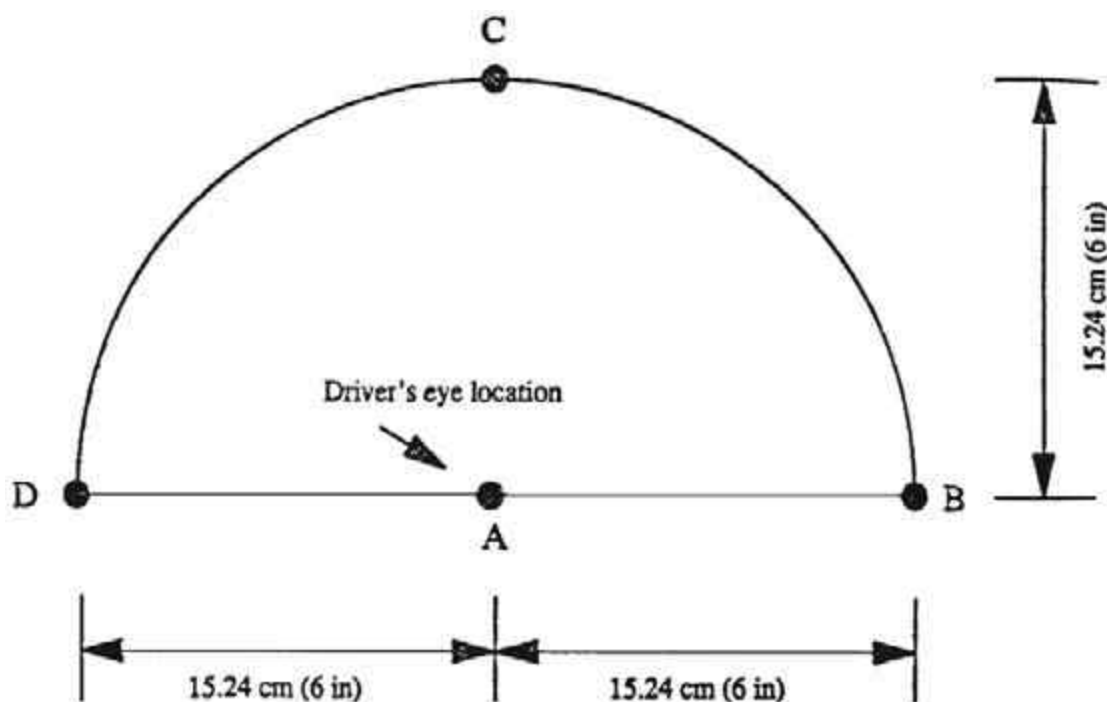


Figure 3. Camera Locations for School Bus Field-of-View Test

S13.4 The driver's eye location is the eye location of a 25th percentile adult female, when seated in the driver's seat as follows:

(a) The center point of the driver's eye location is the point located 68.58 centimeters (27 inches) vertically above the intersection of the seat cushion and the seat back at the longitudinal centerline of the seat.

(b) Adjust the driver's seat to the midway point between the forward-most and rear-most positions, and if separately adjustable in the vertical direction, adjust to the lowest position. If an adjustment position does not exist at the midway point, use the closest adjustment position to the rear of the midpoint. If a seat back is adjustable, adjust the seat back angle to the manufacturer's nominal design riding position in accordance with the manufacturer's recommendations.

S13.5 Adjustable mirrors are adjusted before the test in accordance with the manufacturer's recommendations. Such mirrors are not moved or readjusted at any time during the test.

13.6 Place a 35 mm or larger format camera, or video camera, so that its image plane is located at the center point of the driver's eye location or at any single point within a semicircular area established by a 15.24 centimeter (6 inch) radius parallel to and forward of the center point (see figure 3). With the camera at any single location on or within that semicircle look through the camera and the windows of the bus and determine whether the entire top surface of each cylinder is directly visible.

S13.7 For each cylinder whose entire top surface is determined under paragraph 13.4 of this section not to be directly visible at the driver's eye location,

(a) Place a comparison chart (see figure 4) above the mirror that provides the fullest view of the cylinder in situations where a cylinder is partially visible through more than one mirror.

Regulations

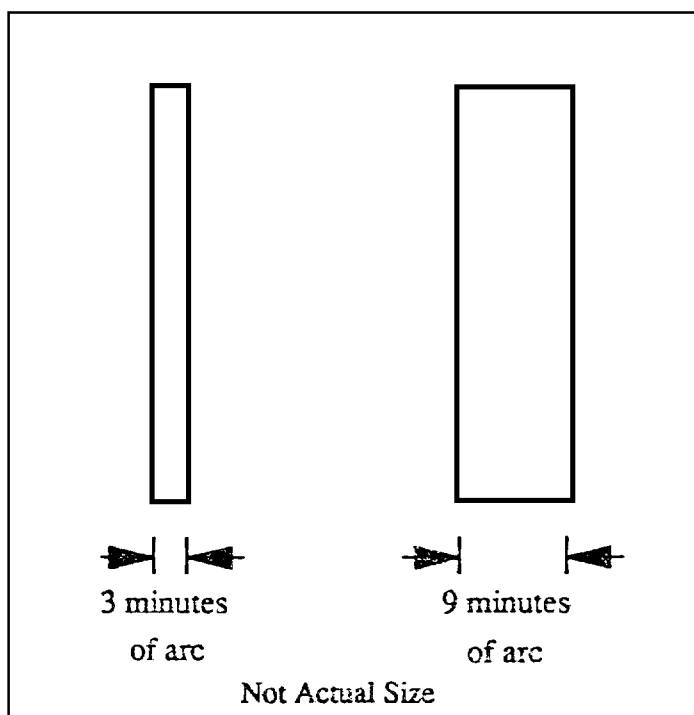


Figure 4. Comparison Chart for Indirect Field-of-View Measurement

The width of the bars in Figure 4 indicating three minutes of arc and nine minutes of arc are derived from the following formula:

For 3 minutes of arc:

$$X = D \times 0.000873,$$

Where:

X=the width of a line, in the unit of measurement D, representing 3 minutes of arc;

D=distance from center point of driver's eye location to the center of the mirror's surface; and

0.000873=tangent of 3 minutes of arc.

For 9 minutes of arc:

$$X = D \times 0.002618,$$

Where:

X=the width of a line, in the unit of measurement D, representing 9 minutes of arc;

D=distance from center point of driver's eye location to the center of the mirror's surface, and 0.002618=tangent of 9 minutes of arc.

(b) Photograph each cylinder through the mirror(s) that provides a view of the cylinder. Photograph each cylinder with the camera located so that the view through its film or image plane is located at any single location within the semicircle established under 13.4, [POINT A,B,C, OR D] ensuring that the image of the mirror and comparison chart fill the camera's view finder to the extent possible.

S13.8 Make all observations and take all photographs with the service/entry door in the closed position and the stop signal arm(s) in the fully retracted position.

S14. Rear visibility test procedure.

S14.1 Field of view and image size test procedure.

S14.1.1 **Lighting.** The ambient illumination conditions in which testing is conducted consists of light that is evenly distributed from above and is at an intensity of between 7,000 lux and 10,000 lux, as measured at the center of the exterior surface of the vehicle's roof.

S14.1.2 Vehicle conditions.

S14.1.2.1 **Tires.** The vehicle's tires are set to the vehicle manufacturer's recommended cold inflation pressure.

S14.1.2.2 **Fuel tank loading.** The fuel tank is full.

S14.1.2.3 **Vehicle load.** The vehicle is loaded to simulate the weight of the driver and four passengers or the designated occupant capacity, if less. The weight of each occupant is represented by 45 kg resting on the seat pan and 23 kg resting on the vehicle floorboard placed in the driver's designated seating position and any other available designated seating position.

S14.1.2.4 **Rear hatch and trunk lids.** If the vehicle is equipped with rear hatches or trunk lids, they are closed and latched in their normal vehicle operating condition.

S14.1.2.5 Driver's seat positioning.

S14.1.2.5.1 Adjust the driver's seat to the midpoint of the longitudinal adjustment range. If the seat cannot be adjusted to the midpoint of the longitudinal adjustment range, the closest adjustment position to the rear of the midpoint shall be used.

S14.1.2.5.2 Adjust the driver's seat to the lowest point of all vertical adjustment ranges present.

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S14.1.2.5.3 Using the three dimensional SAE Standard J826 JUL95 (incorporated by reference, see §571.5) manikin, adjust the driver's seat back angle at the vertical portion of the H-point machine's torso weight hanger to 25 degrees. If this adjustment setting is not available, adjust the seat-back angle to the positional detent setting closest to 25 degrees in the direction of the manufacturer's nominal design riding position.

S14.1.3 Test object. Each test object is a right circular cylinder that is 0.8 m high and 0.3 m in external diameter. There are seven test objects, designated A through G, and they are marked as follows.

(a) Test objects A, B, C, D, and E are marked with a horizontal band encompassing the uppermost 150 mm of the side of the cylinder.

(b) Test objects F and G are marked on the side with a solid vertical stripe of 150 mm width extending from the top to the bottom of each cylinder.

(c) Both the horizontal band and vertical stripe shall be of a color that contrasts with both the rest of the cylinder and the test surface.

S14.1.4 Test object locations and orientation. Place the test objects at locations specified in S14.1.4(a)-(f) and illustrated in Figure 5. Measure the distances shown in Figure 5 from a test object to another test object or other object from the cylindrical center (axis) of the test object as viewed from above. Each test object is oriented so that its axis is vertical.

(a) Place test objects F and G so that their centers are in a transverse vertical plane that is 0.3 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

(b) Place test objects D and E so that their centers are in a transverse vertical plane that is 3.05 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

(c) Place test objects A, B and C so that their centers are in a transverse vertical plane that is 6.1 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

(d) Place test object B so that its center is in a longitudinal vertical plane passing through the vehicle's longitudinal centerline.

(e) Place test objects C, E, and G so that their centers are in a longitudinal vertical plane located 1.52 m, measured laterally and horizontally, to the right of the vehicle longitudinal center line.

(f) Place test objects A, D, and F so that their centers are in a longitudinal vertical plane located 1.52 m, measured laterally and horizontally, to the left of the vehicle longitudinal center line.

S14.1.5 Test reference point. Obtain the test reference point using the following procedure.

(a) Locate the center of the forward-looking eye midpoint (M_f) illustrated in Figure 6 so that it is 635 mm vertically above the H point (H) and 96 mm aft of the H point.

(b) Locate the head/neck joint center (J) illustrated in Figure 6 so that it is 100 mm rearward of M_f and 588 mm vertically above the H point.

(c) Draw an imaginary horizontal line between M_f and a point vertically above J, defined as J_2 .

(d) Rotate the imaginary line about J_2 in the direction of the rearview image until the straight-line distance between M_f and the center of the display used to present the rearview image required in this standard reaches the shortest possible value.

(e) Define this new, rotated location of M_f to be M_r (eye midpoint rotated).

S14.1.6 Display adjustment. If the display is mounted with a rotational adjustment mechanism, adjust the display such that the surface of the display is normal to the imaginary line traveling through M_r and J_2 or as near to normal as the display adjustment will allow.

S14.1.7 Steering wheel adjustment. The steering wheel is adjusted to the position where the longitudinal centerline of all vehicle tires are parallel to the longitudinal centerline of the vehicle. If no such position exists, adjust the steering wheel to the position where the longitudinal centerline of all vehicle tires are closest to parallel to the longitudinal centerline of the vehicle.

S14.1.8 Measurement procedure.

(a) Locate a 35 mm or larger format still camera, video camera, or digital equivalent such that the center of the camera's image plane is located at M_r and the camera lens is directed at the center of the display's rearview image.

(b) Affix a ruler at the base of the rearview image in an orientation perpendicular with a test object cylinder centerline. If the vehicle head restraints obstruct the camera's view of the display, they may be adjusted or removed.

(c) Photograph the image of the visual display with the ruler included in the frame and the rearview image displayed.

S14.1.8.1 Extract photographic data.

(a) Using the photograph, measure the apparent length, of a 50 mm delineated section of the in-photo ruler, along the ruler's edge, closest to the rearview image and at a point near the horizontal center of the rearview image.

(b) Using the photograph, measure the horizontal width of the colored band at the upper portion of each of the three test objects located at positions A, B, and C in Figure 5.

(c) Define the measured horizontal widths of the colored bands of the three test objects as d_a , d_b , and d_c .

S14.1.8.2 Obtain scaling factor. Using the apparent length of the 50 mm portion of the ruler as it appears in the photograph, divide this apparent length by 50 mm to obtain a scaling factor. Define this scaling factor as s_{scale} .

S14.1.8.3 Determine viewing distance. Determine the actual distance from the rotated eye midpoint location (M_r) to the center of the rearview image. Define this viewing distance as a_{eye} .

Regulations

S14.1.8.4 Calculate visual angle subtended by test objects. Use the following equation to calculate the subtended visual angles:

$$\theta_i = 60 \sin^{-1} \left(\frac{d_i}{a_{eye} S_{scale}} \right)$$

where i can take on the value of either *test object A*, *B*, or *C*, and arcsine is calculated in units of degrees.

S14.2 Image response time test procedure. The temperature inside the vehicle during this test is any temperature between 15°C and 25°C. Immediately prior to commencing the actions listed in subparagraphs (a)-(c) of this paragraph, all components of the rear visibility system are in a powered off state. Then:

- Open the driver's door to any width,
- Close the driver's door
- Activate the starting system using the key, and
- Select the vehicle's reverse direction at any time not less than 4.0 seconds and not more than 6.0 seconds after the driver's door is opened. The driver door is open when the edge of the driver's door opposite of the door's hinge is no longer flush with the exterior body panel.

S14.3 Durability test procedures. For the durability tests specified in S14.3.1, S14.3.2, and S14.3.3, the external components are mounted on an environmental test fixture.

S14.3.1 Corrosion test procedure. The external components are subjected to two 24-hour corrosion test cycles. In each corrosion test cycle, the external components are subjected to a salt spray (fog) test in accordance with ASTM B117-03 (incorporated by reference, see §571.5) for a period of 24 hours. Allow 1 hour to elapse without spray between the two test cycles.

S14.3.2 Humidity exposure test procedure. The external components are subjected to 24 consecutive 3-hour humidity test cycles. In each humidity test cycle, external components are subjected to a temperature of 100°+7°-0° F (38°+4°-0° C) with a relative humidity of not less than 90% for a period of 2 hours. After a period not to exceed 5 minutes, the external components are subjected to a temperature of 32°+5°-0° F (0°+3°-0° C) and a humidity of not more than 30% ± 10% for 1 hour. Allow no more than 5 minutes to elapse between each test cycle.

S14.3.3 Temperature exposure test procedure. The external components are subjected to 4 consecutive 2-hour temperature test cycles. In each temperature test cycle, the external components are first subjected to a temperature of 176° ± 5° F (80° ± 3° C) for a period of one hour. After a period not to exceed 5 minutes, the external components are subjected to a temperature of 32°+5°-0° F (0°+3°-0° C) for 1 hour. Allow no more than 5 minutes to elapse between each test cycle.

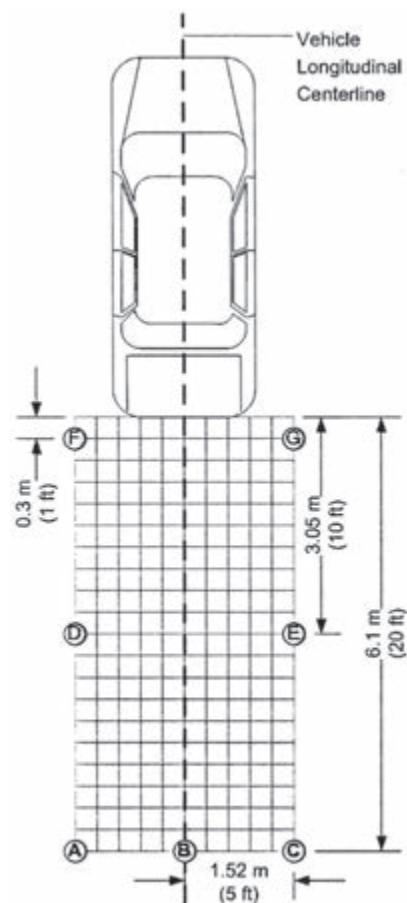
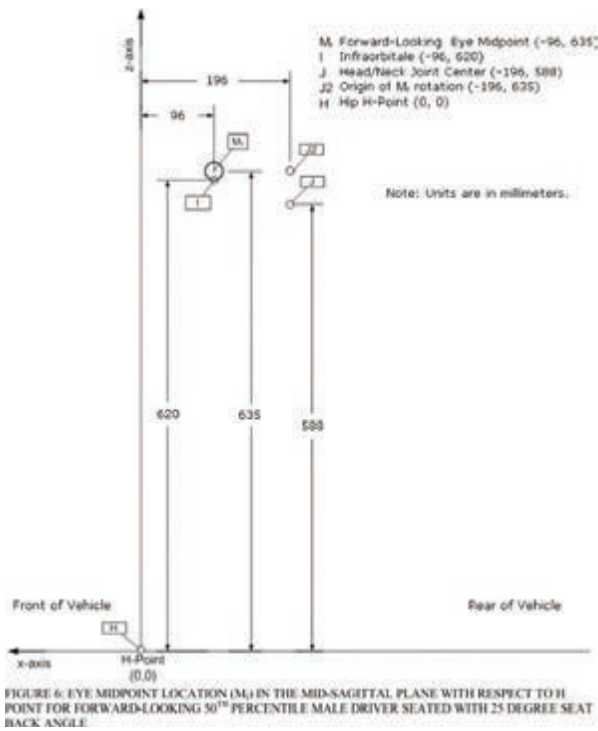


FIGURE 5: TEST CYLINDER LOCATIONS

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S15 Rear visibility phase-in schedule. For the purposes of the requirements in S15.1 through S15.7, production year means the 12-month period between May 1 of one year and April 30 of the following year, inclusive.

S15.1 Vehicles manufactured on or after May 1, 2016 and before May 1, 2018. At any time during or after the production years ending April 30, 2017 and April 30, 2018, each manufacturer shall, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles (by make, model and vehicle identification number) that have been certified as complying with S5.5.1 or S6.2.1 of this standard. The manufacturer's designation of a vehicle as a certified vehicle is irrevocable.

S15.2 Vehicles manufactured on or after May 1, 2016 and before May 1, 2017. Except as provided in S15.4, for passenger cars, multipurpose passenger vehicles, trucks, buses, and low-speed vehicles with a GVWR of 4,536 kg or less, manufactured by a manufacturer on or after May 1, 2016, and before May 1, 2017, the number of such vehicles complying with S5.5.1 or S6.2.1 shall be not less than 10 percent of the manufacturer's—

- (a) Production of such vehicles during that period; or
- (b) Average annual production of such vehicles manufactured in the three previous production years.

S15.3 Vehicles manufactured on or after May 1, 2017 and before May 1, 2018. Except as provided in S15.4, for passenger cars, multipurpose passenger vehicles, trucks, buses, and low-speed vehicles with a GVWR of 4,536 kg or less, manufactured by a manufacturer on or after May 1, 2017, and before May 1, 2018, the number of such vehicles complying with S5.5.1 or

S6.2.1 shall be not less than 40 percent of the manufacturer's—

- (a) Production of such vehicles during that period; or
- (b) Average annual production of such vehicles manufactured in the three previous production years.

S15.4 Exclusions from phase-in. The following vehicles shall not be subject to the requirements in S15.1 through S15.3 but shall achieve full compliance with this standard at the end of the phase-in period in accordance with S5.5(b) and S6.2(b):

(a) Vehicles that are manufactured by small manufacturers or by limited line manufacturers.

(b) Vehicles that are altered (within the meaning of 49 CFR 567.7) before May 1, 2017, after having been previously certified in accordance with part 567 of this chapter, and vehicles manufactured in two or more stages before May 1, 2018.

S15.5 Vehicles produced by more than one manufacturer. For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S15.1 through S15.3, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S15.6—

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S15.6 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S15.5.

S15.7 Calculation of complying vehicles.

(a) For the purposes of calculating the vehicles complying with S15.2, a manufacturer may count a vehicle if it is manufactured on or after May 1, 2016 but before May 1, 2017.

(b) For purposes of complying with S15.3, a manufacturer may count a vehicle if it is manufactured on or after May 1, 2017 but before May 1, 2018 and,

(c) For the purposes of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer, each vehicle that is excluded from having to meet the applicable requirement is not counted.

§571.113 Standard No. 113; Hood latch system.

S1. Purpose and scope. This standard establishes the requirement for providing a hood latch system or hood latch systems.

S2. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. Definitions.

Regulations

Hood means any exterior movable body panel forward of the windshield that is used to cover an engine, luggage, storage, or battery compartment.

S4. Requirements.

S4.1 Each hood must be provided with a hood latch system.

S4.2 A front opening hood which, in any open position, partially or completely obstructs a driver's forward view through the windshield must be provided with a second latch position on the hood latch system or with a second hood latch system.

§571.116 Standard No. 116; Motor vehicle brake fluids.

S1.Scope. This standard specifies requirements for fluids for use in hydraulic brake systems of motor vehicles, containers for these fluids, and labeling of the containers.

S2. Purpose. The purpose of this standard is to reduce failures in the hydraulic braking systems of motor vehicles which may occur because of the manufacture or use of improper or contaminated fluid.

S3. Application. This standard applies to all fluid for use in hydraulic brake systems of motor vehicles. In addition, S5.3 applies to passenger cars, multipurpose passenger vehicles, trucks, buses, trailers, and motorcycles.

S4. Definitions.

Blister means a cavity or sac on the surface of a brake cup.

Brake fluid means a liquid designed for use in a motor vehicle hydraulic brake system in which it will contact elastomeric components made of styrene and butadiene rubber (SBR), ethylene and propylene rubber (EPR), polychloroprene (CR) brake hose inner tube stock or natural rubber (NR).

Chipping means a condition in which small pieces are missing from the outer surface of a brake cup.

Duplicate samples means two samples of brake fluid taken from a single packaged lot and tested simultaneously.

Hydraulic system mineral oil means a mineral-oil-based fluid designed for use in motor vehicle hydraulic brake systems in which the fluid is not in contact with components made of SBR, EPR or NR.

Packager means any person who fills containers with brake fluid that are subsequently distributed for retail sale.

Packaged lot is that quantity of brake fluid shipped by the manufacturer to the packager in a single container, or that quantity of brake fluid manufactured by a single plant run of 24 hours or less, through the same processing equipment and with no change in ingredients.

Scuffing means a visible erosion of a portion of the outer surface of a brake cup.

A

silicone base brake fluid (SBBF) is a brake fluid which consists of not less than 70 percent by weight of a diorganopolysiloxane.

Sloughing means degradation of a brake cup as evidenced by the presence of carbon black loosely held on

the brake cup surface, such that a visible black streak is produced when the cup, with a 500 ±10 gram dead-weight on it, is drawn base down over a sheet of white bond paper placed on a firm flat surface.

Stickiness means a condition on the surface of a brake cup such that fibers will be pulled from a wad of U.S.P. absorbent cotton when it is drawn across the surface.

S5. Requirements. This section specifies performance requirements for DOT 3, DOT 4 and DOT 5 brake fluids; requirements for brake fluid certification; and requirements for container sealing, labeling and color coding for brake fluids and hydraulic system mineral oils. Where a range of tolerances is specified, the brake fluid shall meet the requirements at all points within the range.

S5.1 Brake fluid. When tested in accordance with S6, brake fluids shall meet the following requirements:

S5.1.1 Equilibrium reflux boiling point (ERBP). When brake fluid is tested according to S6.1, the ERBP shall not be less than the following value for the grade indicated:

- (a) DOT 3: 205 °C. (401 °F.).
- (b) DOT 4: 230 °C. (446 °F.).
- (c) DOT 5: 260 °C. (500 °F.).

S5.1.2 Wet ERBP. When brake fluid is tested according to S6.2, the wet ERBP shall not be less than the following value for the grade indicated:

- (a) DOT 3: 140 °C. (284 °F.).
- (b) DOT 4: 155 °C. (311 °F.).
- (c) DOT 5: 180 °C. (356 °F.).

S5.1.3. Kinematic viscosities. When brake fluid is tested according to S6.3, the kinematic viscosities in square millimeters per second at stated temperatures shall be neither less than 1.5 mm²/s at 100 °C. (212 °F.) nor more than the following maximum value for the grade indicated:

- (a) DOT 3: 1,500 mm²/s at minus 40 °C. (minus 40 °F.).
- (b) DOT 4: 1,800 mm²/s at minus 40 °C. (minus 40 °F.).
- (c) DOT 5: 900 mm²/s at minus 40 °C. (minus 40 °F.).

S5.1.4 pH value. When brake fluid, except DOT 5 SBBF, is tested according to S6.4, the pH value shall not be less than 7.0 nor more than 11.5.

S5.1.5 Brake fluid stability.

S5.1.5.1 High-temperature stability. When brake fluid is tested according to S6.5.3 the ERBP shall not change by more than 3 °C. (5.4 °F.) plus 0.05° for each degree that the ERBP of the fluid exceeds 225 °C. (437 °F.).

S5.1.5.2 Chemical stability. When brake fluid, except DOT 5 SBBF, is tested according to S6.5.4, the change in temperature of the refluxing fluid mixture shall not exceed 3.0 °C (5.4 °F.) plus 0.05° for each degree that the ERBP of the fluid exceeds 225 °C (437 °F.).

S5.1.6 Corrosion. When brake fluid is tested according to S6.6—

- (a) The metal test strips shall not show weight changes exceeding the limits stated in Table I.

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TABLE I

Test strip material	Maximum permissible weight change, mg./sq. cm. of surface
Steel, tinned iron, cast iron	0.2
Aluminum	.1
Brass, copper	.4

(b) Excluding the area of contact (13 ± 1 mm. ($\frac{1}{2} \pm \frac{1}{32}$ inch) measured from the bolt hole end of the test strip), the metal test strips shall not show pitting or etching to an extent discernible without magnification;

(c) The water-wet brake fluid at the end of the test shall show no jelling at 23 ± 5 °C (73.4 ± 9 °F.);

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(d) No crystalline deposit shall form and adhere to either the glass jar walls or the surface of the metal strips;

(e) At the end of the test, sedimentation of the water-wet brake fluid shall not exceed 0.10 percent by volume;

(f) The pH value of water-wet brake fluid, except DOT 5 SBBF, at the end of the test shall not be less than 7.0 nor more than 11.5;

(g) The cups at the end of the test shall show no disintegration, as evidenced by blisters or sloughing;

(h) The hardness of the cup shall not decrease by more than 15 International Rubber Hardness Degrees (IRHD); and

(i) The base diameter of the cups shall not increase by more than 1.4 mm. (0.055 inch).

S5.1.7 Fluidity and appearance at low temperature.

When brake fluid is tested according to S6.7, at the storage temperature and for the storage times given in Table II—

(a) The fluid shall show no sludging, sedimentation, crystallization, or stratification;

(b) Upon inversion of the sample bottle, the time required for the air bubble to travel to the top of the fluid shall not exceed the bubble flow times shown in Table II; and

(c) On warming to room temperature, the fluid shall resume the appearance and fluidity that it had before chilling.

TABLE II—FLUIDITY AND APPEARANCE AT LOW TEMPERATURES

Storage temperature	Storage time (hours)	Maximum bubble flow time (seconds)
Minus 40 ± 2° C. (minus 40 ± 3.6°F.)	144 ± 4.0	10
Minus 50 ± 2° C. (minus 58 ± 3.6°F.)	6 ± 0.2	35

S5.1.8 [Removed and Reserved]

S5.1.9 Water tolerance.

(a) **At low temperature.** When brake fluid is tested according to S6.9.3(a)—

(1) The fluid shall show no sludging, sedimentation, crystallization, or stratification;

(2) Upon inversion of the centrifuge tube, the air bubble shall travel to the top of the fluid in not more than 10 seconds;

(3) If cloudiness has developed, the wet fluid shall regain its original clarity and fluidity when warmed to room temperature; and

(b) **At 60° C (140° F.)** When brake fluid is tested according to S6.9.3(b)—(1) The fluid shall show no stratification; and (2) Sedimentation shall not exceed 0.15 percent by volume after centrifuging.

S5.1.10 Compatibility.

(a) **At low temperature.** When brake fluid is tested according to S6.10.3(a), the test specimen shall show no sludging, sedimentation, or crystallization. In addition, fluids, except DOT SBBF, shall show no stratification.

(b) **At 60° C. (140° F.)** When brake fluid is tested according to S6.10.3(b)—(1) Sedimentation shall not exceed 0.05 percent by volume after centrifuging; and (2) Fluids, except DOT SBBF, shall show no stratification.

S5.1.11 **Resistance to oxidation.** When brake fluid is tested according to S6.11—

(a) The metal test strips outside the areas in contact with the tinfoil shall not show pitting or etching to an extent discernible without magnification;

(b) No more than a trace of gum shall be deposited on the test strips outside the areas in contact with the tinfoil;

(c) The aluminum strips shall not change in weight by more than 0.05 mg./sq. cm.; and

(d) The cast iron strips shall not change in weight by more than 0.3 mg./sq. cm.

S5.1.12 **Effects on cups.** When brake cups are subjected to brake fluid in accordance with S6.12—

(a) The increase in the diameter of the base of the cups shall be not less than 0.15 mm. (0.006 inch) or more than 1.40 mm. (0.055 inch);

(b) The decrease in hardness of the cups shall be not more than 10 IRHD at 70° C. (158° F.) or more than 15 IRHD at 120° C. (248° F.), and there shall be no increase in hardness of the cups; and

(c) The cups shall show no disintegration as evidenced by stickiness, blisters, or sloughing.

S5.1.13 **Stroking properties.** When brake fluid is tested according to S6.13—

(a) Metal parts of the test system shall show no pitting or etching to an extent discernible without magnification;

(b) The change in diameter of any cylinder or piston shall not exceed 0.13 mm. (0.005 inch);

(c) The average decrease in hardness of seven of the eight cups tested (six wheel cylinder and one master cylinder primary) shall not exceed 15 IRHD. Not more than one of the seven cups shall have a decrease in hardness greater than 17 IRHD;

(d) None of the eight cups shall be in an unsatisfactory operating condition as evidenced by stickiness, scuffing, blisters, cracking, chipping, or other change in shape from its original appearance;

(e) None of the eight cups shall show an increase in base diameter greater than 0.90 mm (0.035 inch);

(f) The average lip diameter set of the eight cups shall not be greater than 65 percent.

(g) During any period of 24,000 strokes, the volume loss of fluid shall not exceed 36 milliliters;

(h) The cylinder pistons shall not freeze or function improperly throughout the test;

(i) The total loss of fluid during the 100 strokes at the end of the test shall not exceed 36 milliliters;

(j) The fluid at the end of the test shall show no formation of gels;

(k) At the end of the test the amount of sediment shall not exceed 1.5 percent by volume; and

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(l) Brake cylinders shall be free of deposits that are abrasive or that cannot be removed when rubbed moderately with a nonabrasive cloth wetted with ethanol.

S5.1.14 Fluid color. Brake fluid and hydraulic system mineral oil shall be of the color indicated:

DOT 3, DOT 4, and DOT 5.1 non-SBBF—colorless to amber.

DOT 5 SBBF—purple.

Hydraulic system mineral oil—green.

S5.2 Packaging and labeling requirements for motor vehicle brake fluids.

S5.2.1 Container sealing. Each brake fluid or hydraulic system mineral oil container with a capacity of 177 mL or more shall be provided with a resealable closure that has an inner seal impervious to the packaged brake fluid. The container closure shall include a tamper-proof feature that will either be destroyed or substantially altered when the container closure is initially opened.

S5.2.2 Certification, marking, and labeling.

S5.2.2.1 Each manufacturer of a DOT grade brake fluid shall furnish to each packager, distributor, or dealer to whom he delivers brake fluid, the following information:

(a) A serial number identifying the production lot and the date of manufacture of the brake fluid.

(b) The grade (DOT 3, DOT 4, DOT 5) of the brake fluid. If DOT 5 grade brake fluid, it shall be further distinguished as “DOT 5 SILICONE BASE” or “DOT 5.1 NON-SILICONE BASE.”

(c) The minimum wet boiling point in Fahrenheit of the brake fluid.

(d) Certification that the brake fluid conforms to §571.116.

S5.2.2.2 Each packager of brake fluid shall furnish the information specified in paragraphs (a) through (g) of this S5.2.2.2 by clearly marking it on each brake fluid container or on a label (labels) permanently affixed to the container, in any location except a removable part such as a lid. After being subjected to the operations and conditions specified in S6.14, the information required by this section shall be legible to an observer having corrected visual acuity of $20/40$ (Snellen ratio) at a distance of 305 mm, and any label affixed to the container in compliance with this section shall not be removable without its being destroyed or defaced.

(a) Certification that the brake fluid conforms to §571.116.

(b) The name of the packager of the brake fluid, which may be in code form.

(c) The name and complete mailing address of the distributor.

(d) A serial number identifying the packaged lot and date of packaging.

(e) Designation of the contents as “DOT—MOTOR VEHICLE BRAKE FLUID” (Fill in DOT 3, DOT 4, DOT 5 SILICONE BASE, or DOT 5.1 NON-SILICONE BASE as applicable).

(f) The minimum wet boiling point in Fahrenheit of the DOT brake fluid in the container.

(g) The following safety warnings in capital and lower case letters as indicated:

(1) FOLLOW VEHICLE MANUFACTURER’S RECOMMENDATIONS WHEN ADDING BRAKE FLUID.

(2) KEEP BRAKE FLUID CLEAN AND DRY. Contamination with dirt, water, petroleum products or other materials may result in brake failure or costly repairs.

(3) STORE BRAKE FLUID ONLY IN ITS ORIGINAL CONTAINER. KEEP CONTAINER CLEAN AND TIGHTLY CLOSED TO PREVENT ABSORPTION OF MOISTURE.

(4) **CAUTION: DO NOT REFILL CONTAINER, AND DO NOT USE FOR OTHER LIQUIDS.** (Not required for containers with a capacity in excess of 19 L.) **S5.2.2.3** Each packager of hydraulic system mineral oil shall furnish the information specified in paragraphs (a) through (e) of this

S5.2.2.3 by clearly marking it on each brake fluid container or on a label (labels) permanently affixed to the container, in any location except a removable part such as a lid. After being subjected to the operations and conditions specified in S6.14, the information required by this section shall be legible to an observer having corrected visual acuity of $20/40$ (Snellen ratio) at a distance of 305 mm and any label affixed to the container in compliance with this section shall not be removable without its being destroyed or defaced.

(a) The name of the packager of the hydraulic system mineral oil, which may be in code form.

(b) The name and complete mailing address of the distributor.

(c) A serial number identifying the packaged lot and date of packaging.

(d) Designation of the contents as “HYDRAULIC SYSTEM MINERAL OIL” in capital letters at least 3 mm high.

(e) The following safety warnings in capital and lower case letters as indicated:

(1) FOLLOW VEHICLE MANUFACTURER’S RECOMMENDATIONS WHEN ADDING HYDRAULIC SYSTEM MINERAL OIL.

(2) Hydraulic System Mineral Oil is NOT COMPATIBLE with the rubber components of brake systems designed for use with DOT brake fluids.

(3) KEEP HYDRAULIC SYSTEM MINERAL OIL CLEAN. Contamination with dust or other materials may result in brake failure or costly repair.

(4) **CAUTION: STORE HYDRAULIC SYSTEM MINERAL OIL ONLY IN ITS ORIGINAL CONTAINER. KEEP CONTAINER CLEAN AND TIGHTLY CLOSED. DO NOT REFILL CONTAINER OR USE OTHER LIQUIDS.** (The last sentence is not required for containers with a capacity in excess of 19 L.)

S5.2.2.4 If a container for brake fluid or hydraulic system mineral oil is not normally visible but designed to be protected by an outer container or carton during use, the outer container or carton rather than the inner

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container shall meet the labeling requirements of S5.2.2.2 or S5.2.2.3, as appropriate.

S5.3 Motor vehicle requirement. Each passenger car, multipurpose passenger vehicle, truck, bus, trailer, and motorcycle that has a hydraulic brake system shall be equipped with fluid that has been manufactured and packaged in conformity with the requirements of this standard.

S6. Test procedures.

S6.1 Equilibrium reflux boiling point. Determine the ERBP of a brake fluid by running duplicate samples according to the following procedure and averaging the results.

S6.1.1 Summary of procedure. Sixty milliliters (ml.) of brake fluid are boiled under specified equilibrium conditions (reflux) at atmospheric pressure in a 100-ml. flask. The average temperature of the boiling fluid at the end of the reflux period, corrected for variations in barometric pressure if necessary, is the ERBP.

S6.1.2 Apparatus. (See Figure 1) The test apparatus shall consist of—

(a) **Flask.** (See Figure 2) A 100-ml. round-bottom, short-neck heat-resistant glass flask having a neck with a 1938 standard taper, female ground-glass joint and a side-entering tube, with an outside diameter of 10 millimeters (mm.), which centers the thermometer bulb in the flask 6.5 mm. from the bottom;

(b) **Condenser.** A water-cooled, reflux, glass-tube type, condenser having a jacket 200 mm. in length, the bottom end of which has a 1938 standard-taper, drip-tip, male ground-glass joint;

(c) **Boiling stones.** Three clean, unused silicon carbide grains (approximately 2 mm. (0.08 inch) in diameter, grit No. 8);

(d) **Thermometer.** Standardized calibrated partial immersion (76 mm.), solid stem, thermometers conforming to the requirements for an ASTM 2C or 2F, and an ASTM 3C or 3F thermometer; and

(e) **Heat source.** Variable autotransformer-controlled heating mantle designed to fit the flask, or an electric heater with rheostat heat control.

S6.1.3 Preparation of apparatus. (a) Thoroughly

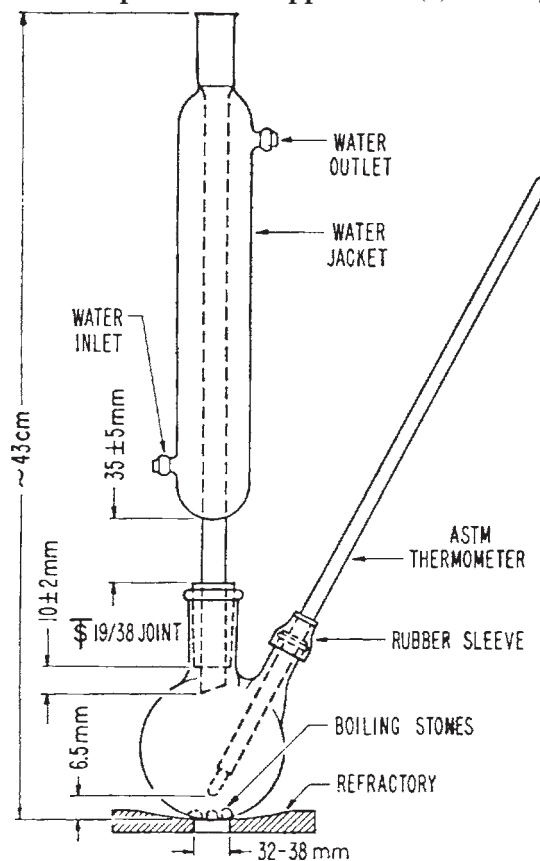


Figure 1 Boiling Point Test Apparatus

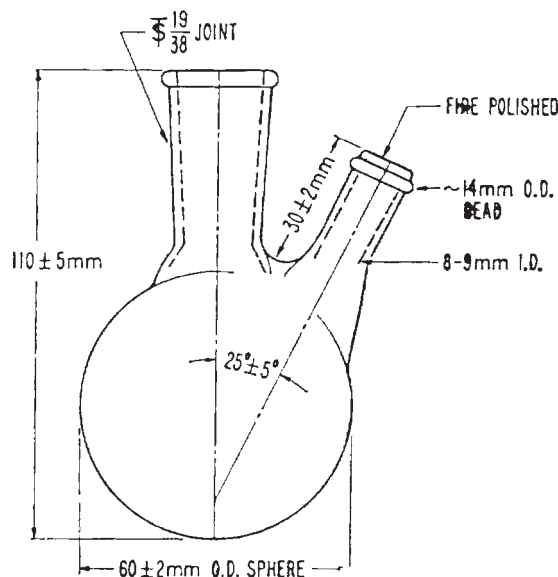


Figure 2 Detail of 100 ml Short-Neck Flask

clean and dry all glassware.

(b) Insert thermometer through the side tube until the tip of the bulb is 6.5 mm. (1/4 inch) from the bottom center

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of the flask. Seal with a short piece of natural rubber, EPDM, SBR, or butyl tubing.

(c) Place 60 ±1 ml. of brake fluid and the silicon carbide grains into the flask.

(d) Attach the flask to the condenser. When using a heating mantle, place the mantle under the flask and support it with a ring-clamp and laboratory-type stand, holding the entire assembly in place by a clamp. When using a rheostat-controlled heater, center a standard porcelain or hard asbestos refractory, having a diameter opening 32 to 38 mm., over the heating element and mount the flask so that direct heat is applied only through the opening in the refractory. Place the assembly in an area free from drafts or other types of sudden temperature changes. Connect the cooling water inlet and outlet tubes to the condenser. Turn on the cooling water. The water supply temperature shall not exceed 28 °C. (82.4 °F.) and the temperature rise through the condenser shall not exceed 2 °C. (3.6 °F.).

S6.1.4 Procedure. Apply heat to the flask so that within 10 ±2 minutes the fluid is refluxing in excess of 1 drop per second. The reflux rate shall not exceed 5 drops per second at any time. Immediately adjust the heating rate to obtain an equilibrium reflux rate of 1 to 2 drops per second over the next 5 ±2 minutes. Maintain this rate for an additional 2 minutes, taking four temperature readings at 30-second intervals. Record the average of these as the observed ERBP. If no reflux is evident when the fluid temperature reaches 260 °C (500 °F), discontinue heating and report ERBP as in excess of 260 °C (500 °F).

S6.1.5 Calculation. (a) **Thermometer inaccuracy.** Correct the observed ERBP by applying any correction factor obtained in standardizing the thermometer.

(b) **Variation from standard barometric pressure.** Apply the factor shown in Table III to calculate the barometric pressure correction to the ERBP.

TABLE III—CORRECTION FOR BAROMETRIC PRESSURE

Observed ERBP corrected for thermometer inaccuracy	Correction per 1 mm difference in pressure ^a	
	°C.	(°F.)
100° C. (212° F.) to 190° C. (374° F.)	0.039	(0.07)
Over 190° C. (374° F.)	0.04	(0.08)

^aTo be added in case barometric pressure is below 760 mm.; to be subtracted in case barometric pressure is above 670 mm.

(c) If the two corrected observed ERBP's agree within 2 °C. (4 °C. for brake fluids having an ERBP over 230 °C./446 °F.) average the duplicate runs as the ERBP; otherwise, repeat the entire test, averaging the four corrected observed values to determine the original ERBP.

S6.2 Wet ERBP. Determine the wet ERBP of a brake fluid by running duplicate samples according to the following procedure.

S6.2.1. Summary of procedure. A 350 ml. sample of the brake fluid is humidified under controlled conditions; 350 ml. of SAE triethylene glycol monomethyl ether, brake fluid grade, referee material (TEGME) as described in appendix E of SAE Standard J1703 NOV83 (incorporated by reference, see §571.5), is used to establish the

end point for humidification. After humidification, the water content and ERBP of the brake fluid are determined.

S6.2.2 Apparatus for humidification. (See Figure 3).

Test apparatus shall consist of—

(a) Glass jars. Four SAE RM-49 corrosion test jars or equivalent screwtop, straight-sided, round glass jars each having a capacity of about 475 ml. and approximate inner dimensions of 100 mm. in height by 75 mm. in diameter, with matching lids having new, clean inserts providing water-vapor-proof seals;

(b) Desiccator and cover. Two bowl-form glass desiccators, 250-mm. inside diameter, having matching tubulated covers fitted with No. 8 rubber stoppers; and

(c) Desiccator plate. Two 230-mm. diameter, perforated porcelain desiccator plates, without feet, glazed on one side.

S6.2.3 Reagents and materials.(a) Distilled water, see S7.1.

(b) SAE TEGME referee material (see Appendix E of SAE Standard J1703 NOV83 (incorporated by reference, see §571.5)).

S6.2.4 Preparation of apparatus. Lubricate the ground-glass joint of the desiccator. Pour 450 ±10 ml. of distilled water into each desiccator and insert perforated porcelain desiccator plates. Place the desiccators in an oven with temperature controlled at 50 ±1 °C. (122 ±1.8 °F.) throughout the humidification procedure.

S6.2.5 Procedure. Pour 350 ±5 ml. of brake fluid into an open corrosion test jar. Prepare in the same manner a duplicate test fluid sample and two duplicate specimens of the SAE TEGME referee material (350 ±5 ml. of TEGME in each jar). The water content of the SAE TEGME fluid is adjusted to 0.50 ±0.05 percent by weight at the start of the test in accordance with S7.2. Place one sample each of the test brake fluid and the prepared TEGME sample into the same desiccator. Repeat for the second sample of test brake fluid and TEGME in a second desiccator. Place the desiccators in the 50 °C. (122 °F.) controlled oven and replace desiccator covers. At intervals, during oven humidification, remove the rubber stoppers in the tops of desiccators. Using a long needed hypodermic syringe, take a sample of not more than 2 ml. from each TEGME sample and determine its water content. Remove no more than 10 ml. of fluid from each SAE TEGME sample during the humidification procedure. When the water content of the SAE fluid reaches 3.70 ±0.05 percent by weight (average of the duplicates), remove the two test fluid specimens from their desiccators and promptly cap each jar tightly. Allow the sealed jars to cool for 60 to 90 minutes at 23° ±5 °C. (73.4° ±9 °F.). Measure the water contents of the test fluid specimens in accordance with S7.2 and determine their ERBP's in accordance with S6.1. If the two ERBP's agree within 4 °C. (8 °F.), average them to determine the wet ERBP; otherwise repeat and average the four individual ERBP's as the wet ERBP of the brake fluid.

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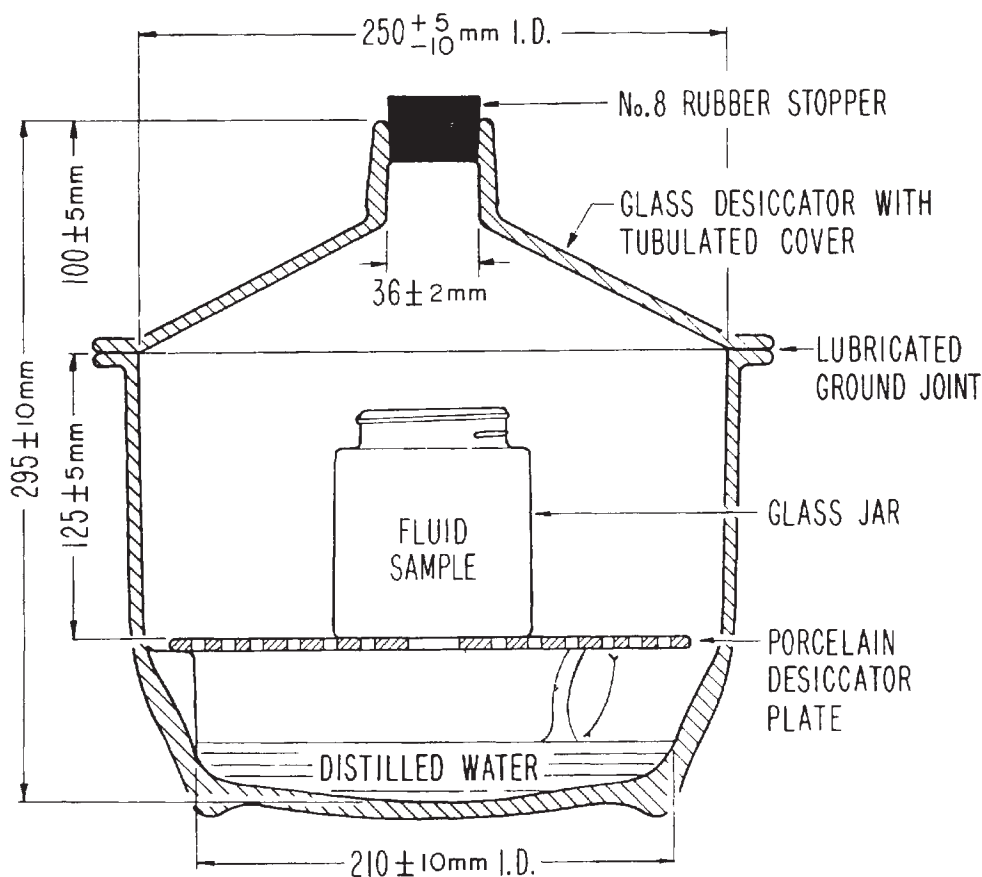


Fig-3 HUMIDIFICATION APPARATUS

S6.3 Kinematic viscosities. Determine the kinematic viscosity of a brake fluid in mm²/s by the following procedure. Run duplicate samples at each of the specified temperatures, making two times runs on each sample.

S6.3.1 Summary of the procedure. The time is measured for a fixed volume of the brake fluid to flow through a calibrated glass capillary viscometer under an accurately reproducible head and at a closely controlled temperature. The kinematic viscosity is then calculated from the measured flow time and the calibration constant of the viscometer.

S6.3.2 Apparatus.

(a) **Viscometers.** Calibrated glass capillary-type viscometers, ASTM D2515-66 (incorporated by reference, see §571.5), measuring viscosity within the precision limits of S6.4.7. Use suspended level viscometers for viscosity measurements at low temperatures. Use Cannon-Fenske Routine or other modified Ostwald viscometers at ambient temperatures and above.

(b) **Viscometer holders and frames.** Mount a viscometer in the constant-temperature bath so that the mounting tube is held within 1° of the vertical.

(c) **Viscometer bath.** A transparent liquid bath of sufficient depth such that at no time during the

measurement will any portion of the sample in the viscometer be less than 2 cm. below the surface or less than 2 cm. above the bottom. The bath shall be cylindrical in shape, with turbulent agitation sufficient to meet the temperature control requirements. For measurements within 15° to 100 °C. (60° to 212 °F.) the temperature of the bath medium shall not vary by more than 0.01 °C. (0.02 °F.) over the length of the viscometers, or between the positions of the viscometers, or at the locations of the thermometers. Outside this range, the variation shall not exceed 0.03 °C. (0.05 °F.).

(d) **Thermometers.** Liquid-in-Glass Kinematic Viscosity Test Thermometers, covering the range of test temperatures indicated in Table IV and conforming to ASTM E1-68 (incorporated by reference, see §571.5), and in the IP requirements for IP Standard Thermometers. Use two standardized thermometers in the bath.

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TABLE IV—KINEMATIC VISCOSITY THERMOMETERS

Temperature range		For tests at		Subdivisions		Thermometer number	
°C.	°F.	°C.	°F.	°C.	°F.	ASTM	IP
Minus 55.3 to minus 52.5	Minus 67.5 to minus 62.5	Minus 55	Minus 67	0.05	0.1	74 F	69 F. or C.
Minus 41.4 to minus 38.6	Minus 42.5 to minus 37.5	Minus 40	Minus 40	0.05	0.1	73 F	68 F. or C.
98.6 to 101.4	207.5 to 212.5	100	212	0.05	0.1	30 F	32 F. or C.

(e) **Timing device.** Stop watch or other timing device graduated in divisions representing not more than 0.2 second, with an accuracy of at least ± 0.05 percent when tested over intervals of 15 minutes. Electrical timing devices may be used when the current frequency is controlled to an accuracy of 0.01 percent or better.

S6.3.3 Standardization.

(a) **Viscometers.** Use viscometers calibrated in accordance with appendix 1 of ASTM D445-65 (incorporated by reference, see §571.5). The calibration constant, C, is dependent upon the gravitational acceleration at the place of calibration. This must, therefore, be supplied by the standardization laboratory together with the instrument constant. Where the acceleration of gravity, g, in the two locations differs by more than 0.1%, correct the calibration constant as follows:

$$C_2 = (g_2/g_1) \times C_1$$

where the subscripts 1 and 2 indicate respectively the standardization laboratory and the testing laboratory.

(b) **Thermometers.** Check liquid-in-glass thermometers to the nearest 0.01 °C (0.02 °F) by direct comparison with a standardized thermometer. Kinematic Viscosity Test Thermometers shall be standardized at “total immersion.” The ice point of standardized thermometers shall be determined before use and the official corrections shall be adjusted to conform to the changes in ice points. (See ASTM E77-66 (incorporated by reference, see §571.5)).

(c) **Timers.** Time signals are broadcast by the National Bureau of Standards, Station WWV, Washington, DC at 2.5, 5, 10, 15, 20, 25, 30, and 35 Mc/sec (MHz). Time signals are also broadcast by Station CHU from Ottawa, Canada, at 3.330, 7.335, and 14.670 Mc/sec, and Station MSF at Rugby, United Kingdom, at 2.5, 5, and 10 Mc/sec.

S6.3.4 Procedure. (a) Set and maintain the bath at the appropriate test temperature (see S5.1.3) within the limits specified in S6.3.2(c). Apply the necessary corrections, if any, to all thermometer readings.

(b) Select a clean, dry, calibrated viscometer giving a flow time not less than its specified minimum, or 200 seconds, whichever is the greater.

(c) Charge the viscometer in the manner used when the instrument was calibrated. Do not filter or dry the brake fluid, but protect it from contamination by dirt and moisture during filling and measurements.

(1) Charge the suspended level viscometers by tilting about 30° from the vertical and pouring sufficient brake fluid through the fill tube into the lower reservoir so that when the viscometer is returned to vertical position the meniscus is between the fill marks. For measurements below 0 °C. (32 °F.), before placing the filled viscometer

into the constant temperature bath, draw the sample into the working capillary and timing bulb and insert small rubber stoppers to suspend the fluid in this position, to prevent accumulation of water condensate on the walls of the critical portions of the viscometer. Alternatively, fit loosely packed drying tubes into the open ends of the viscometer to prevent water condensation, but do not restrict the flow of the sample under test by the pressures created in the instrument.

(2) If a Cannon-Fenske Routine viscometer is used, charge by inverting and immersing the smaller arm into the brake fluid and applying vacuum to the larger arm. Fill the tube to the upper timing mark, and return the viscometer to an upright position.

(d) Mount the viscometer in the bath in a true vertical position (see S6.3.2(b)).

(e) The viscometer shall remain in the bath until it reaches the test temperature.

(f) At temperatures below 0 °C. (32 °F.) conduct an untimed preliminary run by allowing the brake fluid to drain through the capillary into the lower reservoir after the test temperature has been established.

(g) Adjust the head level of the brake fluid to a position in the capillary arm about 5 mm. above the first timing mark.

(h) With brake fluid flowing freely measure to within 0.2 second the time required for the meniscus to pass from the first timing mark to the second. If this flow time is less than the minimum specified for the viscometer, or 200 seconds, whichever is greater, repeat using a viscometer with a capillary of smaller diameter.

(i) Repeat S6.3.4 (g) and (h). If the two timed runs do not agree within 0.2 percent, reject and repeat using a fresh sample of brake fluid.

S6.3.5 Cleaning the viscometers. (a) Periodically clean the instrument with chromic acid to remove organic deposits. Rinse thoroughly with distilled water and acetone, and dry with clean dry air.

(b) Between successive samples rinse the viscometer with ethanol (isopropanol when testing DOT 5 fluids) followed by an acetone or ether rinse. Pass a slow stream of filtered dry air through the viscometer until the last trace of solvent is removed.

S6.3.6 Calculation. (a) The following viscometers have a fixed volume charged at ambient temperature, and as a consequence C varies with test temperature: Cannon-Fenske Routine, Pinkevitch, Cannon-Manning Semi-Micro, and Cannon Fenske Opaque. To calculate C at test temperatures other than the calibration temperature for these viscometers, see ASTM D2515-66

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(incorporated by reference, see §571.5) or follow instructions given on the manufacturer's certificate of calibration.

(b) Average the four timed runs on the duplicate samples to determine the kinematic viscosities.

S6.3.7 Precision (at 95 percent confidence level).

(a) **Repeatability.** If results on duplicate samples by the same operator differ by more than 1 percent of their mean, repeat the tests.

S6.4 pH value. Determine the pH value of a brake fluid by running one sample according to the following procedure.

S6.4.1 Summary of the procedure. Brake fluid is diluted with an equal volume of an ethanol-water solution. The pH of the resultant mixture is measured with a prescribed pH meter assembly at 23 °C. (73.4 °F.).

S6.4.2 Apparatus. The pH assembly consists of the pH meter, glass electrode, and calomel electrode, as specified in Appendices A1.1, A1.2, and A1.3 of ASTM D1121-67 (incorporated by reference, see §571.5) The glass electrode is a full range type (pH 0–14), with low sodium error.

S6.4.3 Reagents. Reagent grade chemicals conforming to the specifications of the Committee on Analytical Reagents of the American Chemical Society.

(a) **Distilled water.** Distilled water (S7.1) shall be boiled for about 15 minutes to remove carbon dioxide, and protected with a soda-lime tube or its equivalent while cooling and in storage. (Take precautions to prevent contamination by the materials used for protection against carbon dioxide.) The pH of the boiled distilled water shall be between 6.2 and 7.2 at 25 °C. (77 °F.).

(b) **Standard buffer solutions.** Prepare buffer solutions for calibrating the pH meter and electrode pair from salts sold specifically for use, either singly or in combination, as pH standards. Dry salts for 1 hour at 110 °C. (230 °F.) before use except for borax which shall be used as the decahydrate. Store solutions with pH less than 9.5 in bottles of chemically resistant glass or polyethylene. Store the alkaline phosphate solution in a glass bottle coated inside with paraffin. Do not use a standard with an age exceeding three months.

(1) Potassium hydrogen phthalate buffer solution (0.05 M, pH=4.01 at 25 °C. (77 °F.)). Dissolve 10.21 g. of potassium hydrogen phthalate ($\text{KHC}_8\text{H}_4\text{O}_4$) in distilled water. Dilute to 1 liter.

(2) Neutral phosphate buffer solution (0.025 M with respect to each phosphate salt, pH=6.86 at 25 °C. (77 °F.)). Dissolve 3.40 g. of potassium dihydrogen phosphate (KH_2PO_4) and 3.55 g. of anhydrous disodium hydrogen phosphate (Na_2HPO_4) in distilled water.

(3) Borax buffer solution (0.01 M, pH=9.18 at 25 °C. (77 °F.)). Dissolve 3.81 g. of disodium tetraborate decahydrate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) in distilled water, and dilute to 1 liter. Stopper the bottle except when actually in use.

(4) Alkaline phosphate buffer solution (0.01 M trisodium phosphate, pH=11.72 at 25 °C. (77 °F.)). Dissolve 1.42 g. of anhydrous disodium hydrogen phosphate (Na_2HPO_4) in 100 ml. of a 0.1 M carbonate-free solution of sodium hydroxide. Dilute to 1 liter with distilled water.

(5) Potassium chloride electrolyte. Prepare a saturated solution of potassium chloride (KCl) in distilled water.

(c) **Ethanol-water mixture.** To 80 parts by volume of ethanol (S7.3) add 20 parts by volume of distilled water. Adjust the pH of the mixture to 7 ± 0.1 using 0.1 N sodium hydroxide (NaOH) solution. If more than 4 ml. of NaOH solution per liter of mixture is required for neutralization, discard the mixture.

S6.4.4 Preparation of electrode system.

(a) **Maintenance of electrodes.** Clean the glass electrode before using by immersing in cold chromic-acid cleaning solution. Drain the calomel electrode and fill with KCl electrolyte, keeping level above that of the mixture at all times. When not in use, immerse the lower halves of the electrodes in distilled water, and do not immerse in the mixture for any appreciable period of time between determinations.

(b) **Preparation of electrodes.** Condition new glass electrodes and those that have been stored dry as recommended by the manufacturer. Before and after using, wipe the glass electrode thoroughly with a clean cloth, or a soft absorbent tissue, and rinse with distilled water. Before each pH determination, soak the prepared electrode in distilled water for at least 2 minutes. Immediately before use, remove any excess water from the tips of the electrode.

S6.4.5 Standardization of the pH assembly and testing of the electrodes. (a) Immediately before use, standardize the pH assembly with a standard buffer solution. Then use a second standard buffer solution to check the linearity of the response of the electrodes at different pH values, and to detect a faulty glass electrode or incorrect temperature compensation. The two buffer solutions bracket the anticipated pH value of the test brake fluid.

(b) Allow instrument to warm up, and adjust according to the manufacturer's instructions. Immerse the tips of the electrodes in a standard buffer solution and allow the temperature of the buffer solution and the electrodes to equalize. Set the temperature knob at the temperature of the buffer solution. Adjust the standardization or asymmetry potential control until the meter registers a scale reading, in pH units, equal to the known pH of the standardizing buffer solution.

(c) Rinse the electrodes with distilled water and remove excess water from the tips. Immerse the electrodes in a second standard buffer solution. The reading of the meter shall agree with the known pH of the second standard buffer solution within ± 0.05 unit without changing the setting of the standardization of asymmetry potential control.

(d) A faulty electrode is indicated by failure to obtain a correct value for the pH of the second standard buffer solution after the meter has been standardized with the first.

S6.4.6 Procedure. To 50 ± 1 ml. of the test brake fluid add 50 ± 1 ml. of the ethanol-water (S6.4.3(c)) and mix thoroughly. Immerse the electrodes in the mixture. Allow the system to come to equilibrium, readjust the temperature compensation if necessary, and take the pH reading.

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S6.5 Fluid stability. Evaluate the heat and chemical stability of a brake fluid by the following procedure, running duplicate samples for each test and averaging the results.

S6.5.1 Summary of the procedure. The degradation of the brake fluid at elevated temperature, alone or in a mixture with a reference fluid, is evaluated by determining the change in boiling point after a period of heating under reflux conditions.

S6.5.2 Apparatus. Use the apparatus and preparation specified in S6.1.2 and S6.1.3.

S6.5.3 High temperature stability.

S6.5.3.1 Procedure. (a) Heat a new 60 ±1 ml. sample of the brake fluid to 185° ±2 °C. (365° ±3.6 °F.). Hold at this temperature for 120 ±5 minutes. Bring to a reflux rate in excess of 1 drop per second within 5 minutes. The reflux rate should not exceed 5 drops per second at any time. Over the next 5 ±2 minutes adjust the heating rate to obtain an equilibrium reflux rate of 1 to 2 drops per second. Maintain this rate for an additional 2 minutes, taking four temperature readings at 30-second intervals. Average these as the observed ERBP. If no reflux is evident when the fluid temperature reaches 260 °C. (500 °F), discontinue heating and report ERBP as in excess of 260 °C. (500 °F.).

S6.5.3.2 Calculation. Correct the observed ERBP for thermometer and barometric pressure factors according to S6.1.5 (a) and (b). Average the corrected ERBP's of the duplicate samples. The difference between this average and the original ERBP obtained in S6.1 is the change in ERBP of the fluid.

S6.5.4 Chemical stability.

S6.5.4.1 Materials. SAE RM-66-04 Compatibility Fluid as described in appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see §571.5).

(a) Mix 30 ±1 ml. of the brake fluid with 30 ±1 ml. of SAE RM-66-04 Compatibility Fluid in a boiling point flask (S6.1.2(a)). Determine the initial ERBP of the mixture by applying heat to the flask so that the fluid is refluxing in 10 ±2 minutes at a rate in excess of 1 drop per second, but not more than 5 drops per second. Note the maximum fluid temperature observed during the first minute after the fluid begins refluxing at a rate in excess of 1 drop per second. Over the next 15 ±1 minutes, adjust and maintain the reflux rate at 1 to 2 drops per second. Maintain this rate for an additional 2 minutes, recording the average value of four temperature readings taken at 30 second intervals as the final ERBP.

(b) Thermometer and barometric corrections are not required.

S6.5.4.3 Calculation. The difference between the initial ERBP and the final average temperature is the change in temperature of the refluxing mixture. Average the results of the duplicates to the nearest 0.5 °C (1.0 °F).

S6.6 Corrosion. Evaluate the corrosiveness of a brake fluid by running duplicate samples according to the following procedure.

S6.6.1 Summary of the procedure. Six specified metal corrosion test strips are polished, cleaned, and weighed, then assembled as described. Assembly is placed

on a standard wheel cylinder cup in a corrosion test jar, immersed in the water-wet brake fluid, capped and placed in an oven at 100 °C. (212 °F.) for 120 hours. Upon removal and cooling, the strips, fluid, and cups are examined and tested.

S6.6.2 Equipment. (a) **Balance.** An analytical balance having a minimum capacity of 50 grams and capable of weighing to the nearest 0.1 mg.

(b) **Desiccators.** Desiccators containing silica gel or other suitable desiccant.

(c) **Oven.** Gravity convection oven capable of maintaining the desired set point within 2 °C. (3.6 °F.).

(d) **Micrometer.** A machinist's micrometer 25 to 50 mm. (1 to 2 inches) capacity, or an optical comparator, capable of measuring the diameter of the SBR wheel cylinder (WC) cups to the nearest 0.02 mm. (0.001 inch).

S6.6.3 Materials. (a) **Corrosion test strips.** Two sets of strips from each of the metals listed in Appendix C of SAE Standard J1703b (1970) (incorporated by reference, see §571.5). Each strip shall be approximately 8 cm long, 1.3 cm wide, not more than 0.6 cm thick, and have a surface area of 25±5 cm² and a hole 4 to 5 mm (0.16 to 0.20 inch) in diameter on the centerline about 6 mm from one end. The hole shall be clean and free from burrs. Tinned iron strips shall be unused. Other strips, if used, shall not be employed if they cannot be polished to a high finish.

(b) **SBR cups.** Two unused standard SAE SBR wheel cylinder (WC) cups, as specified in S7.6.

(c) **Corrosion test jars and lids.** Two screw-top straight-sided round glass jars, each having a capacity of approximately 475 ml. and inner dimensions of approximately 100 mm. in height and 75 mm. in diameter, and a tinned steel lid (no insert or organic coating) vented with a hole 0.8 ±0.1 mm. (0.031 ±0.004 inch) in diameter (No. 68 drill).

(d) **Machine screws and nuts.** Clean, rust and oil-free, uncoated mild steel round or fillister head machine

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screws, size 6 or 8-32 UNC-Class 2A, five-eighths or three-fourths inch long (or equivalent metric sizes), and matching uncoated nuts.

(e) **Supplies for polishing strips.** Waterproof silicon carbide paper, grit No. 320 A; and grit 1200; lint-free polishing cloth.

(f) **Distilled water** as specified in S7.1.

(g) **Ethanol** as specified in S7.3.

(h) **Isopropanol** as specified in S7.7.

S6.6.4 Preparation.

(a) **Corrosion test strips.** Except for the tinned iron strips, abrade corrosion test strips on all surface areas with 320A silicon carbide paper wet with ethanol (isopropanol when testing DOT 5 SBBF fluids) until all surface scratches, cuts and pits visible to an observer having corrected visual acuity of $20/40$ (Snellen ratio) at a distance of 300 mm (11.8 inches) are removed. Use a new piece of paper for each different type of metal. Polish the strips with the 00 grade steel wool. Except for the tinned iron strips, further abrade the test strips on all surface areas with 1200 silicon carbide paper wet with ethanol (isopropanol when testing DOT 5 SBBF fluids), again using a new piece of paper for each different type of metal. Handle the strips with forceps after polishing. Weigh and record the weight of each strip to the nearest 0.1 mg. Assemble the strips on a clean dry machine screw, with matching plain nut, in the order of tinned iron, steel, aluminum, cast iron, brass, and copper. Bend the strips, other than the cast iron, so that there is a separation of $3 \pm \frac{1}{2}$ mm ($\frac{1}{8} \pm \frac{1}{16}$ inch) between adjacent strips for a distance of about 5 cm (2 inches) from the free end of the strips. (See Figure 4.) Tighten the screw on each test strip assembly so that the strips are in electrolytic contact, and can be lifted by either of the outer strips (tinned iron or copper) without any of the strips moving relative to the others when held horizontally. Immerse the strip assemblies in 90% ethyl alcohol. Dry with dried filtered compressed air, then desiccate at least 1 hour before use.

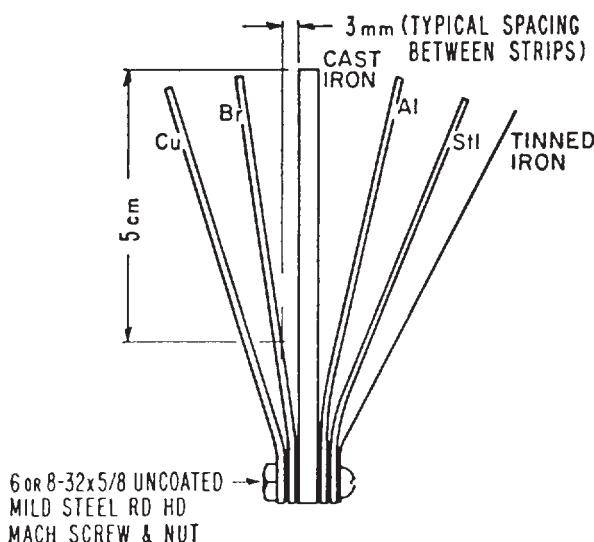


Fig 4. Corrosion Strip Assembly

(b) **SBR WC cups.** Measure the base diameters of the two standard SBR cups, using an optical comparator or micrometer, to the nearest 0.02 mm. (0.001 inch) along the centerline of the SAE and rubber-type identifications and at right angles to this centerline. Take the measurements at least 0.4 mm. (0.015 inch) above the bottom edge and parallel to the base of the cup. Discard any cup if the two measured diameters differ by more than 0.08 mm. (0.003 inch). Average the two readings on each cup. Determine the hardness of the cups according to S7.4.

S6.6.5 Procedure. Rinse the cups in ethanol (isopropanol when testing DOT 5 SBBF fluids) for not more than 30 seconds and wipe dry with a clean lint-free cloth. Place one cup with lip edge facing up, in each jar. Insert a metal strip assembly inside each cup with the fastened end down and the free end extending upward. (See Figure 5.) When testing brake fluids, except DOT 5 SBBF, mix 760 ml. of brake fluid with 40 ml. of distilled water. When testing DOT 5 SBBF's, humidify 800 ml. of brake fluid in accordance with S6.2, eliminating determination of the ERBP. Using this water-wet mixture, cover each strip assembly to a minimum depth of 10 mm. above the tops of the strips. Tighten the lids and place the jars for 120 ± 2 hours in an oven maintained at $100 \pm 2^\circ$ C. ($212 \pm 3.6^\circ$ F.). Allow the jars to cool at $23 \pm 5^\circ$ C. ($73.4 \pm 9^\circ$ F.) for 60 to 90 minutes. Immediately remove the strips from the jars using forceps, agitating the strip assembly in the fluid to remove loose adhering sediment. Examine the test strips and jars for adhering crystalline deposits. Disassemble the metal strips, and remove adhering fluid by flushing with water; clean each strip by wiping with a clean cloth wetted with ethanol (isopropanol when testing DOT 5 fluids). Examine the strips for evidence of corrosion and pitting. Disregard staining or discoloration. Place the strips in a desiccator containing silica gel or other suitable desiccant, maintained at $23 \pm 5^\circ$ C. ($73.4 \pm 9^\circ$ F.), for at least 1 hour. Weigh each strip to the nearest 0.1 mg. Determine the change in weight of each metal strip. Average the results for the two strips of each type of metal. Immediately following the cooling period, remove the cups from the jars with forceps. Remove loose adhering sediment by agitation of the cups in the mixture. Rinse the cups in ethanol (isopropanol when testing DOT 5 fluids) and air-dry. Examine the cups for evidence of sloughing, blisters, and other forms of disintegration. Measure the base diameter and hardness of each cup within 15 minutes after removal from the mixture. Examine the mixture for gelling. Agitate the mixture to suspend and uniformly disperse sediment. From each jar, transfer a 100 ml. portion of the mixture to an ASTM cone-shaped centrifuge tube. Determine the percent sediment after centrifuging as described in S7.5. Measure the pH value of the corrosion test fluid according to S6.4.6. Measure the pH value of the test mixture according to S6.4.6.

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S6.6.6 Calculation.

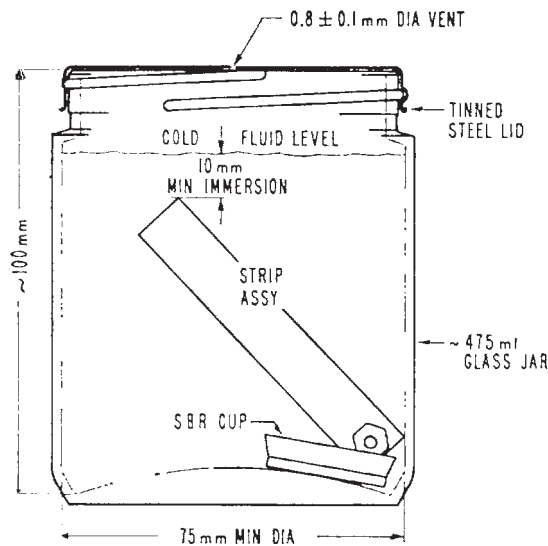


Fig 5. Corrosion Test Apparatus

(a) Measure the area of each type of test strip to the nearest square centimeter. Divide the average change in mass for each type by the area of that type.

(b) Note other data and evaluations indicating compliance with S5.1.6. In the event of a marginal pass on inspection by attributes, or of a failure in one of the duplicates, run another set of duplicate samples. Both repeat samples shall meet all requirements of S5.1.6.

S6.7 Fluidity and appearance at low temperatures. Determine the fluidity and appearance of a sample of brake fluid at each of two selected temperatures by the following procedure.

S6.7.1 Summary of procedure. Brake fluid is chilled to expected minimum exposure temperatures and observed for clarity, gellation, sediment, separation of components, excessive viscosity or thixotropy.

S6.7.2 Apparatus.

(a) **Oil sample bottle.** Two clear flint glass 4-ounce bottles made especially for sampling oil and other liquids, with a capacity of approximately 125 ml., an outside diameter of 37 ± 0.05 mm. and an overall height of 165 ± 2.5 mm.

(b) **Cold chamber.** An air bath cold chamber capable of maintaining storage temperatures down to minus 55° C. (minus 67° F.) with an accuracy of $\pm 2^\circ$ C. (3.6 F.).

(c) **Timing device.** A timing device in accordance with S6.3.2(e).

S6.7.3 Procedure.

(a) Place 100 ± 1 ml. of brake fluid at room temperature in an oil sample bottle. Stopper the bottle with an unused cork and place in the cold chamber at the higher storage temperature specified in Table II (S5.1.7(c)). After 144 ± 4 hours remove the bottle from the chamber, quickly wipe it with a clean, lint-free cloth, saturated with ethanol (isopropanol when testing DOT 5 fluids) or acetone. Examine the fluid for evidence of sludging, sedimentation, crystallization, or stratification. Invert the bottle and determine the number of seconds

required for the air bubble to travel to the top of the fluid. Let sample warm to room temperature and examine.

(b) Repeat S6.7.3(a), substituting the lower cold chamber temperature specified in Table II, and a storage period of 6 hours ± 12 minutes.

NOTE: Test specimens from either storage temperature may be used for the other only after warming up to room temperature.

S6.8 [Removed and Reserved]

S6.9 Water tolerance. Evaluate the water tolerance characteristics of a brake fluid by running one test specimen according to the following procedure.

S6.9.1 Summary of the procedure.

Brake fluid, except DOT 5 SBBF, is diluted with 3.5 percent water (DOT 5 SBBF is humidified), then stored at minus 40° C. (minus 40° F.) for 120 hours. The cold, water-wet fluid is first examined for clarity, stratification, and sedimentation, then placed in an oven at 60° C. (140° F.) for 24 hours. On removal, it is again examined for stratification, and the volume percent of sediment determined by centrifuging.

S6.9.2 Apparatus.

(a) **Centrifuge tube.** See S7.5.1(a).

(b) **Centrifuge.** See S7.5.1(b).

(c) **Cold chamber.** See S6.7.2(b).

(d) **Oven.** Gravity or forced convection oven.

(e) **Timing device.** See S6.3.2(e).

S6.9.3 Procedure.

(a) **At low temperature.** Humidify 100 ± 1 ml. of DOT 5 SBBF brake fluid in accordance with S6.2 eliminating determination of the ERBP. When testing brake fluids except DOT 5 SBBF, mix 3.5 ± 0.1 ml. of distilled water with 100 ± 1 ml. of the brake fluid; pour into a centrifuge tube. Stopper the tube with a clean cork and place in the cold chamber maintained at minus $40^\circ \pm 2^\circ$ C. (minus $40^\circ \pm 3.6^\circ$ F.). After $120 \text{ hours} \pm 2$ hours remove the tube, quickly wipe with clean lint-free cloth saturated with ethanol or acetone and examine the fluid for evidence of sludging, sedimentation, crystallization, or stratification. Invert the tube and determine the number of seconds required for the air bubble to travel to the top of the fluid. (The air bubble is considered to have reached the top of the fluid when the top of the bubble reaches the 2 ml. graduation of the centrifuge tube.) If the wet fluid has become cloudy, warm to $23^\circ \pm 5^\circ$ C. ($73.4^\circ \pm 9^\circ$ F.) and note appearance and fluidity.

(b) **At 60° C. (140° F.).** Place tube and brake fluid from S6.9.3(a) in an oven maintained at $60 \pm 2^\circ$ C. ($140^\circ \pm 3.6^\circ$ F.) for 24 ± 2 hours. Remove the tube and immediately examine the contents for evidence of stratification. Determine the percent sediment by centrifuging as described in S7.5.

S6.10 Compatibility. The compatibility of a brake fluid with other brake fluids shall be evaluated by running one test sample according to the following procedure.

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S6.10.1 Summary of the procedure.

Brake fluid is mixed with an equal volume of SAE RM-66-04 Compatibility Fluid, then tested in the same way as for water tolerance (S6.9) except that the bubble flow time is not measured. This test is an indication of the compatibility of the test fluid with other motor vehicle brake fluids at both high and low temperatures.

S6.10.2 Apparatus and materials.

(a) **Centrifuge tube.** See S7.5.1(a).

(b) **Centrifuge.** See S7.5.1(b).

(c) **Cold Chamber.** See S6.7.2(b).

(d) **Oven.** See S6.9.2(d).

(e) **SAE RM-66-04 Compatibility Fluid.** As described in appendix B of SAE Standard J1703 JAN95 (incorporated by reference, see §571.5).

S6.10.3 Procedure.

(a) At low temperature.

Mix 50 ± 0.5 mL of brake fluid with 50 ± 0.5 mL of SAE RM-66-04 Compatibility Fluid. Pour this mixture into a centrifuge tube and stopper with a clean dry cork. Place tube in the cold chamber maintained at $\text{minus } 40^\circ \pm 2^\circ \text{C}$. ($\text{minus } 40^\circ \pm 4^\circ \text{F}$). After 24 ± 2 hours, remove tube, quickly wipe with a clean lint-free cloth saturated with ethanol (isopropanol when testing DOT 5 fluids) or acetone. Examine the test specimen for evidence of slugging, sedimentation, or crystallization. Test fluids, except DOT 5 SBBF, shall be examined for stratification.

S6.11 Resistance to oxidation. The stability of a brake fluid under oxidative conditions shall be evaluated by running duplicate samples according to the following procedure.

S6.11.1 Summary of procedure.

Brake fluids, except DOT 5 SBBF, are activated with a mixture of approximately 0.2 percent benzoyl peroxide and 5 percent water. DOT 5 SBBF is humidified in accordance with S6.2 eliminating determination of the ERBP, and then approximately 0.2 percent benzoyl peroxide is added. A corrosion test strip assembly consisting of cast iron and an aluminum strip separated by tinfoil squares at each end is then rested on a piece of SBR WC cup positioned so that the test strip is half immersed in the fluid and oven aged at 70°C . (158°F .) for 168 hours. At the end of this period, the metal strips are examined for pitting, etching, and loss of mass.

S6.11.2 Equipment.

(a) **Balance.** See S6.6.2(a).

(b) **Desiccators.** See S6.6.2(b).

(c) **Oven.** See S6.6.2(c).

(d) Three glass test tubes approximately 22 mm. outside diameter by 175 mm. in length.

S6.11.3 Reagents and materials.

(a) **Benzoyl peroxide, reagent grade, 96 percent.** (Benzoyl peroxide that is brownish, or dusty, or has less than 90% purity, must be discarded.) Reagent strength may be evaluated by ASTM E298-68 (incorporated by reference, see §571.5).

(b) **Corrosion test strips.** Two sets of cast iron and aluminum metal test strips as described in appendix C

of SAE Standard J1703b (1970) (incorporated by reference, see §571.5).

(c) **Tinfoil.** Four unused pieces of tinfoil approximately 12 mm. ($\frac{1}{2}$ inch) square and between 0.02 and 0.06 mm. (0.0008 and 0.0024 inch) in thickness. The foil shall be at least 99.9 percent tin and contain not more than 0.025 percent lead.

(d) **SBR cups.** Two unused, approximately one-eighth sections of a standard SAE SBR WC cup (as described in S7.6).

(e) **Machine screw and nut.** Two clean oil-free, No. 6 or 8-32 $\times$ $\frac{3}{8}$ - or $\frac{1}{2}$ -inch long (or equivalent metric size), round or fillister head, uncoated mild steel machine screws, with matching plain nuts.

S6.11.4 Preparation.

(a) **Corrosion test strips.** Prepare two sets of aluminum and cast iron test strips according to S6.6.4(a) except for assembly. Weigh each strip to the nearest 0.1 mg. and assemble a strip of each metal on a machine screw, separating the strips at each end with a piece of tinfoil. Tighten the nut enough to hold both pieces of foil firmly in place.

(b) **Test mixture.** Place 30 ± 1 ml. of the brake fluid under test in a 22 by 175 mm. test tube. For all fluids except DOT 5 SBBF, add 0.060 ± 0.002 grams of benzoyl peroxide, and 1.50 ± 0.05 ml. of distilled water. For DOT 5 SBBF, use test fluid humidified in accordance with S6.2, and add only the benzoyl peroxide. Stopper the tube loosely with a clean dry cork, shake, and place in an oven for 2 hours at $70^\circ \pm 2^\circ \text{C}$. ($158^\circ \pm 3.6^\circ \text{F}$.). Shake every 15 minutes to effect solution of the peroxide, but do not wet cork. Remove the tube from the oven and allow to cool to $23^\circ \pm 5^\circ \text{C}$. ($73.4^\circ \pm 9^\circ \text{F}$.) Begin testing according to paragraph S6.11.5 not later than 24 hours after removal of tube from oven.

S6.11.5 Procedure. Place a one-eighth SBR cup section in the bottom of each tube. Add 10 ml. of prepared test mixture to each test tube. Place a metal-strip assembly in each, the end of the strip without the screw resting on the rubber, and the solution covering about one-half the length of the strips. Stopper the tubes with clean dry corks and store upright for 70 ± 2 hours at $23^\circ \pm 5^\circ \text{C}$. ($73.4^\circ \pm 9^\circ \text{F}$.). Loosen the corks and place the tubes for 168 ± 2 hours in an oven maintained at $70^\circ \pm 2^\circ \text{C}$. ($158^\circ \pm 3.6^\circ \text{F}$.). Afterwards remove and disassemble strips. Examine the strips and note any gum deposits. Wipe the strips with a clean cloth wet with ethanol (isopropanol when testing DOT 5 fluids) and note any pitting, etching or roughening of surface disregarding stain or discoloration. Place the strips in a desiccator over silica gel or other suitable desiccant, at $23^\circ \pm 5^\circ \text{C}$. ($73.4^\circ \pm 9^\circ \text{F}$.) for at least 1 hour. Again weigh each strip to the nearest 0.1 mg.

S6.11.6 Calculation. Determine corrosion loss by dividing the change in mass of each metal strip by the total surface area of each strip measured in square millimeters (mm^2), to the nearest square millimeter (mm^2). Average the results for the two strips of each type of metal, rounding to the nearest 0.05 mg. per 100 square millimeter (mm^2). If only one of the duplicates fails for

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any reason, run a second set of duplicate samples. Both repeat samples shall meet all requirements of S5.1.11.

S6.12 Effect on SBR cups. The effects of a brake fluid in swelling, softening, and otherwise affecting standard SBR WC cups shall be evaluated by the following procedure.

S6.12.1 Summary of the procedure. Four standard SAE SBR WC cups are measured and their hardnesses determined. The cups, two to a jar, are immersed in the test brake fluid. One jar is heated for 70 hours at 70 °C. (158 °F), and the other for 70 hours at 120 °C (248 °F). Afterwards, the cups are washed, examined for disintegration, remeasured and their hardnesses redetermined.

S6.12.2 Equipment and supplies.

(a) **Oven.** See S6.6.2(c).

(b) **Glass jars and lids.** Two screw-top, straight-sided round glass jars, each having a capacity of approximately 250 ml. and inner dimensions of approximately 125 mm. in height and 50 mm. in diameter, and a tinned steel lid (no insert or organic coating).

(c) **SBR cups.** See S7.6.

S6.12.3 Preparation. Measure the base diameters of the SBR cups as described in S6.6.4(b), and the hardness of each as described in S7.4.

S6.12.4 Procedure. Wash the cups in 90 percent ethanol (isopropanol when testing DOT 5 fluids) (see S7.3), for not longer than 30 seconds and quickly dry with a clean, lint-free cloth. Using forceps, place two cups into each of the two jars; add 75 ml. of brake fluid to each jar and cap tightly. Place one jar in an oven held at 70° ±2 °C. (158 ±3.6°F.) for 70 ±2 hours. Place the other jar in an oven held at 120° ±2 °C. (248° ±3.6 °F.) for 70 ±2 hours. Allow each jar to cool for 60 to 90 minutes at 23° ±5 °C. (73.4° ±9 °F.). Remove cups, wash with ethanol (isopropanol when testing DOT 5 fluids) for not longer than 30 seconds, and quickly dry. Examine the cups for disintegration as evidenced by stickiness, blisters, or sloughing. Measure the base diameter and hardness of each cup within 15 minutes after removal from the fluid.

S6.12.5 Calculation. (a) Calculate the change in base diameter for each cup. If the two values, at each temperature, do not differ by more than 0.10 mm. (0.004 inch) average them to the nearest 0.02 mm. (0.001 inch). If the two values differ by more than 0.10 mm., repeat the test at the appropriate temperature and average the four values as the change in base diameter.

(b) Calculate the change in hardness for each cup. The average of the two values for each pair is the change in hardness.

(c) Note disintegration as evidenced by stickiness, blisters, or sloughing.

S6.13 Strokings properties. Evaluate the lubricating properties, component compatibility, resistance to leakage, and related qualities of a brake fluid by running one sample according to the following procedures.

S6.13.1 Summary of the procedure. Brake fluid is stroked under controlled conditions at an elevated temperature in a simulated motor vehicle hydraulic braking system consisting of three slave wheel cylinders and an actuating master cylinder connected by steel tubing. Ref-

eree standard parts are used. All parts are carefully cleaned, examined, and certain measurements made immediately prior to assembly for test. During the test, temperature, rate of pressure rise, maximum pressure, and rate of stroking are specified and controlled. The system is examined periodically during stroking to assure that excessive leakage of fluid is not occurring. Afterwards, the system is torn down. Metal parts and SBR cups are examined and remeasured. The brake fluid and any resultant sludge and debris are collected, examined, and tested.

S6.13.2 Apparatus and equipment. Either the drum and shoe type of stroking apparatus (see Figure 1 of SAE Standard J1703b (1970) (incorporated by reference, see §571.5)), except using only three sets of drum and shoe assemblies, or the stroking fixture type of apparatus as shown in Figure 2 of SAE Standard J1703 NOV83 (incorporated by reference, see §571.5) with the components arranged as shown in Figure 1 of SAE Standard J1703 NOV83. The following components are required.

(a) **Brake assemblies.** With the drum and shoe apparatus: three drum and shoe assembly units (SAE RM-29a) consisting of three forward brake shoes and three reverse brake shoes with linings and three front wheel brake drum assemblies with assembly component parts. With stroking fixture type apparatus: three fixture units including appropriate adapter mounting plates to hold brake wheel cylinder assemblies.

(b) **Braking pressure actuation mechanism.** An actuating mechanism for applying a force to the master cylinder pushrod without side thrust. The amount of force applied by the actuating mechanism shall be adjustable and capable of applying sufficient thrust to the master cylinder to create a pressure of at least 6895 kPa (1,000 p.s.i.) in the simulated brake system. A hydraulic gage or pressure recorder, having a range of at least 0 to 6895 kPa (0 to 1,000 p.s.i.), shall be installed between the master cylinder and the brake assemblies and shall be provided with a shutoff valve and with a bleeding valve for removing air from the connecting tubing. The actuating mechanism shall be designed to permit adjustable stroking rates of approximately 1,000 strokes per hour. Use a mechanical or electrical counter to record the total number of strokes.

(c) **Heated air bath cabinet.** An insulated cabinet or oven having sufficient capacity to house the three mounted brake assemblies or stroking fixture assemblies, master cylinder, and necessary connections. A thermostatically controlled heating system is required to maintain a temperature of 70° ±5 °C (158° ±9 °F) or 120° ±5 °C (248° ±9 °F). Heaters shall be shielded to prevent direct radiation to wheel or master cylinder.

(d) **Master cylinder (MC) assembly (SAE RM-15a).** One cast iron housing hydraulic brake system cylinder having a diameter of approximately 28 mm. (1 1/8 inch) and fitted for a filler cap and standpipe (see S6.13.2(e)). The MC piston shall be made from SAE CA360 copperbase alloy (half hard). A new MC assembly is required for each test.

(e) **Filler cap and standpipe.** MC filler cap provided with a glass or uncoated steel standpipe. Standpipe must

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provide adequate volume for thermal expansion, yet permit measurement and adjustment of the fluid level in the system to ± 3 ml. Cap and standpipe may be cleaned and reused.

(f) **Wheel cylinder (WC) assemblies (SAE RM-14a).** Three unused cast iron housing straight bore hydraulic brake WC assemblies having diameters of approximately 28 mm ($1\frac{1}{8}$ inch) for each test. Pistons shall be made from unanodized SAE AA 2024 aluminum alloy.

(g) **Micrometer.** Same as S6.6.2(d).

S6.13.3 Materials.

(a) **Standard SBR brake cups.** Six standard SAE SBR wheel cylinder test cups, one primary MC test cup, and one secondary MC test cup, all as described in S7.6, for each test.

(b) **Steel tubing.** Double wall steel tubing meeting SAE Standard J527a (1967) (incorporated by reference, see §571.5). A complete replacement of tubing is essential when visual inspection indicates any corrosion or deposits on inner surface of tubing. Tubing from master cylinder to one wheel cylinder shall be replaced for each test (minimum length .9 m). Uniformity in tubing size is required between master cylinder and wheel cylinder. The standard master cylinder has two outlets for tubing, both of which must be used.

S6.13.4 Preparation of test apparatus.

(a) **Wheel cylinder assemblies.** Use unused wheel cylinder assemblies. Disassemble cylinders and discard cups. Clean all metal parts with ethanol (isopropanol when testing DOT 5 fluids). Inspect the working surfaces of all metal parts for scoring, galling, or pitting and cylinder bore roughness, and discard all defective parts. Remove any stains on cylinder walls with crocus cloth and ethanol (isopropanol when testing DOT 5 fluids). If stains cannot be removed, discard the cylinder. Measure the internal diameter of each cylinder at a location approximately 19 mm. (0.75 inch) from each end of the cylinder bore, taking measurements in line with the hydraulic inlet opening and at right angles to this centerline. Discard the cylinder if any of these four readings exceeds the maximum or minimum limits of 28.66 to 28.60 mm. (1.128 to 1.126 inch). Measure the outside diameter of each piston at two points approximately 90° apart. Discard any piston if either reading exceeds the maximum or minimum limits of 28.55 to 28.52 mm. (1.124 to 1.123 inch). Select parts to insure that the clearance between each piston and mating cylinder is within 0.08 to 0.13 mm. (0.003 to 0.005 inch). Use unused SBR cups. To remove dirt and debris, rinse the cups in 90 percent ethyl alcohol for not more than 30 seconds and wipe dry with a clean lint-free cloth. Discard any cups showing defects such as cuts, molding flaws, or blisters. Measure the lip and base diameters of all cups with an optical comparator or micrometer to the nearest 0.02 mm. (0.001 inch) along the centerline of the SAE and rubber-type identifications and at right angles to this centerline. Determine base diameter measurements at least 0.4 mm. (0.015 inch) above the bottom edge and parallel to the base of the cup. Discard any cup if the two measured lip or base diameters differ by more than 0.08 mm. (0.003 inch). Average the lip and base diameters of each cup. Determine the hardness of all cups according to S7.4.

Dip the rubber and metal parts of wheel cylinders, except housing and rubber boots, in the fluid to be tested and install them in accordance with the manufacturer's instructions. Manually stroke the cylinders to insure that they operate easily. Install cylinders in the simulated brake system.

(b) **Master cylinder assembly.** Use an unused master cylinder and unused standard SBR primary and secondary MC cups which have been inspected, measured and cleaned in the manner specified in S6.13.4(a), omitting hardness of the secondary MC cup. However, prior to determining the lip and base diameters of the secondary cup, dip the cup in test brake fluid, assemble on the MC piston, and maintain the assembly in a vertical position at $23^{\circ} \pm 5^{\circ} \text{C}$. ($73.4^{\circ} \pm 9^{\circ} \text{F}$.) for at least 12 hours. Inspect the relief and supply ports of the master cylinder; discard the cylinder if ports have burrs or wire edges. Measure the internal diameter of the cylinder at two locations (approximately midway between the relief and supply ports and approximately 19 mm. (0.75 inch) beyond the relief port toward the bottom or discharge end of the bore), taking measurements at each location on the vertical and horizontal centerline of the bore. Discard the cylinder if any reading exceeds the maximum or minimum limits of 28.65 to 28.57 mm. (1.128 to 1.125 inch). Measure the outside diameter of each end of the master cylinder piston at two points approximately 90° apart. Discard the piston if any of these four readings exceed the maximum or minimum limits of 28.55 to 28.52 mm. (1.124 to 1.123 inch). Dip the rubber and metal parts of the master cylinder, except the housing and push rod-boot assembly, in the brake fluid and install in accordance with manufacturer's instructions. Manually stroke the master cylinder to insure that it operates easily. Install the master cylinder in the simulated brake system.

(c) Assembly and adjustment of test apparatus.

(1) When using a shoe and drum type apparatus, adjust the brake shoe toe clearances to 1.0 ± 0.1 mm (0.040 ± 0.004 inch). Fill the system with brake fluid, bleeding all wheel cylinders and the pressure gage to remove entrapped air. Operate the actuator manually to apply a pressure greater than the required operating pressure and inspect the system for leaks. Adjust the actuator and/or pressure relief valve to obtain a pressure of 6895 kPa ± 345 kPa (1,000 ± 50 p.s.i.). A smooth pressure stroke pattern is required when using a shoe and drum type apparatus. The pressure is relatively low during the first part of the stroke and then builds up smoothly to the maximum stroking pressure at the end of the stroke, to permit the primary cup to pass the compensating hole at a relatively low pressure. Using stroking fixtures, adjust the actuator and/or pressure relief valve to obtain a pressure of 6895 kPa ± 345 kPa (1,000 ± 50 p.s.i.).

(2) Adjust the stroking rate to 1,000 ± 100 strokes per hour. Record the fluid level in the master cylinder standpipe.

S6.13.5 Procedure. Operate the system for 16,000 $\pm 1,000$ cycles at $23^{\circ} \pm 5^{\circ} \text{C}$. ($73.4^{\circ} \pm 9^{\circ} \text{F}$.) Repair any leakage, readjust the brake shoe clearances, and add fluid to the master cylinder standpipe to bring to the level originally recorded, if necessary. Start the test again

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and raise the temperature of the cabinet within 6 ± 2 hours to $120^\circ \pm 5^\circ \text{C}$. ($248^\circ \pm 9^\circ \text{F}$). During the test observe operation of wheel cylinders for improper functioning and record the amount of fluid required to replenish any loss, at intervals of 24,000 strokes. Stop the test at the end of 85,000 total recorded strokes. These totals shall include the number of strokes during operation at $23^\circ \pm 5^\circ \text{C}$. ($73.4^\circ \pm 9^\circ \text{F}$.) and the number of strokes required to bring the system to the operating temperature. Allow equipment to cool to room temperature. Examine the wheel cylinders for leakage. Stroke the assembly an additional 100 strokes, examine wheel cylinders for leakage and record volume loss of fluid. Within 16 hours after stopping the test, remove the master and wheel cylinders from the system, retaining the fluid in the cylinders by immediately capping or plugging the ports. Disassemble the cylinders, collecting the fluid from the master cylinder and wheel cylinders in a glass jar. When collecting the stroked fluid, remove all residue which has deposited on rubber and metal internal parts by rinsing and agitating such parts in the stroked fluid and using a soft brush to assure that all loose adhering sediment is collected. Clean SBR cups in ethanol (isopropanol when testing DOT 5 fluids) and dry. Inspect the cups for stickiness, scuffing, blistering, cracking, chipping, and change in shape from original appearance. Within 1 hour after disassembly, measure the lip and base diameters of each cylinder cup by the procedures specified in S6.13.4 (a) and (b) with the exception that lip or base diameters of cups may now differ by more than 0.08 mm. (0.003 inch). Determine the hardness of each cup according to S7.4. Note any sludge or gel present in the test fluid. Within 1 hour after draining the cylinders, agitate the fluid in a glass jar to suspend and uniformly disperse sediment and transfer a 100 ml. portion of this fluid to a centrifuge tube and determine percent sediment as described in S7.5. Allow the tube and fluid to stand for 24 hours, centrifuge and record any additional sediment recovered. Inspect cylinder parts, note any gumming or any pitting on pistons and cylinder walls. Disregard staining or discoloration. Rub any deposits adhering to cylinder walls with a clean soft cloth wetted with ethanol (isopropanol when testing DOT 5 fluids) to determine abrasiveness and removability. Clean cylinder parts in ethanol (isopropanol when testing DOT 5 fluids) and dry. Measure and record diameters of pistons and cylinders according to S6.13.4(a) and (b). Repeat the test if mechanical failure occurs that may affect the evaluation of the brake fluid.

S6.13.6 Calculation.(a) Calculate the changes in diameters of cylinders and pistons (see S5.1.13(b)).

(b) Calculate the average decrease in hardness of the seven cups tested, as well as the individual values (see S5.1.13(c)).

(c) Calculate the increases in base diameters of the eight cups (see S5.1.13(e)).

(d) Calculate the lip diameter interference set for each of the eight cups by the following formula and average the eight values (see S5.1.13(f)).

$$\frac{[(D_1 - D_2)/(D_1 - D_2)] \times 100}{\text{Interference Set}} = \text{percentage Lip Diameter}$$

where:

D_1 = Original lip diameter.

D_2 = Final lip diameter.

D_3 = Original cylinder bore diameter.

S6.14 Container information. Each container with information marked directly on the container surface or on a label (labels) affixed to the container pursuant to S5.2.2.2 or S5.2.2.3 is subjected to the following procedure:

(a) If the container has a label affixed to it, make a single vertical cut all the way through the label with the container in the vertical position.

(b) Immerse the container in the same brake fluid or hydraulic system mineral oil contained therein for 15 minutes at room temperature ($23 \pm 5^\circ \text{C}$; $73.4 \pm 9^\circ \text{F}$).

(c) Within 5 minutes after removing the container from the fluid or oil, remove excess liquid from the surface of the container by wiping with a clean dry cloth.

S7. Auxiliary test methods and reagent standards.

S7.1 Distilled water. Nonreferee reagent water as specified in ASTM D1193-70 (incorporated by reference, see §571.5) or water of equal purity.

S7.2 Water content of motor vehicle brake fluids. Use analytical methods based on ASTM D1123-59 (incorporated by reference, see §571.5) for determining the water content of brake fluids, or other methods of analysis yielding comparable results. To be acceptable for use, such other method must measure the weight of water added to samples of the SAE RM-66-04 (see Appendix A of SAE Standard J1703 NOV83 (incorporated by reference in §571.5)) and TEGME Compatibility Fluids (see Appendix B of SAE Standard J1703 JAN95 (incorporated by reference in §571.5)) within ± 15 percent of the water added for additions up to 0.8 percent by weight, and within ± 5 percent of the water added for additions greater than 0.8 percent by weight. The SAE RM-66-04 Compatibility Fluid used to prepare the samples must have an original ERBP of not less than 205°C (401°F) when tested in accordance with S6.1. The SAE TEGME fluid used to prepare the samples must have an original ERBP of not less than 240°C (464°F) when tested in accordance with S6.1.

S7.3 Ethanol. 95 percent (190 proof) ethyl alcohol, USP or ACS, or Formula 3-A Specially Denatured Alcohol of the same concentration (as specified at 27 CFR 21.35). For pretest washings of equipment, use approximately 90 percent ethyl alcohol, obtained by adding 5 parts of distilled water to 95 parts of ethanol.

S7.4 Measuring the hardness of SBR brake cups. Hardness measurements on SBR wheel cylinder cups and master cylinder primary cups shall be made by using the following apparatus and the following procedure.

S7.4.1 Apparatus.

(a) **Anvil.** A rubber anvil having a flat circular top 20 ± 1 mm. ($13/16 \pm 1/16$ inch) in diameter, a thickness of at least 9 mm. ($3/8$ inch) and a hardness within 5 IRHDs of the SBR test cup.

(b) **Hardness tester.** A hardness tester meeting the requirements for the standard instrument as described

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in ASTM D1415-68 (incorporated by reference, see §571.5) and graduated directly in IRHD units.

S7.4.2 Procedure. Make hardness measurements at $23^{\circ} \pm 2^{\circ} \text{C}$. ($73.4^{\circ} \pm 4^{\circ} \text{F}$.). Equilibrate the tester and anvils at this temperature prior to use. Center brake cups lip side down on an anvil of appropriate hardness. Following the manufacturer's operating instructions for the hardness tester, make one measurement at each of four points 6 mm from the center of the cup and spaced 90° apart. Average the four values, and round off to the nearest IRHD.

S7.5 Sediment by centrifuging. The amount of sediment in the test fluid shall be determined by the following procedure.

S7.5.1 Apparatus.

(a) **Centrifuge tube.** Cone-shaped centrifuge tubes conforming to the dimensions given in Figure 6, and made of thoroughly annealed glass. The graduations shall be numbered as shown in Figure 6, and shall be clear and distinct. Scale-error tolerances and smallest graduations between various calibration marks are given in Table V and apply to calibrations made with air-free water at 20°C . (68°F .).

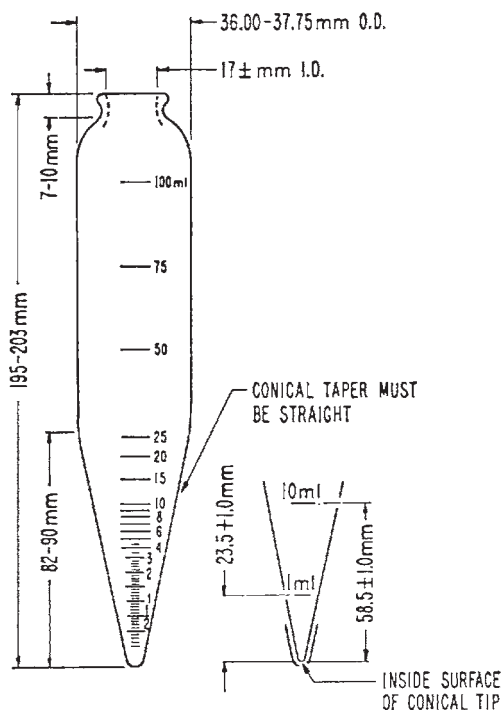


Fig 6 ASTM 8-in Centrifuge Tube

TABLE V—CALIBRATION TOLERANCES FOR 8-INCH CENTRIFUGE TUBE

RANGE, ML	SUBDIVISION, ML	VOLUME TOLERANCE, ML
0 to 0.1	0.05	± 0.02
Above 0.1 to 0.3	0.05	± 0.03
Above 0.3 to 0.5	0.05	± 0.05
Above 0.5 to 1	0.10	± 0.05

TABLE V—CALIBRATION TOLERANCES FOR 8-INCH CENTRIFUGE TUBE, Continued

RANGE, ML	SUBDIVISION, ML	VOLUME TOLERANCE, ML
Above 1 to 2	0.10	± 0.10
Above 2 to 3	0.20	± 0.10
Above 3 to 5	0.5	± 0.20
Above 5 to 10	1.	± 0.50
Above 10 to 25	5.	± 1.00
Above 25 to 100	25.	± 1.00

(b) **Centrifuge.** A centrifuge capable of whirling two or more filled centrifuge tubes at a speed which can be controlled to give a relative centrifugal force (r.c.f.) between 600 and 700 at the tip of the tubes. The revolving head, trunnion rings, and trunnion cups, including the rubber cushion, shall withstand the maximum centrifugal force capable of being delivered by the power source. The trunnion cups and cushions shall firmly support the tubes when the centrifuge is in motion.

Calculate the speed of the rotating head using this equation:

$$\text{r.p.m.} = 265 \left[\sqrt{25.4 \times \text{r.c.f.} / d} \right]$$

Where:

r.c.f. = Relative centrifugal force, and

d = Diameter of swing, in millimeters, measured between tips of opposing tubes when in rotating position.

Table VI shows the relationship between diameter, swing, relative centrifugal force (r.c.f.), and revolutions per minute.

TABLE VI—ROTATION SPEEDS FOR CENTRIFUGES OF VARIOUS DIAMETERS

Diameter of swing, inches ^a	r.p.m. at 600 r.c.f.	r.p.m. at 700 r.c.f.
483	1490	1610
508	1450	1570
533	1420	1530
559	1390	1500

^aMeasured in millimeters between tips of opposite tubes when in rotating position.

S7.5.2 Procedure. Balance the corked centrifuge tubes with their respective trunnion cups in pairs by weight on a scale, according to the centrifuge manufacturer's instructions, and place them on opposite sides of the centrifuge head. Use a dummy assembly when one sample is tested. Then whirl them for 10 minutes, at a rate sufficient to produce a r.c.f. between 600 and 700 at the tips of the whirling tubes. Repeat until the volume of sediment in each tube remains constant for three consecutive readings.

S7.5.3 Calculation. Read the volume of the solid sediment at the bottom of the centrifuge tube and report the percent sediment by volume. Where replicate determinations are specified, report the average value.

S7.6 Standard styrene-butadiene rubber (SBR) brake cups. SBR brake cups for testing motor vehicle brake fluids shall be manufactured using the following formulation:

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FORMULATION OF RUBBER COMPOUND

Ingredient	Parts by weight
SBR type 1503 ^a	100
Oil furnace black (NBS 378)	40
Zinc oxide (NBS 370)	5
Sulfur (NBS 371).....	0.25
Stearic Acid (NBS 372).....	1
n-tertiary butyl-2-benzothiazole sulfenamide (NBS 384) .	1
Symmetrical dibetanaphthyl-p-phenylenediamine	1.5
Dicumyl peroxide (40 percent on precipitated CaCO ₃) ^b	4.5
Total.....	153.25

^aPhilprene 1503 has been found suitable.

^bUse only within 90 days of manufacture and store at temperature below 27° C. (80° F.).

NOTE: The ingredients labeled (NBS) must have properties identical with those supplied by the National Bureau of Standards.

Compounding, vulcanization, physical properties, size of the finished cups, and other details shall be as specified in appendix B of SAE Standard J1703b (1970) (incorporated by reference, see §571.5). The cups shall be used in testing brake fluids either within 6 months from date of manufacture when stored at room temperature below 30 °C (86 °F) or within 36 months from date of manufacture when stored at temperatures below minus 15 °C (+5 °F). After removal of cups from refrigeration they shall be conditioned base down on a flat surface for at least 12 hours at room temperature in order to allow cups to reach their true configuration before measurement.

S7.7 Isopropanol. ACS or reagent grade.

EDITORIAL NOTE: For *Federal Register* citations affecting §571.116, see the List of Sections Affected, which appears in the Finding Aids section of the printed volume and on GPO Access.

§571.119 Standard No. 119; New pneumatic tires for motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds) and motorcycles.

S1. Scope. This standard establishes performance and marking requirements for tires for use on motor vehicles with a GVWR of more than 10,000 pounds and motorcycles.

S2. Purpose. The purpose of this standard is to provide safe operational performance levels for tires used on motor vehicles with a GVWR of more than 10,000 pounds, trailers, and motorcycles, and to place sufficient information on the tires to permit their proper selection and use.

S3. Application. This standard applies to new pneumatic tires designed for highway use on motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds), trailers, and motorcycles manufactured after 1948.

S4. Definitions. All terms defined in the Act and the rules and standards issued under its authority are used as defined therein.

Light truck tire means a tire designated by its manufacturer as primarily intended for use on lightweight trucks or multipurpose passenger vehicles.

Model rim assembly means a test device that (a) includes a rim which conforms to the published dimensions of a commercially available rim, (b) includes an air valve assembly when used for testing tubeless tires or an innertube and flap (as required) when used for testing tubetype tires, and (c) undergoes no permanent rim deformation and allows no loss of air through the portion that it comprises of the tire-rim pressure chamber when a tire is properly mounted on the assembly and subjected to the requirements of this standard.

S5. Tire and rim matching information.

S5.1 Each manufacturer of tires shall ensure that a listing of the rims that may be used with each tire that he produces is provided to the public. For purposes of this section each rim listing shall include dimensional specifications and a diagram of the rim. However a listing compiled in accordance with paragraph (a) of this section need not include dimensional specifications or a diagram of a rim if the rim's dimensional specifications and diagram are contained in each listing published in

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accordance with paragraph (b) of this standard. The listing shall be in one of the following forms:

(a) Listed by manufacturer name or brand name in a document furnished to dealers of the manufacturer's tires to any person upon request and in duplicate to: Docket Section, National Highway Safety Administration, 400 Seventh Street SW., Washington, DC 20590; or

(b) Contained in publications, current at the date of manufacture of the tire or any later date, of at least one of the following organizations:

The Tire and Rim Association

The European Tyre and Rim Technical Organization

Japan Automobile Tire Manufacturers' Association, Inc

Deutsche Industrie Norm

British Standards Institution

Scandinavian Tire and Rim Organization

The Tyre and Rim Association of Australia

S5.2 Information contained in a publication specified in S5.1(b) which lists general categories of tires and rims by size designation, type of construction, and/or intended use, shall be considered to be manufacturer's information pursuant to S5.1 for the listed tires, unless the publication itself or specific information provided according to S5.1(a) indicates otherwise.

S6. Requirements. Each tire shall be capable of meeting any of the applicable requirements set forth below, when mounted on a model rim assembly corresponding to any rim designated by the tire manufacturer for use with the tire in accordance with S5. However, a particular tire need not meet further requirements after having been subjected to and met the endurance test (S6.1), strength test (S6.2), or high speed performance test (S6.3).

S6.1 Endurance.

S6.1.1 Prior to testing in accordance with the procedures of S7.2, a tire shall exhibit no visual evidence of tread, side-wall, ply, cord, innerliner, or bead separation, chunking, broken cords, cracking, or open splices.

S6.1.2 When tested in accordance with the procedures of S7.2:

(a) There shall be no visual evidence of tread, sidewall, ply, cord, innerliner, or bead separation, chunking, broken cords, cracking, or open splices.

(b) The tire pressure at the end of the test shall be not less than the initial pressure specified in S7.2(a).

S6.2 Strength. When tested in accordance with the procedures of S7.3 a tire's average breaking energy value shall be not less than the value specified in Table II for that tire's size and load range.

S6.3 High speed performance. When tested in accordance with the procedures of S7.3, a tire shall meet the requirements set forth in S6.1.1 and S6.1.2 (a) and (b). However, this requirement applies only to motorcycle tires and to non-speed-restricted tires of 14.5 or less marked load range A, B, C, or D.

S6.4 Treadwear indicators. Except as specified below, each tire shall have at least six treadwear indicators spaced approximately equally around the circumference of the tire that enable a person inspecting the tire to determine visually whether the tire has worn to a tread depth of 1.6 mm (one-sixteenth of an inch). Tires with a rim diameter code of 12 or smaller shall

have at least three such treadwear indicators. Motorcycle tires shall have at least three such indicators which permit visual determination that the tire has worn to a tread depth of 0.8 mm (one-thirty-second of an inch).

S6.5 Tire markings. Except as specified below, each tire shall be marked on each sidewall with the information specified in paragraphs (a) through (j) of this section. The markings shall be placed between the maximum section width (exclusive of sidewall decorations or curb ribs) and the bead on at least one sidewall, unless the maximum section width of the tire is located in an area which is not more than one-fourth of the distance from the bead to the shoulder of the tire. If the maximum section width falls within that area, the markings shall appear between the bead and a point one-half the distance from the bead to the shoulder of the tire, on at least one sidewall. The markings shall be in letters and numerals not less than 2 mm (0.078 inch) high and raised above or sunk below the tire surface not less than 0.4 mm (0.015 inch), except that the marking depth shall be not less than 0.25 mm (0.010 inch) in the case of motorcycle tires. The tire identification and the DOT symbol labeling shall comply with Part 574 of this chapter. Markings may appear on only one sidewall and the entire sidewall area may be used in the case of motorcycle tires and recreational, boat, baggage, and special trailer tires.

(a) The symbol DOT, which shall constitute a certification that the tire conforms to applicable Federal motor vehicle safety standards. This symbol may be marked on only one sidewall.

(b) The tire identification number required by Part 574 of this chapter. This number may be marked on only one side-wall.

(c) The tire size designation as listed in the documents and publications designated in S5.1.

(d) The maximum load rating and corresponding inflation pressure of the tire, shown as follows:

(Mark on tires rated for single and dual load):

Max load single ____ kg (____ lb) at ____ kPa (____ psi) cold.

Max load dual ____ kg (____ lb) at ____ kPa (____ psi) cold.

(Mark on tires rated only for single load:)

Max load ____ kg (____ lb) at ____ kPa (____ psi) cold.

(e) The speed restriction of the tire, if 90 km/h (55 mph) or less, shown as follows:

Max speed ____ km/h (____ mph).

(f) The actual number of plies and the composition of the ply cord material in the sidewall, and, if different, in the tread area.

(g) The words "tubeless" or "tube type" as applicable.

(h) The word "regroovable" if the tire is designed for re-grooving.

(i) The word "radial" if a radial tire.

(j) The letter designating the tire load range.

S6.6 Maximum load rating. If the maximum load rating for a particular tire size is shown in one or more of the publications described in S5.1(b), each tire of that size designation shall have a maximum load rating that is not less than the published maximum load rating, or

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if there are differing published ratings for the same tire size designation, not less than the lowest published maximum load rating for the size designation.

S7. Test procedures.

S7.1 General conditions.

S7.1.1 The tests are performed using an appropriate new tube, tube valve and flap assembly (as required) that allows no loss of air for testing of tube-type tires under S7.2, S7.3, and S7.4, and tubeless tires under S7.3.

S7.1.2 The tire must be capable of meeting the requirements of S7.2 and S7.4 when conditioned to a temperature of 35° C (95° F) for 3 hours before the test is conducted, and with an ambient temperature maintained at 35° C (95° F) during all phases of testing. The tire must be capable of meeting the requirements of S7.3 when conditioned at a temperature of 21° C (70° F) for 3 hours before the test is conducted.

S7.2 Endurance. (a) Mount the tire on a model rim assembly and inflate it to the inflation pressure corresponding to the maximum load rating marked on the tire. Use single maximum load value when the tire is marked with both single and dual maximum load.

(b) After conditioning the tire-rim assembly in accordance with S7.1.2, adjust the tire pressure to that specified in (a) immediately before mounting the tire rim assembly.

(c) Mount the tire-rim assembly on an axle and press it against a flat-faced steel test wheel that is 1708 mm (67.23 inches) in diameter and at least as wide as the tread of the tire.

(d) Apply the test load and rotate the test wheel as indicated in Table III for the type of tire tested conducting each successive phase of the test without interruption.

(e) Immediately after running the tire the required time, measure the tire inflation pressure. Remove the tire from the model rim assembly, and inspect the tire.

S7.3 Strength. (a) Mount the tire on a model rim assembly and inflate it to the pressure corresponding to the maximum load, or maximum dual load where there is both a single and dual load marked on the tire. If the tire is tubeless, a tube may be inserted to prevent loss of air during the test in the event of puncture.

(b) After conditioning the tire-rim assembly in accordance with S7.1.2, adjust the tire pressure to that specified in (a).

(c) Force a cylindrical steel plunger, with a hemispherical end and of the diameter specified in Table I for the tire size, perpendicularly into a raised tread element as near as possible to the centerline of the tread, at a rate of 50 mm (2 inches) per minute, until the tire breaks or the plunger is stopped by the rim.

(d) Record the force and the distance of penetration just before the tire breaks, or if it fails to break, just before the plunger is stopped by the rim.

(e) Repeat the plunger application at 72° intervals around the circumference of the tire, until five measurements are made. However, in the case of tires of 12-in rim diameter or smaller, repeat the plunger application at 120° intervals around the circumference of the tire, until three measurements are made.

(f) Compute the breaking energy for each test point by one of the two following formulas:

$$(1) W = [(F \times P)/2] \times 10^{-3} \text{ (joules)}$$

Where:

W=Breaking energy (in joules) (kJ)

F=Force in newtons (N) and

P=Penetration in millimeters (mm), or;

$$(2) W = (FP/2)$$

Where:

W= Breaking energy in inch-pounds,

F=Force in pounds,

P=Penetration in inches.

(g) Determine the average breaking energy value for the tire by computing the average of the values obtained in accordance with paragraph (f).

S7.4 High speed performance. (a) Perform steps (a) through (c) of S7.2.

(b) Apply a force of 88 percent of the maximum load rating marked on the tire (use single maximum load value when the tire is marked with both single and dual maximum loads), and rotate the test wheel at 250 rpm for 2 hours.

(c) Remove the load, allow the tire to cool to 35° C (95° F), and then adjust the pressure to that marked on the tire for single tire use.

(d) Reapply the same load, and without interruption or readjustment of inflation pressure, rotate the test wheel at 375 rpm for 30 minutes, then at 400 rpm for 30 minutes, and then at 425 rpm for 30 minutes.

(e) Immediately after running the tire the required time, measure the tire inflation pressure. Remove the tire from the model rim assembly, and inspect the tire.

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TABLE I—STRENGTH TEST PLUNGER DIAMETER

Tire type:	Plunger diameter	
	(mm)	(inches)
Light truck	19.05	¾
Motorcycle.....	7.94	5/16
≤ 12 rim diameter code (except motorcycle)	19.05	¾
Tubeless:		
≤ 17.5 rim diameter code.....	19.05	¾
>17.5 rim diameter code, load range F or less.....	31.75	1¼
> 17.5 rim diameter code, load range over F	38.10	1½
Tube-type:		
Load range F or less	31.75	1¼
Load range over F	38.10	1½

TABLE II.—MINIMUM STATIC BREAKING ENERGY
(Joules (J) and Inch-Pounds (inch-lbs))

Tire characteristic	Motorcycle		All 12 rim diameter code or smaller except motorcycle		Light truck and 17.5 rim diameter code or smaller Tubeless		Tires other than Light Truck, Motorcycle, 12 rim diameter code or smaller							
							Tube type		Tubeless greater than 17.5 rim diameter code		Tube type		Tubeless greater than 17.5 rim diameter code	
Plunger diameter (mm and inches)	7.94 mm	5/16"	19.05 mm	3/4"	19.05 mm	3/4"	31.75 mm	1 1/4"	31.75 mm	1 1/4"	38.10 mm	1 1/2"	38.10 mm	1 1/2"
Breaking Energy	J	In-lbs	J	In-lbs	J	In-lbs	J	In-lbs	J	In-lbs	J	In-lbs	J	In-lbs
Load Range:														
A	16	150	67	600	225	2,000	.....	.....	.....	.....	.....	.....	.....	.....
B	33	300	135	1,200	293	2,600	.....	.....	.....	.....	.....	.....	.....	.....
C	45	400	203	1,800	361	3,200	768	6,800	576	5,100	.....	.....	.....	.....
D .....	.....	.....	271	2,400	514	4,550	892	7,900	734	6,500	.....	.....	.....	.....
E .....	.....	.....	338	3,000	576	5,100	1,412	12,500	971	8,600	.....	.....	.....	.....
F .....	.....	.....	406	3,600	644	5,700	1,785	15,800	1,412	12,500	.....	.....	.....	.....
G .....	.....	.....	.....	.....	711	6,300	.....	.....	.....	.....	2,282	20,200	1,694	15,000
H .....	.....	.....	.....	.....	768	6,800	.....	.....	.....	.....	2,598	23,000	2,090	18,500
J .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,824	25,000	2,203	19,500
L .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,050	27,000	.....	.....
M .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,220	28,500	.....	.....
N .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,389	30,000	.....	.....

TABLE III.—ENDURANCE TEST SCHEDULE

Description	Load range	Test wheel speed		Test load: Percent of maximum load rating			Total test revolutions (thousands)
		km/h	r/m	I—7 hours	II—16 hours	III—24 hours	
Speed restricted service:							
90 km/h (55 mph)	F, G, H, J, L, M, N.....	40	125	66	84	101	352.0
80 km/h (50 mph)	F, G, H, J, L	32	100	66	84	101	282.5
56 km/h (35 mph)	All	24	75	66	84	101	211.0
Motorcycle.....	All	80	250	¹ 100	² 108	117	510.0
All other	F.....	64	200	66	84	101	564.0
	G	56	175	66	84	101	493.5
	H, J, L, N.....	48	150	66	84	101	423.5

¹4 hr. for tire sizes subject to high speed requirements (S6.3).²6 hr. for tire sizes subject to high speed requirements (S6.3).

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§571.120 Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information for motor vehicles with a GVWR of more than 4,536 kilograms (10,000 pounds).

S1. Scope. This standard specifies tire and rim selection requirements, rim marking requirements and motor home/recreation vehicle trailer load carrying capacity information.

S2. Purpose. The purpose of this standard is to provide safe operational performance by ensuring that vehicles to which it applies are equipped with tires of adequate size and load rating and with rims of appropriate size and type designation, and by ensuring that consumers are informed of motor home/recreation vehicle trailer load carrying capacity.

S3. Application. This standard applies to multipurpose passenger vehicles, trucks, buses, trailers, and motor cycles, to rims for use on those vehicles, and to non-pneumatic spare tire assemblies for use on those vehicles.

S4. Definitions. All terms defined in the Act and the rules and standards issued under its authority are used as defined therein.

Rim base means the portion of a rim remaining after removal of all split or continuous rim flanges, side rings, and locking rings that can be detached from the rim.

Rim size designation means rim diameter and width.

Rim diameter means nominal diameter of the bead seat.

Rim width means nominal distance between rim flanges.

Rim type designation means the industry or manufacturer's designation for a rim by style or code.

Weather side means the surface area of the rim not covered by the inflated tire.

S5. Requirements.

S5.1 Tire and rim selection.

S5.1.1 Except as specified in S5.1.3, each vehicle equipped with pneumatic tires for highway service shall be equipped with tires that meet the requirements of §571.119, New pneumatic tires for motor vehicles with a GVWR of more than 10,000 pounds, and rims that are listed by the manufacturer of the tires as suitable for use with those tires, in accordance with S5.1 of §571.119, except that vehicles may be equipped with a non-pneumatic spare tire assembly that meets the requirements of §571.129, New non-pneumatic tires for passenger cars, and S8 of this standard. Vehicles equipped with such an assembly shall meet the requirements of S5.3.3, S7, and S9 of this standard.

S5.1.2 Except in the case of a vehicle which has a speed attainable in 3.2 kilometers of 80 kilometers per hour or less, the sum of the maximum load ratings of the tires fitted to an axle shall be not less than the gross axle weight rating (GAWR) of the axle system as specified on the vehicle's certification label required by 49 CFR part 567.

Except in the case of a vehicle which has a speed attainable in 2 miles of 50 mph or less, the sum of the maximum load ratings of the tires fitted to an axle shall be not less than the gross axle weight rating (GAWR) of the axle system as specified on the vehicle's certification label required by 49 CFR part 567. If the certification label shows more than one GAWR for the axle system, the sum shall be not less than the GAWR corresponding to the size designation of the tires fitted to the axle. If the size designation of the tires fitted to the axle does not appear on the certification label, the sum shall be not less than the lowest GAWR appearing on the label. When a tire subject to FMVSS No. 109 or 139 is installed on a multipurpose passenger vehicle, truck, bus, or trailer, the tire's load rating shall be reduced by dividing by 1.10 before calculating the sum (*i.e.*, the sum of the load ratings of the tires on each axle, when the tires' load carrying capacity at the recommended tire cold inflation pressure is reduced by dividing by 1.10, must be appropriate for the GAWR).

S5.1.3 In place of tires that meet the requirements of Standard No. 119, a truck, bus, or trailer may at the request of a purchaser be equipped at the place of manufacture of the vehicle with retreaded or used tires owned or leased by the purchaser, if the sum of the maximum load ratings meets the requirements of S5.1.2. Used tires employed under this provision must have been originally manufactured to comply with Standard No. 119, as evidenced by the DOT symbol.

S5.2 Rim marking. Each rim or, at the option of the manufacturer in the case of a singlepiece wheel, wheel disc shall be marked with the information listed in paragraphs (a) through (e) of this paragraph, in lettering not less than 3 millimeters high, impressed to a depth or, at the option of the manufacturer, embossed to a height of not less than 0.125 millimeters. The information listed in paragraphs (a) through (c) of this paragraph shall appear on the weather side. In the case of rims of multipiece construction, the information listed in paragraphs (a) through (e) of this paragraph shall appear on the rim base and the information listed in paragraphs (b) and (d) of this paragraph shall also appear on each other part of the rim.

(a) A designation which indicates the source of the rim's published nominal dimensions, as follows:

- (1) "T" indicates The Tire and Rim Association.
- (2) "E" indicates The European Tyre and Rim Technical Organization
- (3) "J" indicates Japan Automobile Tire Manufacturers' Association, Inc.
- (4) "D" indicates Deutsche Industrie Norm.
- (5) "B" indicates British Standards Institution.
- (6) "S" indicates Scandinavian Tire and Rim Organization.
- (7) "A" indicates The Tyre and Rim Association of Australia.
- (8) "N" indicates an independent listing pursuant to S4.4.1(a) of Standard No. 109 or S5.1(a) of Standard No. 119.

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(b) The rim size designation, and in case of multipiece rims, the rim type designation. For example: 20 x 5.50, or 20 x 5.5.

(c) The symbol DOT, constituting a certification by the manufacturer of the rim that the rim complies with all applicable motor vehicle safety standards.

(d) A designation that identifies the manufacturer of the rim by name, trademark, or symbol.

(e) The month, day, and year, or the month and year of manufacture, expressed either numerically or by use of a symbol, at the option of the manufacturer. For example,

“September 4, 1976” may be expressed as:

90476,	904,	or	76
	76		904

“September 1976” may be expressed as:

976,	9,	or	76
	76		9

S5.2(e)(1) Any manufacturer that elects to express the date of manufacture by means of a symbol shall notify NHTSA in writing of the full names and addresses of all manufacturers and brand name owners utilizing that symbol and the name and address of the trademark owner of that symbol, if any. The notification shall describe in narrative form and in detail how the month, day, and year or the month and year are depicted by the symbol. Such description shall include an actual size graphic depiction of the symbol, showing and/or explaining the interrelationship of the component parts of the symbol as they will appear on the rim or single piece wheel disc, including dimensional specifications, and where the symbol will be located on the rim or single piece wheel disc. The notification shall be received by NHTSA at least 60 calendar days prior to first use of the symbol. The notification shall be mailed to the Office of Vehicle Safety Compliance, National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, DC 20590. All information provided to NHTSA under this paragraph will be placed in the public docket.

(2) Each manufacturer of wheels shall provide an explanation of its date of manufacture symbol to any person upon request.

S5.3 Label information. Each vehicle with a gross vehicle weight rating (GVWR) of more than 10,000 pounds, and motorcycles, shall show the information specified in S5.3.1 and S5.3.2 and, in the case of a vehicle equipped with a non-pneumatic spare tire, the information specified in S5.3.3, in the English language, lettered in block capitals and numerals not less than 2.4 millimeters high and in the format set forth following this paragraph. This information shall appear either—

(a) After each GAWR listed on the certification label required by §567.4 or §567.5 of this chapter; or at the option of the manufacturer,

(b) On the tire information label affixed to the vehicle in the manner, location, and form described in §567.4 (b) through (f) of this chapter as appropriate of each GVWR-GAWR combination listed on the certification label.

S5.3.1 Tires. The size designation (not necessarily for the tires on the vehicle) and the recommended cold inflation pressure for those tires such that the sum of the load ratings of the tires on each axle (when the tires' load carrying capacity at the specified pressure is reduced by dividing by 1.10, in the case of a tire subject to FMVSS No. 109) is appropriate for the GAWR as calculated in accordance with S5.1.2.

S5.3.2 Rims. The size designation and, if applicable, the type designation of Rims (not necessarily those on the vehicle) appropriate for those tires.

TRUCK EXAMPLE

SUITABLE TIRE - RIM CHOICE

GVWR:	7,840 kg (17,289 LB)
GAWR:	FRONT—2,850 kg (6,280 LB) WITH 7.50—20 (D) TIRES, 20 x 6.00 RIMS AT 520 kPa (75 psi) COLD SINGLE.
GAWR:	REAR—4,990 kg (11,000 LB) WITH 7.50—20 (D) TIRES, 20 x 6.00 RIMS, AT 450 kPa (65 psi) COLD DUAL.
GVWR:	13,280 kg (29,279 LB).
GAWR:	FRONT—4,826 kg (10,640 LB) WITH 10.00—20 (F) TIRES, 20 x 7.50 RIMS, AT 620 kPa (90 psi) COLD SINGLE.
GAWR:	REAR—8,454 kg (18,639 LB) WITH 10.00—20 (F) TIRES, 20 x 7.50 RIMS, AT 550 kPa (80 psi) COLD DUAL.

S6 Load Limits for Non-Pneumatic Spare Tires. The highest vehicle maximum load on the tire for the vehicle shall not be greater than the load rating for the non-pneumatic spare tire.

S7 Labeling Requirements for Non-Pneumatic Spare Tires or Tire Assemblies. Each non-pneumatic tire or, in the case of a non-pneumatic tire assembly in which the non-pneumatic tire is an integral part of the assembly, each non-pneumatic tire assembly shall include, in letters or numerals not less than 0.156 inches high, the information specified in paragraphs S7 (a) and (b). The information shall be permanently molded, stamped, or otherwise permanently marked into or onto the non-pneumatic tire or non-pneumatic tire assembly, or shall appear on a label that is permanently attached to the tire or tire assembly. If a label is used, it shall be subsurface printed, made of material that is resistant to fade, heat, moisture and abrasion, and attached in such a manner that it cannot be removed without destroying or defacing the label on the non-pneumatic tire or tire assembly. The information specified in paragraphs S7 (a) and (b) shall appear on both sides of the non-pneumatic tire or tire assembly, except, in the case of a non-pneumatic tire assembly which has a particular side that must always face outward when mounted on a vehicle, in which case the information specified in paragraphs S7 (a) and (b) shall only be required on the outward facing side. The information shall be positioned on the tire or tire assembly such that it is not placed on the tread or the outermost edge of the tire and is not obstructed by any portion of any non-pneumatic rim or wheel center member designated for use with that tire in this standard or in Standard No. 129.

(a) FOR TEMPORARY USE ONLY; and

(b) MAXIMUM 50 M.P.H.

S8. Requirements for Vehicles Equipped with Non-Pneumatic Spare Tire Assemblies.

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S8.1 Vehicle Placarding Requirements. A placard, permanently affixed to the inside of the spare tire stowage area or equally accessible location adjacent to the non-pneumatic spare tire assembly, shall display the information set forth in S7 in block capitals and numerals not less than 0.25 inches high preceded by the words “IMPORTANT—USE OF SPARE TIRE” in letters not less than 0.375 inches high.

S8.2 Supplementary Information. The owner’s manual of the vehicle shall contain, in writing in the English language and in not less than 10 point type, the following information under the heading “IMPORTANT—USE OF SPARE TIRE”:

(a) A statement indicating the information related to appropriate use for the non-pneumatic spare tire including at a minimum the information set forth in S8 (a) and (b) and either the information set forth in S5.3.6 or a statement that the information set forth in S5.3.6 is located on the vehicle placard and on the non-pneumatic tire;

(b) An instruction to drive carefully when the non-pneumatic spare tire is in use, and to install the proper pneumatic tire and rim at the first reasonable opportunity; and

(c) A statement that operation of the vehicle is not recommended with more than one non-pneumatic spare tire in use at the same time.

S9. Non-Pneumatic Rims and Wheel Center Members.

S9.1 Non-Pneumatic Rim Requirements. Each non-pneumatic rim that is part of a separable non-pneumatic spare tire assembly shall be constructed to the dimensions of a non-pneumatic rim that is listed pursuant to S4.4 of §571.129 for use with the non-pneumatic tire, designated by its non-pneumatic tire identification code, with which the vehicle is equipped.

S9.2 Wheel Center Member Requirements. Each wheel center member that is part of a separable non-pneumatic spare tire assembly shall be constructed to the dimensions of a wheel center member that is listed pursuant to S4.4 of §571.129 for use with the non-pneumatic tire, designated by its non-pneumatic tire identification code, with which the vehicle is equipped.

S10. Each motor home and recreation vehicle (RV) trailer must meet the applicable requirements in S10.

S10.1 On motor homes, the sum of the gross axle weight ratings (GAWR) of all axles on the vehicle must not be less than the gross vehicle weight rating (GVWR).

S10.2 On RV trailers, the sum of the GAWRs of all axles on the vehicle plus the vehicle manufacturer’s recommended tongue weight must not be less than the GVWR. If tongue weight is specified as a range, the minimum value must be used.

S10.3 The tires on each motor home and RV trailer at first retail sale must be the same size as the tire size on the labeling required by S5.3.

S10.4 Each motor home and RV trailer single stage or final stage manufacturer must affix either a motor home occupant and cargo carrying capacity (OCCC) label (Figure 1) or a RV trailer cargo carrying capacity (CCC)

label (Figure 2) to its vehicles that meets the following criteria:

S10.4.1 The RV load carrying capacity labels (Figures 1 and 2) must be legible, visible, moisture resistant, presented in the English language, have a minimum print size of 2.4 millimeters ($\frac{3}{32}$ inches) high and be printed in black print on a yellow background.

S10.4.2 The weight value for load carrying capacity on the RV load carrying capacity labels (Figures 1 and 2) must be displayed to the nearest kilogram with conversion to the nearest pound and must be such that the vehicle’s weight does not exceed its GVWR when loaded with the stated load carrying capacity. The UVW and the GVWR used to determine the RV’s load carrying capacity must reflect the weights and design of the motor home or RV trailer as configured for delivery to the dealer/service facility. If applicable, the weight of full propane tanks must be included in the RV’s UVW and the weight of on-board potable water must be treated as cargo.

S10.4.3 The RV load carrying capacity labels (Figures 1 and 2) must be:

(a) Permanently affixed and must be visibly located on the interior of the forward-most exterior passenger door on the right side of the vehicle; or

(b) If a permanent RV load carrying capacity label (Figure 1 or 2) is affixed in the location specified at S5.3(b), a temporary version of the RV load carrying capacity label (Figure 1 or 2) may be visibly located on the interior of the forward-most exterior passenger door on the right side of the vehicle.

S10.4.4 Permanent and temporary motor home OCCC labels must contain the following information in accordance with Figure 1:

(a) The statement: “MOTOR HOME OCCUPANT AND CARGO CARRYING CAPACITY” in block letters.

(b) The Vehicle Identification Number (VIN).

(c) The statement “THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED: XXX kg or XXX lbs” in block letters with appropriate values included.

(d) The statement “Safety belt equipped seating capacity: XXX” with the appropriate value included. This is the total number of safety belt equipped seating positions.

(e) The statement: “CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal) and the tongue weight of a towed trailer counts as cargo” with appropriate values included.

S10.4.5 Permanent and temporary RV trailer CCC labels must contain the following information in accordance with Figure 2:

(a) The statement: “RECREATION VEHICLE TRAILER CARGO CARRYING CAPACITY” in block letters.

(b) The Vehicle Identification Number (VIN).

(c) The statement: “THE WEIGHT OF CARGO SHOULD NEVER EXCEED: XXX kg or XXX lbs” in block letters with appropriate values included.

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(d) The statement: “CAUTION: A full load of water equals XXX kg or XXX lbs of cargo @ 1 kg/L (8.3 lb/gal)” with appropriate values included.

S10.5 Weight added to motor homes and RV trailers between final vehicle certification and first retail sale of the vehicle.

S10.5.1 If weight exceeding 45.4 kg (100 pounds) is added to a motor home or RV trailer between final vehicle certification and first retail sale of the vehicle, the load carrying capacity values on the RV load carrying capacity labels (Figures 1 and 2) required by S10.4 must be corrected using one or a combination of the following methods:

(a) Permanently affix the load carrying capacity modification label (Figure 3) which displays the amount the load carrying capacity is reduced to the nearest kilogram with conversion to the nearest pound, within 25 millimeters of the original, permanent RV load carrying capacity label (Figure 1 or 2). The load carrying capacity modification label must be legible, visible, permanent, moisture resistant, presented in the English language, have a minimum print size of 2.4 millimeters (3/32 inches) high and be printed in black print on a yellow background. If the manufacturer selects S10.4.3(b), apply a temporary version of the load carrying capacity modification label (Figure 3) within 25 millimeters of the original, temporary RV load carrying capacity label (Figure 1 or 2) on the interior of the forward-most exterior passenger door on the right side of the vehicle. Both temporary and permanent versions of the load carrying capacity modification label (Figure 3) may be printed without values and values may be legibly applied to the label with a black, fine point, indelible marker. The label must contain the statements “CAUTION—LOAD CAR-

RYING CAPACITY REDUCED” in block letters and “Modifications to this vehicle have reduced the original load carrying capacity by XXX kg or XXX lbs” in accordance with Figure 3 with appropriate values in place of XXX. If two load carrying capacity modification labels are required (one permanent and one temporary), the weight values on each must agree, or

(b) Modify the original permanent RV load carrying capacity label (Figure 1 or 2) with correct load carrying capacity weight values. If the manufacturer selects S10.4.3(b), the temporary RV load carrying capacity label (Figure 1 or 2) must also be modified with correct load carrying capacity weight values. Modification of labels requires a machine printed overlay with printed corrected values or blanks for corrected values that may be entered with a black, fine-point, indelible marker. Crossing out old values and entering corrected values on the original label is not permissible, or

(c) Replace the original, permanent RV load carrying capacity label (Figure 1 or 2) with the same label containing correct load carrying capacity weight values. If the manufacturer selects S10.4.3(b), the temporary RV load carrying capacity label (Figure 1 or 2) must also be replaced with the same label containing correct load carrying capacity weight values.

S10.5.2 Corrected load carrying capacity weight values or the weight amount the load carrying capacity is reduced, must reflect the total weight added between final vehicle certification and first retail sale and must be accurate within one percent of the actual added weight. No re-labeling is required if the weight of the vehicle is reduced between final vehicle certification and the first retail sale.

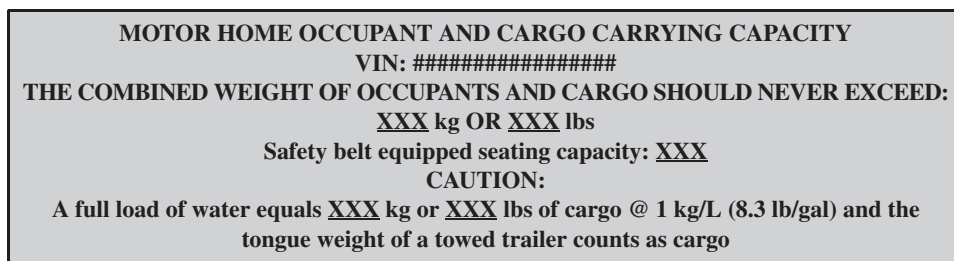


Figure 1— Motor Home Occupant and Cargo Carrying Capacity Label

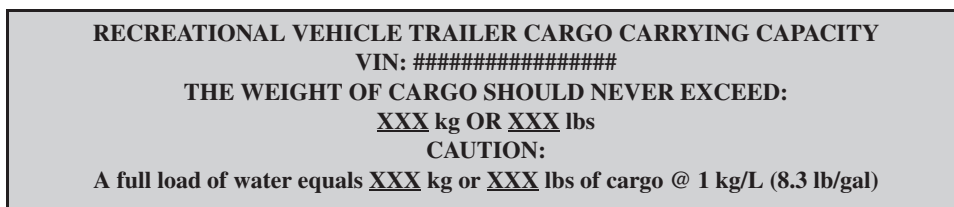


Figure 2— RV Trailer Cargo Carrying Capacity Label

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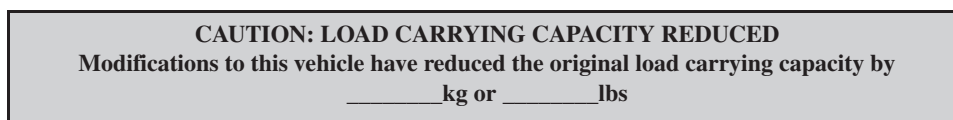


Figure 3— Load Carrying Capacity Modification Label

§571.121 Standard No. 121; Air brake systems.

S1. Scope. This standard establishes performance and equipment requirements for braking systems on vehicles equipped with air brake systems.

S2. Purpose. The purpose of this standard is to insure safe braking performance under normal and emergency conditions.

S3. Application. This standard applies to trucks, buses, and trailers equipped with air brake systems. However, it does not apply to:

(a) Any trailer that has a width of more than 102.36 inches with extendable equipment in the fully retracted position and is equipped with two short track axles in a line across the width of the trailer.

(b) Any vehicle equipped with an axle that has a gross axle weight rating (GAWR) of 29,000 pounds or more;

(c) Any truck or bus that has a speed attainable in 2 miles of not more than 33 mph;

(d) Any truck that has a speed attainable in 2 miles of not more than 45 mph, an unloaded vehicle weight that is not less than 95 percent of its gross vehicle weight rating (GVWR), and no capacity to carry occupants other than the driver and operating crew;

(e) Any trailer that has a GVWR of more than 120,000 pounds and whose body conforms to that described in the definition of heavy hauler trailer set forth in S4;

(f) Any trailer that has an unloaded vehicle weight which is not less than 95 percent of its GVWR; and

(g) Any load divider dolly.

S4. Definitions.

Agricultural commodity trailer means a trailer that is designed to transport bulk agricultural commodities in off-road harvesting sites and to a processing plant or storage location, as evidenced by skeletal construction that accommodates harvest containers, a maximum length of 28 feet, and an arrangement of air control lines and reservoirs that minimizes damage in field operations.

Air brake system means a system that uses air as a medium for transmitting pressure or force from the driver control to the service brake, including an air-over-hydraulic brake subsystem, but does not include a system that uses compressed air or vacuum only to assist the driver in applying muscular force to hydraulic or mechanical components.

Air-over-hydraulic brake subsystem means a subsystem of the air brake system that uses compressed air to transmit a force from the driver control to a hydraulic brake system to actuate the service brakes.

Antilock brake system or ABS means a portion of a service brake system that automatically controls the degree of rotational wheel slip during braking by:

(1) Sensing the rate of angular rotation of the wheels;

(2) Transmitting signals regarding the rate of wheel angular rotation to one or more controlling devices which interpret those signals and generate responsive controlling output signals; and

(3) Transmitting those controlling signals to one or more modulators which adjust brake actuating forces in response to those signals.

Auto transporter means a truck and a trailer designed for use in combination to transport motor vehicles, in that the towing vehicle is designed to carry cargo at a location other than the fifth wheel and to load this cargo only by means of the towed vehicle.

Common diaphragm means a single brake chamber diaphragm which is a component of the parking, emergency, and service brake systems.

Container chassis trailer means a semitrailer of skeleton construction limited to a bottom frame, one or more axles, specially built and fitted with locking devices for the transport of intermodal shipping containers, so that when the chassis and container are assembled, the units serve the same function as an over the road trailer.

Directly controlled wheel means a wheel for which the degree of rotational wheel slip is sensed, either at that wheel or on the axle shaft for that wheel and corresponding signals are transmitted to one or more modulators that adjust the brake actuating forces at that wheel. Each modulator may also adjust the brake actuating forces at other wheels that are on the same axle or in the same axle set in response to the same signal or signals.

Effective projected luminous lens area means that area of the projection on a plane perpendicular to the lamp axis of that portion of the light-emitting surface that directs light to the photometric test pattern, and does not include mounting hole bosses, reflex reflector area, bends or rims that may glow or produce small areas of increased intensity as a result of uncontrolled light from small areas ($\frac{1}{2}$ degree radius around the test point).

Full-treadle brake application means a brake application in which the treadle valve pressure in any of the valve's output circuits reaches 85 pounds per square inch (psi) within 0.2 seconds after the application is initiated, or in which maximum treadle travel is achieved within 0.2 seconds after the application is initiated.

Heavy hauler trailer means a trailer which has one or more of the following characteristics, but which is not a container chassis trailer:

(1) Its brake lines are designed to adapt to separation or extension of the vehicle frame; or

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(2) Its body consists only of a platform whose primary cargo-carrying surface is not more than 40 inches above the ground in an unloaded condition, except that it may include sides that are designed to be easily removable and a permanent “front end structure” as that term is used in §393.106 of this title.

Independently controlled wheel means a directly controlled wheel for which the modulator does not adjust the brake actuating forces at any other wheel on the same axle.

Indirectly controlled wheel means a wheel at which the degree of rotational wheel slip is not sensed, but at which the modulator of an antilock braking system adjusts its brake actuating forces in response to signals from one or more sensed wheel(s).

Initial brake temperature means the average temperature of the service brakes on the hottest axle of the vehicle 0.2 mile before any brake application in the case of road tests, or 18 seconds before any brake application in the case of dynamometer testing.

Intermodal shipping container means a reusable, transportable enclosure that is especially designed with integral locking devices for securing the container to the trailer to facilitate the efficient and bulk shipping and transfer of goods by, or between various modes of transport, such as highway, rail, sea and air.

Load divider dolly means a trailer composed of a trailer chassis and one or more axles, with no solid bed, body, or container attached, and which is designed exclusively to support a portion of the load on a trailer or truck excluded from all the requirements of this standard.

Maximum drive-through speed means the highest possible constant speed at which the vehicle can be driven through 200 feet of a 500-foot radius curve arc without leaving the 12-foot lane.

Maximum treadle travel means the distance that the treadle moves from its position when no force is applied to its position when the treadle reaches a full stop.

Peak friction coefficient or PFC means the ratio of the maximum value of braking test wheel longitudinal force to the simultaneous vertical force occurring prior to wheel lockup, as the braking torque is progressively increased.

Pulpwood trailer means a trailer that is designed exclusively for harvesting logs or pulpwood and constructed with a skeletal frame with no means for attachment of a solid bed, body, or container, and with an arrangement of air control lines and reservoirs designed to minimize damage in off-road operations.

Tandem axle means a group or set of two or more axles placed in a close arrangement, one behind the other, with the centerlines of adjacent axles not more than 72 inches apart.

Straddle trailer means a trailer that is designed to transport bulk agricultural commodities from the harvesting location as evidenced by a framework that is driven over the cargo and lifting arms that suspend the cargo for transit.

Wheel lockup means 100 percent wheel slip.

S5. Requirements. Each vehicle shall meet the following requirements under the conditions specified in

S6. However, at the option of the manufacturer, the following vehicles may meet the stopping distance requirements specified in Table IIa instead of Table II: Three-axle tractors with a front axle that has a GAWR of 14,600 pounds or less, and with two rear drive axles that have a combined GAWR of 45,000 pounds or less, that are manufactured before August 1, 2011; and all other tractors that are manufactured before August 1, 2013.

S5.1 Required equipment for trucks and buses. Each truck and bus shall have the following equipment:

S5.1.1 Air compressor. An air compressor of sufficient capacity to increase air pressure in the supply and service reservoirs from 85 psi to 100 psi when the engine is operating at the vehicle manufacturer's maximum recommended r.p.m. within a time, in seconds, determined by the quotient (Actual reservoir capacity x 25)/Required reservoir capacity.

S5.1.1.1 Air compressor cut-in pressure. The air compressor governor cut-in pressure for each bus shall be 85 p.s.i. or greater. The air compressor governor cut-in pressure for each truck shall be 100 p.s.i. or greater.

S5.1.2 Reservoirs. One or more service reservoir systems, from which air is delivered to the brake chambers, and either an automatic condensate drain valve for each service reservoir or a supply reservoir between the service reservoir system and the source of air pressure.

S5.1.2.1 The combined volume of all service reservoirs and supply reservoirs shall be at least 12 times the combined volume of all service brake chambers. For each brake chamber type having a full stroke at least as great as the first number in Column 1 of Table V, but no more than the second number in Column 1 of Table V, the volume of each brake chamber for purposes of calculating the required combined service and supply reservoir volume shall be either that specified in Column 2 of Table V or the actual volume of the brake chamber at maximum travel of the brake piston or pushrod, whichever is lower. The volume of a brake chamber not listed in Table V is the volume of the brake chamber at maximum travel of the brake piston or pushrod. The reservoirs of the truck portion of an auto transporter need not meet this requirement for reservoir volume.

S5.1.2.2 Each reservoir shall be capable of withstanding an internal hydrostatic pressure of five times the compressor cutout pressure or 500 psi, whichever is greater, for 10 minutes.

S5.1.2.3 Each service reservoir system shall be protected against loss of air pressure due to failure or leakage in the system between the service reservoir and the source of air pressure, by check valves or equivalent devices whose proper functioning can be checked without disconnecting any air line or fitting.

S5.1.2.4 Each reservoir shall have a condensate drain valve that can be manually operated.

S5.1.3 Towing vehicle protection system. If the vehicle is intended to tow another vehicle equipped with air brakes, a system to protect the air pressure in the towing vehicle from the effects of a loss of air pressure in the towed vehicle.

S5.1.4 Pressure gauge. A pressure gauge in each service brake system, readily visible to a person seated in

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the normal driving position, that indicates the service reservoir system air pressure. The accuracy of the gauge shall be within plus or minus 7 percent of the compressor cut-out pressure.

S5.1.5 Warning signal. A signal, other than a pressure gauge, that gives a continuous warning to a person in the normal driving position when the ignition is in the “on” (“run”) position and the air pressure in the service reservoir system is below 60 psi. The signal shall be either visible within the driver’s forward field of view, or both audible and visible.

S5.1.6 Antilock brake system.

S5.1.6.1(a) Each single-unit vehicle manufactured on or after March 1, 1998, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

(b) Each truck tractor manufactured on or after March 1, 1997, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle and the wheels of at least one rear axle of the vehicle, with the wheels of at least one axle being independently controlled. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system. A truck tractor shall have no more than three wheels controlled by one modulator.

S5.1.6.2 Antilock malfunction signal and circuit.

(a) Each truck tractor manufactured on or after March 1, 1997, and each single unit vehicle manufactured on or after March 1, 1998, shall be equipped with an indicator lamp, mounted in front of and in clear view of the driver, which is activated whenever there is a malfunction that affects the generation or transmission of response or control signals in the vehicle’s antilock brake system. The indicator lamp shall remain activated as long as such a malfunction exists, whenever the ignition (start) switch is in the “on” (“run”) position, whether or not the engine is running. Each message about the existence of such a malfunction shall be stored in the antilock brake system after the ignition switch is turned to the “off” position and automatically reactivated when the ignition switch is again turned to the “on” (“run”) position. The indicator lamp shall also be activated as a check of lamp function whenever the ignition is turned to the “on” (“run”) position. The indicator lamp shall be deactivated at the end of the check of lamp function unless there is a malfunction or a message about a malfunction that existed when the key switch was last turned to the “off” position.

(b) Each truck tractor manufactured on or after March 1, 2001, and each single unit vehicle manufactured on or after March 1, 2001, that is equipped to tow another air-braked vehicle, shall be equipped with an electrical circuit that is capable of transmitting a malfunction signal from the antilock brake system(s) on one or more towed vehicle(s) (e.g., trailer(s) and dolly(ies)) to the trailer ABS malfunction lamp in the cab of the towing vehicle, and shall have the means for connection of this electrical circuit to the towed vehicle. Each such truck tractor and single unit vehicle shall also be equipped with an indicator lamp, separate from the lamp required in S5.1.6.2(a), mounted in front of and in clear view of the

driver, which is activated whenever the malfunction signal circuit described above receives a signal indicating an ABS malfunction on one or more towed vehicle(s). The indicator lamp shall remain activated as long as an ABS malfunction signal from one or more towed vehicle(s) is present, whenever the ignition (start) switch is in the “on” (“run”) position, whether or not the engine is running. The indicator lamp shall also be activated as a check of lamp function whenever the ignition is turned to the “on” (“run”) position. The indicator lamp shall be deactivated at the end of the check of lamp function unless a trailer ABS malfunction signal is present.

(c) [Reserved]

S5.1.6.3 Antilock power circuit for towed vehicles.

Each truck tractor manufactured on or after March 1, 1997, and each single unit vehicle manufactured on or after March 1, 1998, that is equipped to tow another air-braked vehicle shall be equipped with one or more electrical circuits that provide continuous power to the antilock system on the towed vehicle or vehicles whenever the ignition (start) switch is in the “on” (“run”) position. Such a circuit shall be adequate to enable the antilock system on each towed vehicle to be fully operable.

S5.1.7 Service brake stop lamp switch. A switch that lights the stop lamps when the service brake control is statically depressed to a point that produces a pressure of 6 psi or less in the service brake chambers.

S5.1.8 Brake distribution and automatic adjustment. Each vehicle shall be equipped with a service brake system acting on all wheels.

(a) **Brake adjuster.** Wear of the service brakes shall be compensated for by means of a system of automatic adjustment. When inspected pursuant to S5.9, the adjustment of the service brakes shall be within the limits recommended by the vehicle manufacturer.

(b) **Brake indicator.** For each brake equipped with an external automatic adjustment mechanism and having an exposed pushrod, the condition of service brake under-adjustment shall be displayed by a brake adjustment indicator that is discernible when viewed with 20/40 vision from a location adjacent to or underneath the vehicle, when inspected pursuant to S5.9.

S5.2 Required equipment for trailers. Each trailer shall have the following equipment:

S5.2.1 Reservoirs. One or more reservoirs to which the air is delivered from the towing vehicle.

S5.2.1.1 The total volume of each service reservoir shall be at least eight times the combined volume of all service brake chambers serviced by that reservoir. For each brake chamber type having a full stroke at least as great as the first number in Column 1 of Table V, but no more than the second number in column 1, the volume of each brake chamber for purposes of calculating the required total service reservoir volume shall be either the number specified in Column 2 of Table V or the actual volume of the brake chamber at maximum travel of the brake piston or pushrod, whichever is lower. The volume of a brake chamber not listed in Table V is the volume of the brake chamber at maximum travel of the brake piston or pushrod. The reservoirs on a heavy hauler trailer and

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the trailer portion of an auto transporter need not meet this requirement for reservoir volume.

S5.2.1.2 Each reservoir shall be capable of withstanding an internal hydrostatic pressure of 500 psi for 10 minutes.

S5.2.1.3 Each reservoir shall have a condensate drain valve that can be manually operated.

S5.2.1.4 Each service reservoir shall be protected against loss of air pressure due to failure or leakage in the system between the service reservoir and its source of air pressure by check valves or equivalent devices.

S5.2.2 Brake distribution and automatic adjustment. Each vehicle shall be equipped with a service brake system acting on all wheels.

(a) **Brake adjuster.** Wear of the service brakes shall be compensated for by means of a system of automatic adjustment. When inspected pursuant to S5.9, the adjustment of the service brakes shall be within the limits recommended by the vehicle manufacturer.

(b) **Brake indicator.** For each brake equipped with an external automatic adjustment mechanism and having an exposed pushrod, the condition of service brake under-adjustment shall be displayed by a brake adjustment indicator in a manner that is discernible when viewed with 20/40 vision from a location adjacent to or underneath the vehicle, when inspected pursuant to S5.9.

S5.2.3 Antilock brake system.

S5.2.3.1(a) Each semitrailer (including a trailer converter dolly) manufactured on or after March 1, 1998, shall be equipped with an antilock brake system that directly controls the wheels of at least one axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

(b) Each full trailer manufactured on or after March 1, 1998, shall be equipped with an antilock brake system that directly controls the wheels of at least one front axle of the vehicle and at least one rear axle of the vehicle. Wheels on other axles of the vehicle may be indirectly controlled by the antilock brake system.

S5.2.3.2 Antilock malfunction signal. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 2001, that is equipped with an antilock brake system shall be equipped with an electrical circuit that is capable of signaling a malfunction in the trailer's antilock brake system, and shall have the means for connection of this antilock brake system malfunction signal circuit to the towing vehicle. The electrical circuit need not be separate or dedicated exclusively to this malfunction signaling function. The signal shall be present whenever there is a malfunction that affects the generation or transmission of response or control signals in the trailer's antilock brake system. The signal shall remain present as long as the malfunction exists, whenever power is supplied to the antilock brake system. Each message about the existence of such a malfunction shall be stored in the antilock brake system whenever power is no longer supplied to the system, and the malfunction signal shall be automatically reactivated whenever power is again supplied to the trailer's antilock brake system. In addition, each trailer manufactured on or after March 1, 2001, that is designed to tow other air-brake equipped

trailers shall be capable of transmitting a malfunction signal from the antilock brake systems of additional trailers it tows to the vehicle towing it.

S5.2.3.3 Antilock malfunction indicator.

(a) In addition to the requirements of S5.2.3.2, each trailer and trailer converter dolly shall be equipped with an external antilock malfunction indicator lamp that meets the requirements of S5.2.3.3 (b) through (d).

(b)(1) The lamp shall be designed to conform to the performance requirements of SAE Recommended Practice J592 JUN92 (incorporated by reference, see §571.5), or SAE Recommended Practice J592e (1972) (incorporated by reference, see §571.5), for combination, clearance, and side marker lamps, which are marked with a "PC" or "P2" on the lens or housing, in accordance with SAE Recommended Practice J759 JAN95 (incorporated by reference, see §571.5).

(2) The color of the lamp shall be yellow.

(3) The letters "ABS" shall be permanently molded, stamped, or otherwise marked or labeled in letters not less than 10 mm (0.4 inches) high on the lamp lens or its housing to identify the function of the lamp. Alternatively, the letters "ABS" may be painted on the trailer body or dolly or a plaque with the letters "ABS" may be affixed to the trailer body or converter dolly; the letters "ABS" shall be not less than 25 mm (1 inch) high. A portion of one of the letters in the alternative identification shall be not more than 150 mm (5.9 inches) from the edge of the lamp lens.

(c) *Location requirements.* (1) Each trailer that is not a trailer converter dolly shall be equipped with a lamp mounted on a permanent structure on the left side of the trailer as viewed from the rear, no closer than 150 mm (5.9 inches), and no farther than 600 mm (23.6 inches) from the red rear side marker lamp, when measured between the closest edge of the effective projected luminous lens area of each lamp.

(2) Each trailer converter dolly shall be equipped with a lamp mounted on a permanent structure of the dolly so that the lamp is not less than 375 mm (14.8 inches) above the road surface when measured from the center of the lamp with the dolly at curb weight. When a person, standing 3 meters (9.8 feet) from the lamp, views the lamp from a perspective perpendicular to the vehicle's centerline, no portion of the lamp shall be obscured by any structure on the dolly.

(3) Each trailer that is not a trailer converter dolly and on which the malfunction indicator lamp cannot be placed within the location specified in S5.2.3.3(c)(1) shall be equipped with a lamp mounted on a permanent structure on the left side of the trailer as viewed from the rear, near the red rear side marker lamp or on the front face of the left rear fender of a trailer equipped with fenders.

(d) The lamp shall be illuminated whenever power is supplied to the antilock brake system and there is a malfunction that affects the generation or transmission of response or control signals in the trailer's antilock brake system. The lamp shall remain illuminated as long as such a malfunction exists and power is supplied to the antilock brake system. Each message about the existence of such a malfunction shall be stored in the antilock brake

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system whenever power is no longer supplied to the system. The lamp shall be automatically reactivated when power is again supplied to the trailer's antilock brake system. The lamp shall also be activated as a check of lamp function whenever power is first supplied to the antilock brake system and the vehicle is stationary. The lamp shall be deactivated at the end of the check of lamp function, unless there is a malfunction or a message about a malfunction that existed when power was last supplied to the antilock brake system.

S5.3 Service brakes—road tests. The service brake system on each truck tractor shall, under the conditions of S6, meet the requirements of S5.3.1, S5.3.3, S5.3.4, and S5.3.6, when tested without adjustments other than those specified in this standard. The service brake system on each bus and truck (other than a truck tractor) manufactured before July 1, 2005 and each bus and truck (other than a truck tractor) manufactured in two or more stages shall, under the conditions of S6, meet the requirements of S5.3.1, S5.3.3, and S5.3.4 when tested without adjustments other than those specified in this standard. The service brake system on each bus and truck (other than a truck tractor) manufactured on or after July 1, 2005 and each bus and truck (other than a truck tractor) manufactured in two or more stages on or after July 1, 2006 shall, under the conditions of S6, meet the requirements of S5.3.1, S5.3.3, S5.3.4, and S5.3.6, when tested without adjustments other than those specified in this standard. The service brake system on each trailer shall, under the conditions of S6, meet the requirements of S5.3.3, S5.3.4, and S5.3.5 when tested without adjustments other than those specified in this standard. However, a heavy hauler trailer and the truck and trailer portions of an auto transporter need not meet the requirements of S5.3.

S5.3.1 Stopping distance—trucks and buses. When stopped six times for each combination of vehicle type, weight, and speed specified in S5.3.1.1, in the sequence specified in Table I, each truck tractor manufactured on or after March 1, 1997, and each single unit vehicle manufactured on or after March 1, 1998, shall stop at least once in not more than the distance specified in Table II, measured from the point at which movement of the service brake control begins, without any part of the vehicle leaving the roadway, and with wheel lockup permitted only as follows:

(a) At vehicle speeds above 20 mph, any wheel on a nonsteerable axle other than the two rearmost nonliftable, nonsteerable axles may lock up, for any duration. The wheels on the two rearmost nonliftable, nonsteerable axles may lock up according to S5.3.1(b).

(b) At vehicle speeds above 20 mph, one wheel on any axle or two wheels on any tandem may lock up for any duration.

(c) At vehicle speeds above 20 mph, any wheel not permitted to lock in S5.3.1 (a) or (b) may lock up repeatedly, with each lockup occurring for a duration of one second or less.

(d) At vehicle speeds of 20 mph or less, any wheel may lock up for any duration.

S5.3.1.1 Stop the vehicle from 60 mph on a surface with a peak friction coefficient of 0.9 with the vehicle loaded as follows:

(a) Loaded to its GVWR so that the load on each axle, measured at the tire-ground interface, is most nearly proportional to the axles' respective GAWRs, without exceeding the GAWR of any axle.

(b) In the truck tractor only configuration plus up to 500 lbs. or, at the manufacturer's option, at its unloaded weight plus up to 500 lbs. (including driver and instrumentation) and plus not more than an additional 1,000 lbs. for a roll bar structure on the vehicle, and

(c) At its unloaded vehicle weight (except for truck tractors) plus up to 500 lbs. (including driver and instrumentation) or, at the manufacturer's option, at its unloaded weight plus up to 500 lbs. (including driver and instrumentation) plus not more than an additional 1,000 lbs. for a roll bar structure on the vehicle. If the speed attainable in two miles is less than 60 mph, the vehicle shall stop from a speed in Table II that is four to eight mph less than the speed attainable in two miles.

S5.3.2 [Reserved]

S5.3.3 Brake actuation time. Each service brake system shall meet the requirements of S5.3.3.1 (a) and (b).

S5.3.3.1(a) With an initial service reservoir system air pressure of 100 psi, the air pressure in each brake chamber shall, when measured from the first movement of the service brake control, reach 60 psi in not more than 0.45 second in the case of trucks and buses, 0.50 second in the case of trailers, other than trailer converter dollies, designed to tow another vehicle equipped with air brakes, 0.55 second in the case of trailer converter dollies, and 0.60 second in the case of trailers other than trailers designed to tow another vehicle equipped with air brakes. A vehicle designed to tow another vehicle equipped with air brakes shall meet the above actuation time requirement with a 50-cubic-inch test reservoir connected to the control line output coupling. A trailer, including a trailer converter dolly, shall meet the above actuation time requirement with its control line input coupling connected to the test rig shown in Figure 1.

(b) For a vehicle that is designed to tow another vehicle equipped with air brakes, the pressure in the 50-cubic-inch test reservoir referred to in S5.3.3.1(a) shall, when measured from the first movement of the service brake control, reach 60 psi not later than the time the fastest brake chamber on the vehicle reaches 60 psi or, at the option of the manufacturer, in not more than 0.35 second in the case of trucks and buses, 0.55 second in the case

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of trailer converter dollies, and 0.50 second in the case of trailers other than trailer converter dollies.

S5.3.4 Brake release time. Each service brake system shall meet the requirements of S5.3.4.1 (a) and (b).

S5.3.4.1(a) With an initial service brake chamber air pressure of 95 psi, the air pressure in each brake chamber shall, when measured from the first movement of the service brake control, fall to 5 psi in not more than 0.55 second in the case of trucks and buses; 1.00 second in the case of trailers, other than trailer converter dollies, designed to tow another vehicle equipped with air brakes; 1.10 seconds in the case of trailer converter dollies; and 1.20 seconds in the case of trailers other than trailers designed to tow another vehicle equipped with air brakes. A vehicle designated to tow another vehicle equipped with air brakes shall meet the above release time requirement with a 50-cubic-inch test reservoir connected to the control line output coupling. A trailer, including a trailer converter dolly, shall meet the above release time requirement with its control line input coupling connected to the test rig shown in Figure 1.

(b) For vehicles designed to tow another vehicle equipped with air brakes, the pressure in the 50-cubic-inch test reservoir referred to in S5.3.4.1(a) shall, when measured from the first movement of the service brake control, fall to 5 psi in not more than 0.75 seconds in the case of trucks and buses, 1.10 seconds in the case of trailer converter dollies, and 1.00 seconds in the case of trailers other than trailer converter dollies.

S5.3.5 Control signal pressure differential—converter dollies and trailers designed to tow another vehicle equipped with air brakes.

(a) For a trailer designed to tow another vehicle equipped with air brakes, the pressure differential between the control line input coupling and a 50-cubic-inch test reservoir attached to the control line output coupling shall not exceed the values specified in S5.3.5(a) (1), (2), and (3) under the conditions specified in S5.3.5(b) (1) through (4):

(1) 1 psi at all input pressures equal to or greater than 5 psi, but not greater than 20 psi;

(2) 2 psi at all input pressures equal to or greater than 20 psi but not greater than 40 psi; and

(3) Not more than a 5-percent differential at any input pressure equal to or greater than 40 psi.

(b) The requirements in S5.3.5(a) shall be met—

(1) When the pressure at the input coupling is steady, increasing or decreasing;

(2) When air is applied to or released from the control line input coupling using the trailer test rig shown in Figure 1;

(3) With a fixed orifice consisting of a 0.0180 inch diameter hole (no. 77 drill bit) in a 0.032 inch thick disc installed in the control line between the trailer test rig coupling and the vehicle's control line input coupling; and

(4) Operating the trailer test rig in the same manner and under the same conditions as it is operated during testing to measure brake actuation and release times,

as specified in S5.3.3 and S5.3.4, except for the installation of the orifice in the control line to restrict airflow rate.

S5.3.6 Stability and control during braking—trucks and buses. When stopped four consecutive times for each combination of weight, speed, and road conditions specified in S5.3.6.1 and S5.3.6.2, each truck tractor shall stop at least three times within the 12-foot lane, without any part of the vehicle leaving the roadway. When stopped four consecutive times for each combination of weight, speed, and road conditions specified in S5.3.6.1 and S5.3.6.2, each bus and truck (other than a truck tractor) manufactured on or after July 1, 2005, and each bus and truck (other than a truck tractor) manufactured in two or more stages on or after July 1, 2006, shall stop at least three times within the 12-foot lane, without any part of the vehicle leaving the roadway.

S5.3.6.1 Using a full-treadle brake application for the duration of the stop, stop the vehicle from 30 mph or 75 percent of the maximum drive-through speed, whichever is less, on a 500-foot radius curved roadway with a wet level surface having a peak friction coefficient of 0.5 when measured on a straight or curved section of the curved roadway using an ASTM E1136-93 (Reapproved 2003) (incorporated by reference, see §571.5) standard reference tire, in accordance with ASTM E1337-90 (Reapproved 2008) (incorporated by reference, see §571.5), at a speed of 40 mph, with water delivery.

S5.3.6.2 Stop the vehicle, with the vehicle:

(a) Loaded to its GVWR, for a truck tractor, and

(b) At its unloaded weight plus up to 500 pounds (including driver and instrumentation), or at the manufacturer's option, at its unloaded weight plus up to 500 pounds (including driver and instrumentation) and plus not more than an additional 1000 pounds for a roll bar structure on the vehicle, for a truck, bus, or truck tractor.

S5.4 Service brake system—dynamometer tests.

When tested without prior road testing, under the conditions of S6.2, each brake assembly shall meet the requirements of S5.4.1, S5.4.2, and S5.4.3 when tested in sequence and without adjustments other than those specified in the standard. For purposes of the requirements of S5.4.2 and S5.4.3, an average deceleration rate is the change in velocity divided by the deceleration time measured from the onset of deceleration.

S5.4.1 Brake retardation force. The sum of the retardation forces exerted by the brakes on each vehicle designed to be towed by another vehicle equipped with air brakes shall be such that the quotient sum of the brake retardation forces / sum of GAWR's relative to brake chamber air pressure, and shall have values not less than those shown in Column 1 of Table III. Retardation force shall be determined as follows:

S5.4.1.1 After burnishing the brake pursuant to S6.2.6, retain the brake assembly on the inertia dynamometer. With an initial brake temperature between 125°F. and 200°F., conduct a stop from 50 m.p.h., maintaining brake chamber air pressure at a constant 20 psi. Measure the average torque exerted by the brake from

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the time the specified air pressure is reached until the brake stops and divide by the static loaded tire radius specified by the tire manufacturer to determine the retardation force. Repeat the procedure six times, increasing the brakechamber air pressure by 10 psi each time. After each stop, rotate the brake drum or disc until the temperature of the brake falls to between 125°F. and 200°F.

S5.4.2 Brake power. When mounted on an inertia dynamometer, each brake shall be capable of making 10 consecutive decelerations at an average rate of 9 f.p.s.p.s. from 50 m.p.h. to 15 m.p.h., at equal intervals of 72 seconds, and shall be capable of decelerating to a stop from 20 m.p.h. at an average deceleration rate of 14 f.p.s.p.s. 1 minute after the 10th deceleration. The series of decelerations shall be conducted as follows:

S5.4.2.1 With an initial brake temperature between 150 °F. and 200 °F. for the first brake application, and the drum or disc rotating at a speed equivalent to 50 m.p.h., apply the brake and decelerate at an average deceleration rate of 9 f.p.s.p.s. to 15 m.p.h. Upon reaching 15 m.p.h., accelerate to 50 m.p.h. and apply the brake for a second time 72 seconds after the start of the first application. Repeat the cycle until 10 decelerations have been made. The service line air pressure shall not exceed 100 psi during any deceleration.

S5.4.2.2 One minute after the end of the last deceleration required by S5.4.2.1 and with the drum or disc rotating at a speed of 20 m.p.h., decelerate to a stop at an average deceleration rate of 14 f.p.s.p.s.

S5.4.3 Brake recovery. Except as provided in S5.4.3(a) and (b), starting two minutes after completing the tests required by S5.4.2, a vehicle's brake shall be capable of making 20 consecutive stops from 30 mph at an average deceleration rate of 12 f.p.s.p.s., at equal intervals of one minute measured from the start of each brake application. The service line air pressure needed to attain a rate of 12 f.p.s.p.s. shall be not more than 85 lb/in², and not less than 20lb/in² for a brake not subject to the control of an antilock system, or 12 lb/in² for a brake subject to the control of an antilock system.

(a) Notwithstanding S5.4.3, neither front axle brake of a truck-tractor is subject to the requirements set forth in S5.4.3.

(b) Notwithstanding S5.4.3, neither front axle brake of a bus or a truck other than a truck-tractor is subject to the requirement set forth in S5.4.3 prohibiting the service line air pressure from being less than 20 lb/in² for a brake not subject to the control of an antilock system or 12 lb/in² for a brake subject to the control of an antilock system.

S5.5 Antilock system.

S5.5.1 Antilock system malfunction. On a truck tractor manufactured on or after March 1, 1997, that is equipped with an antilock brake system and a single unit vehicle manufactured on or after March 1, 1998, that is equipped with an antilock brake system, a malfunction that affects the generation or transmission of response or control signals of any part of the antilock system shall not increase the actuation and release times of the service brakes.

S5.5.2 Antilock system power-trailers. On a trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, that is equipped with an antilock system that requires electrical power for operation, the power shall be obtained from the towing vehicle through one or more electrical circuits which provide continuous power whenever the powered vehicle's ignition (start) switch is in the "on" ("run") position. The antilock system shall automatically receive power from the stoplamp circuit, if the primary circuit or circuits are not functioning. Each trailer (including a trailer converter dolly) manufactured on or after March 1, 1998, that is equipped to tow another air-braked vehicle shall be equipped with one or more circuits which provide continuous power to the antilock system on the vehicle(s) it tows. Such circuits shall be adequate to enable the antilock system on each towed vehicle to be fully operable.

S5.6 Parking brakes.

(a) Except as provided in S5.6(b) and S5.6(c), each vehicle other than a trailer converter dolly shall have a parking brake system that under the conditions of S6.1 meets the requirements of:

- (1) S5.6.1 or S5.6.2, at the manufacturer's option, and
- (2) S5.6.3, S5.6.4, S5.6.5, and S5.6.6.

(b) At the option of the manufacturer, for vehicles equipped with brake systems which incorporate a common diaphragm, the performance requirements specified in S5.6(a) which must be met with any single leakage-type failure in a common diaphragm may instead be met with the level of leakage-type failure determined in S5.6.7. The election of this option does not affect the performance requirements specified in S5.6(a) which apply with single leakage-type failures other than failures in a common diaphragm.

(c) At the option of the manufacturer, the trailer portion of any agricultural commodity trailer, heavy hauler trailer, or pulpwood trailer may meet the requirements of §393.43 of this title instead of the requirements of S5.6(a).

S5.6.1 Static retardation force. With all other brakes made inoperative, during a static drawbar pull in a forward or rearward direction, the static retardation force produced by the application of the parking brakes shall be:

(a) In the case of a vehicle other than a truck-tractor that is equipped with more than two axles, such that the quotient static retardation force/ GAWR is not less than 0.28 for any axle other than a steerable front axle; and

(b) In the case of a truck-tractor that is equipped with more than two axles, such that the quotient static retardation force/GVWR is not less than 0.14.

S5.6.2 Grade holding. With all parking brakes applied, the vehicle shall remain stationary facing uphill and facing downhill on a smooth, dry portland cement concrete roadway with a 20-percent grade, both

(a) When loaded to its GVWR, and

(b) At its unloaded vehicle weight plus 1500 pounds (including driver and instrumentation and roll bar).

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S5.6.3 Application and holding. Each parking brake system shall meet the requirements of S5.6.3.1 through S5.6.3.4.

S5.6.3.1 The parking brake system shall be capable of achieving the minimum performance specified either in S5.6.1 or S5.6.2 with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (excluding failure of a component of a brake chamber housing but including failure of any brake chamber diaphragm that is part of any other brake system including a diaphragm which is common to the parking brake system and any other brake system), when the pressures in the vehicle's parking brake chambers are at the levels determined in S5.6.3.4.

S5.6.3.2 A mechanical means shall be provided that, after a parking brake application is made with the pressures in the vehicle's parking brake chambers at the levels determined in S5.6.3.4, and all air and fluid pressures in the vehicle's braking systems are then bled down to zero, and without using electrical power, holds the parking brake application with sufficient parking retardation force to meet the minimum performance specified in S5.6.3.1 and in either S5.6.1 or S5.6.2.

S5.6.3.3 For trucks and buses, with an initial reservoir system pressure of 100 psi and, if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the supply line coupling, no later than three seconds from the time of actuation of the parking brake control, the mechanical means referred to in S5.6.3.2 shall be actuated. For trailers, with the supply line initially pressurized to 100 psi using the supply line portion of the trailer test rig (Figure 1) and, if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the rear supply line coupling, no later than three seconds from the time venting to the atmosphere of the front supply line coupling is initiated, the mechanical means referred to in S5.6.3.2 shall be actuated. This requirement shall be met for trucks, buses and trailers both with and without any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.3.4 The parking brake chamber pressures for S5.6.3.1 and S5.6.3.2 are determined as follows. For trucks and buses, with an initial reservoir system pressure of 100 psi and, if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the supply line coupling, any single leakage type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The parking brake control is actuated and the pressures in the vehicle's parking brake chambers are measured three seconds after that actuation is initiated. For trailers, with the supply line initially pressurized to 100 psi using the supply line portion of the trailer test rig (Figure 1) and, if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the rear supply line coupling, any single leakage type

failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The front supply line coupling is vented to the atmosphere and the pressures in the vehicle's parking brake chambers are measured three seconds after that venting is initiated.

S5.6.4 Parking brake control—trucks and buses. The parking brake control shall be separate from the service brake control. It shall be operable by a person seated in the normal driving position. The control shall be identified in a manner that specifies the method of control operation. The parking brake control shall control the parking brakes of the vehicle and of any air braked vehicle that it is designed to tow.

S5.6.5 Release Performance. Each parking brake system shall meet the requirements specified in S5.6.5.1 through S5.6.5.4.

S5.6.5.1 For trucks and buses, with initial conditions as specified in S5.6.5.2, at all times after an application actuation of the parking brake control, and with any subsequent level of pressure, or combination of levels of pressure, in the reservoirs of any of the vehicle's brake systems, no reduction in parking brake retardation force shall result from a release actuation of the parking brake control unless the parking brakes are capable, after such release, of being reapplied at a level meeting the minimum performance specified either in S5.6.1 or S5.6.2. This requirement shall be met both with and without the engine on, and with and without single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.5.2 The initial conditions for S5.6.5.1 are as follows: The reservoir system pressure is 100 psi. If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir is connected to the supply line coupling.

S5.6.5.3 For trailers, with initial conditions as specified in S5.6.5.4, at all times after actuation of the parking brakes by venting the front supply line coupling to the atmosphere, and with any subsequent level of pressure, or combination of levels of pressure, in the reservoirs of any of the vehicle's brake systems, the parking brakes shall not be releasable by repressurizing the supply line using the supply line portion of the trailer test rig (Figure 1) to any pressure above 70 psi, unless the parking brakes are capable, after such release, of reapplication by subsequent venting of the front supply line coupling to the atmosphere, at a level meeting the minimum performance specified either in S5.6.1 or S5.6.2. This requirement shall be met both with and without any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1).

S5.6.5.4 The initial conditions for S5.6.5.3 are as follows: The reservoir system and supply line are pressurized to 100 psi, using the supply line portion of the trailer test rig (Figure 1). If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch

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test reservoir is connected to the rear supply line coupling.

S5.6.6 Accumulation of actuation energy. Each parking brake system shall meet the requirements specified in S5.6.6.1 through S5.6.6.6.

S5.6.6.1 For trucks and buses, with initial conditions as specified in S5.6.6.2, the parking brake system shall be capable of meeting the minimum performance specified either in S5.6.1 or S5.6.2, with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1) at the conclusion of the test sequence specified in S5.6.6.3.

S5.6.6.2 The initial conditions for S5.6.6.1 are as follows: The engine is on. The reservoir system pressure is 100 psi. If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir is connected to the supply line coupling.

S5.6.6.3 The test sequence for S5.6.6.1 is as follows: The engine is turned off. Any single leakage type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is then introduced in the brake system. An application actuation of the parking brake control is then made. Thirty seconds after such actuation, a release actuation of the parking brake control is made. Thirty seconds after the release actuation, a final application actuation of the parking brake control is made.

S5.6.6.4 For trailers, with initial conditions as specified in S5.6.6.5, the parking brake system shall be capable of meeting the minimum performance specified either in S5.6.1 or S5.6.2, with any single leakage-type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), at the conclusion of the test sequence specified in S5.6.6.6.

S5.6.6.5 The initial conditions for S5.6.6.4 are as follows: The reservoir system and supply line are pressurized to 100 psi, using the supply line portion of the trailer test rig (Figure 1). If the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir is connected to the rear supply line coupling.

S5.6.6.6 The test sequence for S5.6.6.4 is as follows. Any single leakage type failure, in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), is introduced in the brake system. The front supply line coupling is vented to the atmosphere. Thirty seconds after the initiation of such venting, the supply line is repressurized with the trailer test rig (Figure 1). Thirty seconds after the initiation of such repressurizing of the supply line, the front supply line is vented to the atmosphere. This procedure is conducted either by connection and disconnection of the supply line coupling or by use of a valve installed in the supply line portion of the trailer test rig near the supply line coupling.

S5.6.7 Maximum level of common diaphragm leakage-type failure/ Equivalent level of leakage from the air chamber containing that diaphragm.

In the case of vehicles for which the option in S5.6(b) has been elected, determine the maximum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) according to the procedures set forth in S5.6.7.1 through S5.6.7.2.3.

S5.6.7.1 Trucks and buses.

S5.6.7.1.1 According to the following procedure, determine the threshold level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which the vehicle's parking brakes become unreleasable. With an initial reservoir system pressure of 100 psi, the engine turned off, no application of any of the vehicle's brakes, and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, introduce a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm). Apply the parking brakes by making an application actuation of the parking brake control. Reduce the pressures in all of the vehicle's reservoirs to zero, turn on the engine and allow it to idle, and allow the pressures in the vehicle's reservoirs to rise until they stabilize or until the compressor shut-off point is reached. At that time, make a release actuation of the parking brake control, and determine whether all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation force to meet the minimum performance specified in either S5.6.1 or S5.6.2. Repeat this procedure with progressively decreasing or increasing levels (whichever is applicable) of leakage-type diaphragm failures or equivalent leakages, to determine the minimum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2.

S5.6.7.1.2 At the level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) determined in S5.6.7.1.1, and using the following procedure, determine the threshold maximum reservoir rate (in psi per minute). With an initial reservoir system pressure of 100 psi, the engine turned off, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, make an application actuation of the parking brake control. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application.

S5.6.7.1.3 Using the following procedure, introduce a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing

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that diaphragm) that results in a maximum reservoir leakage rate that is three times the threshold maximum reservoir leakage rate determined in S5.6.7.1.2. With an initial reservoir system pressure of 100 psi, the engine turned off, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, make an application actuation of the parking brake control. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application. The level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) associated with this reservoir leakage rate is the level that is to be used under the option set forth in S5.6(b).

S5.6.7.2 Trailers.

S5.6.7.2.1 According to the following procedure, determine the threshold level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which the vehicle's parking brakes become unreleasable. With an initial reservoir system and supply line pressure of 100 psi, no application of any of the vehicle's brakes, and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the supply line coupling, introduce a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm). Make a parking brake application by venting the front supply line coupling to the atmosphere, and reduce the pressures in all of the vehicle's reservoirs to zero. Pressurize the supply line by connecting the trailer's front supply line coupling to the supply line portion of the trailer test rig (Figure 1) with the regulator of the trailer test rig set at 100 psi, and determine whether all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2. Repeat this procedure with progressively decreasing or increasing levels (whichever is applicable) of leakage-type diaphragm failures or equivalent leakages, to determine the minimum level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) at which all of the mechanical means referred to in S5.6.3.2 continue to be actuated and hold the parking brake applications with sufficient parking retardation forces to meet the minimum performance specified in either S5.6.1 or S5.6.2.

S5.6.7.2.2 At the level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) determined in S5.6.7.2.1, and using the following procedure, determine the threshold maximum reservoir leakage rate (in psi per minute). With an initial reservoir system and supply line pressure of 100 psi, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the rear supply line coupling,

make a parking brake application by venting the front supply line coupling to the atmosphere. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application.

S5.6.7.2.3 Using the following procedure, a leakage-type failure of the common diaphragm (or equivalent leakage from the air chamber containing that diaphragm) that results in a maximum reservoir leakage rate that is three times the threshold maximum reservoir leakage rate determined in S5.6.7.2.2. With an initial reservoir system and supply line pressure of 100 psi, no application of any of the vehicle's brakes and, if the vehicle is designed to tow a vehicle equipped with air brakes, a 50 cubic inch test reservoir connected to the rear supply line coupling, make a parking brake application by venting the front supply line coupling to the atmosphere. Determine the maximum reservoir leakage rate (in psi per minute), which is the maximum rate of decrease in air pressure of any of the vehicle's reservoirs that results after that parking brake application. The level of common diaphragm leakage-type failure (or equivalent level of leakage from the air chamber containing that diaphragm) associated with this reservoir leakage rate is the level that is to be used under the option set forth in S5.6(b).

S5.7 Emergency brake system for trucks and buses. Each vehicle shall be equipped with an emergency brake system which, under the conditions of S6.1, conforms to the requirements of S5.7.1 through S5.7.3. However, the truck portion of an auto transporter need not meet the road test requirements of S5.7.1 and S5.7.3.

S5.7.1 Emergency brake system performance. When stopped six times for each combination of weight and speed specified in S5.3.1.1, except for a loaded truck tractor with an unbraked control trailer, on a road surface having a PFC of 0.9, with a single failure in the service brake system of a part designed to contain compressed air or brake fluid (except failure of a common valve, manifold, brake fluid housing, or brake chamber housing), the vehicle shall stop at least once in not more than the distance specified in Column 5 of Table II, measured from the point at which movement of the service brake control begins, except that a truck-tractor tested at its unloaded vehicle weight plus up to 1500 pounds shall stop at least once in not more than the distance specified in Column 6 of Table II. The stop shall be made without any part of the vehicle leaving the roadway, and with unlimited wheel lockup permitted at any speed.

S5.7.2 Emergency brake system operation. The emergency brake system shall be applied and released, and be capable of modulation, by means of the service brake control.

S5.7.3 Towing vehicle emergency brake requirements. In addition to meeting the other requirements of S5.7, a vehicle designed to tow another vehicle equipped with air brakes shall—

(a) In the case of a truck-tractor in the unloaded condition and a single unit truck which is capable of towing an airbrake equipped vehicle and is loaded to GVWR, be

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capable of meeting the requirements of S5.7.1 by operation of the service brake control only, with the trailer air supply line and air control line from the towing vehicle vented to the atmosphere in accordance with S6.1.14;

(b) Be capable of modulating the air in the supply or control line to the trailer by means of the service brake control with a single failure in the towing vehicle service brake system as specified in S5.7.1.

(c) [Reserved]

S5.8 Emergency brakes for trailers. Each trailer shall meet the requirements of S5.8.1 through S5.8.3.

S5.8.1 Emergency braking capability. Each trailer other than a trailer converter dolly shall have a parking brake system that conforms to S5.6 and that applies with the force specified in S5.6.1 or S5.6.2 when the air pressure in the supply line is at atmospheric pressure. A trailer converter dolly shall have, at the manufacturer's option—

(a) A parking brake system that conforms to S5.6 and that applies with the force specified in S5.6.1 or S5.6.2 when the air pressure in the supply line is at atmospheric pressure, or

(b) An emergency system that automatically applies the service brakes when the service reservoir is at any pressure above 20 lb/in² and the supply line is at atmospheric pressure. However, any agricultural commodity trailer, heavy hauler trailer, or pulpwood trailer shall meet the requirements of S5.8.1 or, at the option of the manufacturer, the requirements of §393.43 of this title.

S5.8.2 Supply line pressure retention. Any single leakage type failure in the service brake system (except for a failure of the supply line, a valve directly connected to the supply line or a component of a brake chamber housing) shall not result in the pressure in the supply line falling below 70 psi, measured at the forward trailer supply coupling. A trailer shall meet the above supply line pressure retention requirement with its brake system connected to the trailer test rig shown in Figure 1, with the reservoirs of the trailer and test rig initially pressurized to 100 psi and the regulator of the trailer test rig set at 100 psi; except that a trailer equipped with an air-applied, mechanically-held parking brake system and not designed to tow a vehicle equipped with air brakes, at the manufacturer's option, may meet the requirements of S5.8.4 rather than those of S5.8.2 and S5.8.3.

S5.8.3 Automatic application of parking brakes. With an initial reservoir system pressure of 100 psi and initial supply line pressure of 100 psi, and if designed to tow a vehicle equipped with air brakes, with a 50 cubic inch test reservoir connected to the rear supply line coupling, and with any subsequent single leakage type failure in any other brake system, of a part designed to contain compressed air or brake fluid (consistent with the parenthetical phrase specified in S5.6.3.1), whenever the air pressure in the supply line is 70 psi or higher, the parking brakes shall not provide any brake retardation as a result of complete or partial automatic application of the parking brakes.

S5.8.4 Automatic application of air-applied, mechanically held parking brakes. With its brake system connected to the supply line portion of the trailer test rig (Figure 1) and the regulator of the trailer test rig set at 100 psi, and with any single leakage type failure in the service brake system (except for a failure of the supply line, a valve directly connected to the supply line or a component of a brake chamber, but including failure of any common diaphragm), the parking brakes shall not provide any brake retardation as a result of complete or partial automatic application of the parking brakes.

S5.9 Final inspection. Inspect the service brake system for the condition of adjustment and for the brake indicator display in accordance with S5.1.8 and S5.2.2.

S6. Conditions. The requirements of S5 shall be met by a vehicle when it is tested according to the conditions set in this S6, without replacing any brake system part or making any adjustments to the brake system except as specified. Unless otherwise specified, where a range of conditions is specified, the vehicle must be capable of meeting the requirements at all points within the range. On vehicles equipped with automatic brake adjusters, the automatic brake adjusters must remain activated at all times. Compliance of vehicles manufactured in two or more stages may, at the option of the final-stage manufacturer, be demonstrated to comply with this standard by adherence to the instructions of the incomplete vehicle manufacturer provided with the vehicle in accordance with §568.4(a)(7)(ii) and §568.5 of title 49 of the Code of Federal Regulations.

S6.1 Road test conditions.

S6.1.1 Except as otherwise specified, the vehicle is loaded to its GVWR, distributed proportionally to its GAWRs. During the burnish procedure specified in S6.1.8, truck tractors shall be loaded to their GVWR, by coupling them to an unbraked flatbed semitrailer, which semitrailer shall be loaded so that the weight of the tractor-trailer combination equals the GVWR of the truck tractor. The load on the unbraked flatbed semitrailer shall be located so that the truck tractor's wheels do not lock during burnish.

S6.1.2 The inflation pressure is as specified by the vehicle manufacturer for the GVWR.

S6.1.3 Unless otherwise specified, the transmission selector control is in neutral or the clutch is disengaged during all decelerations and during static parking brake tests.

S6.1.4 All vehicle openings (doors, windows, hood, trunk, cargo doors, etc.) are in a closed position except as required for instrumentation purposes.

S6.1.5 The ambient temperature is between 32 °F and 100 °F.

S6.1.6 The wind velocity is zero.

S6.1.7 Unless otherwise specified, stopping tests are conducted on a 12-foot wide level, straight roadway having a peak friction coefficient of 0.9. For road tests in S5.3, the vehicle is aligned in the center of the roadway at the beginning of a stop. Peak friction coefficient is measured using an ASTM E1136 standard reference test tire (see ASTM E1136-96 (Reapproved 2003) (incorporated by reference, see §571.5)) in accordance with

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ASTM Method E1337-90 (Reapproved 2008) (incorporated by reference, see §571.5), at a speed of 40 mph, without water delivery for the surface with PFC of 0.9, and with water delivery for the surface with PFC of 0.5.

S6.1.8 For vehicles with parking brake systems not utilizing the service brake friction elements, burnish the friction elements of such systems prior to the parking brake test according to the manufacturer's recommendations. For vehicles with parking brake systems utilizing the service brake friction elements, burnish the brakes as follows: With the transmission in the highest gear appropriate for a speed of 40 mph, make 500 snubs between 40 mph and 20 mph at a deceleration rate of 10 f.p.s.p.s., or at the vehicle's maximum deceleration rate if less than 10 f.p.s.p.s. Except where an adjustment is specified, after each brake application accelerate to 40 mph and maintain that speed until making the next brake application at a point 1 mile from the initial point of the previous brake application. If the vehicle cannot attain a speed of 40 mph in 1 mile, continue to accelerate until the vehicle reaches 40 mph or until the vehicle has traveled 1.5 miles from the initial point of the previous brake application, whichever occurs first. Any automatic pressure limiting valve is in use to limit pressure as designed. The brakes may be adjusted up to three times during the burnish procedure, at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing, in accordance with the vehicle manufacturer's recommendation.

S6.1.9 Static parking brake tests for a semitrailer are conducted with the front-end supported by an unbraked dolly. The weight of the dolly is included as part of the trailer load.

S6.1.10 In a test other than a static parking test, a truck tractor is tested at its GVWR by coupling it to an unbraked flatbed semi-trailer (hereafter, control trailer) as specified in S6.1.10.2 to S6.1.10.4.

S6.1.10.1 [Reserved]

S6.1.10.2 The center of gravity height of the ballast on the loaded control trailer shall be less than 24 inches above the top of the tractor's fifth wheel.

S6.1.10.3 The control trailer has a single axle with a GAWR of 18,000 pounds and a length, measured from the transverse centerline of the axle to the centerline of the kingpin, of 258 ± 6 inches.

S6.1.10.4 The control trailer is loaded so that its axle is loaded at 4,500 pounds and the tractor is loaded to its GVWR, loaded above the kingpin only, with the tractor's fifth wheel adjusted so that the load on each axle measured at the tire-ground interface is most nearly proportional to the axles' respective GAWRs, without exceeding the GAWR of the tractor's axle or axles or control trailer's axle.

S6.1.11 **Special drive conditions.** A vehicle equipped with an interlocking axle system or a front wheel drive system that is engaged and disengaged by the driver is tested with the system disengaged.

S6.1.12 **Liftable axles.** A vehicle with a liftable axle is tested at GVWR with the liftable axle down and at unloaded vehicle weight with the liftable axle up.

S6.1.13 Trailer test rig.

The trailer test rig shown in Figure 1 is calibrated in accordance with the calibration curves shown in Figure 3. For the requirements of S5.3.3.1 and S5.3.4.1, the pressure in the trailer test rig reservoir is initially set at 100 psi for actuation tests and 95 psi for release tests.

S6.1.14 In testing the emergency braking system of towing vehicles under S5.7.3(a), the hose(s) is vented to the atmosphere at any time not less than 1 second and not more than 1 minute before the emergency stop begins, while the vehicle is moving at the speed from which the stop is to be made and any manual control for the towing vehicle protection system is in the position to supply air and brake control signals to the vehicle being towed. No brake application is made from the time the line(s) is vented until the emergency stop begins and no manual operation of the parking brake system or towing vehicle protection system occurs from the time the line(s) is vented until the stop is completed.

S6.1.15 **Initial brake temperature.** Unless otherwise specified, the initial brake temperature is not less than 150°F and not more than 200°F.

S6.1.16 Thermocouples.

The brake temperature is measured by plug-type thermocouples installed in the approximate center of the facing length and width of the most heavily loaded shoe or disc pad, one per brake, as shown in Figure 2. A second thermocouple may be installed at the beginning of the test sequence if the lining wear is expected to reach a point causing the first thermocouple to contact the rubbing surface of a drum or rotor. The second thermocouple shall be installed at a depth of .080 inch and located within 1 inch circumferentially of the thermocouple installed at .040 inch depth. For centergrooved shoes or pads, thermocouples are installed within one-eighth of an inch to one-quarter of an inch of the groove and as close to the center as possible.

S6.1.17 Selection of compliance options. Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S6.2 Dynamometer test conditions.

S6.2.1 The dynamometer inertia for each wheel is equivalent to the load on the wheel with the axle loaded to its GAWR. For a vehicle having additional GAWRs specified for operation at reduced speeds, the GAWR used is that specified for a speed of 50 mph, or, at the option of the manufacturer, any speed greater than 50 mph.

S6.2.2 The ambient temperature is between 75°F. and 100°F.

S6.2.3 Air at ambient temperature is directed uniformly and continuously over the brake drum or disc at a velocity of 2,200 feet per minute.

S6.2.4 The temperature of each brake is measured by a single plug-type thermocouple installed in the center

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of the lining surface of the most heavily loaded shoe or pad as shown in Figure 2. The thermocouple is outside any center groove.

S6.2.5 The rate of brake drum or disc rotation on a dynamometer corresponding to the rate of rotation on a vehicle at a given speed is calculated by assuming a tire radius equal to the static loaded radius specified by the tire manufacturer.

S6.2.6 Brakes are burnished before testing as follows: place the brake assembly on an inertia dynamometer and adjust the brake as recommended by the vehicle manufacturer. Make 200 stops from 40 mph at a deceleration of 10 f.p.s.p.s., with an initial brake temperature on each stop of not less than 315°F and not more

than 385°F. Make 200 additional stops from 40 mph at a deceleration of 10 f.p.s.p.s. with an initial brake temperature on each stop of not less than 450°F and not more than 550°F. The brakes may be adjusted up to three times during the burnish procedure, at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing, in accordance with the vehicle manufacturer's recommendation.

S6.2.7 The brake temperature is increased to a specified level by conducting one or more stops from 40 m.p.h. at a deceleration of 10 f.p.s.p.s. The brake temperature is decreased to a specified level by rotating the drum or disc at a constant 30 m.p.h.

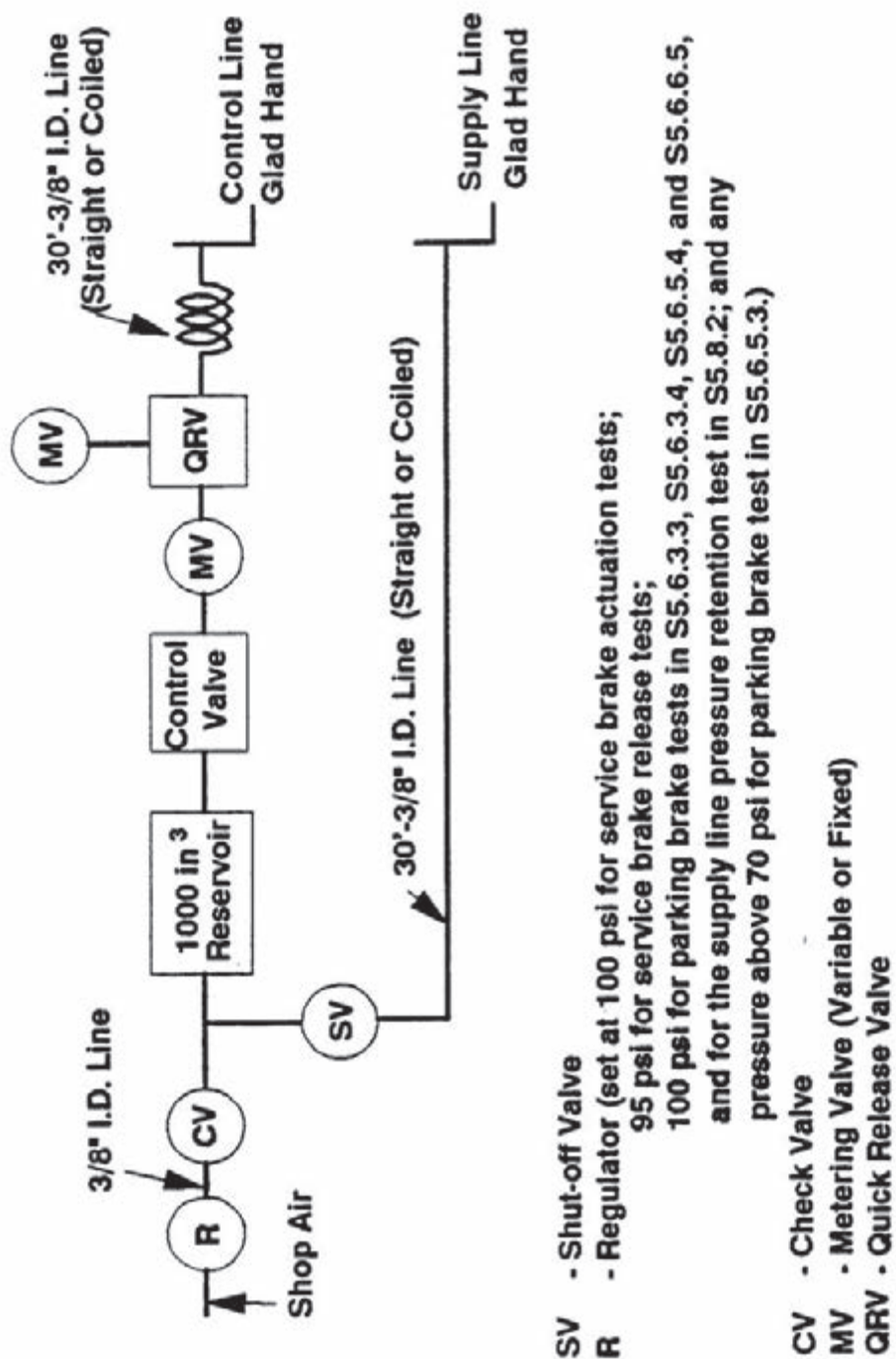
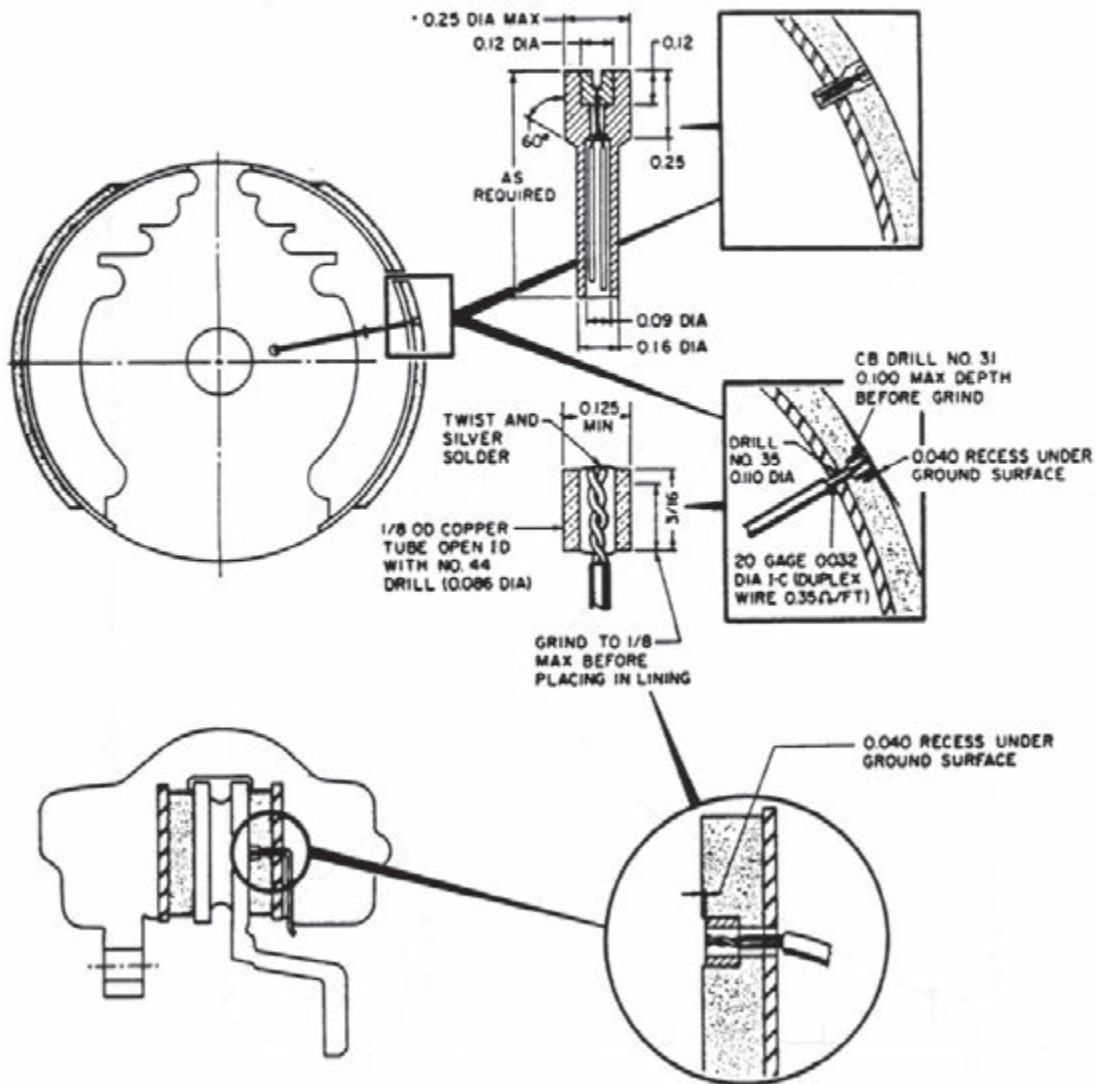


Figure 1. Trailer Test Rig.

FIGURE 2
THERMOCOUPLE INSTALLATION



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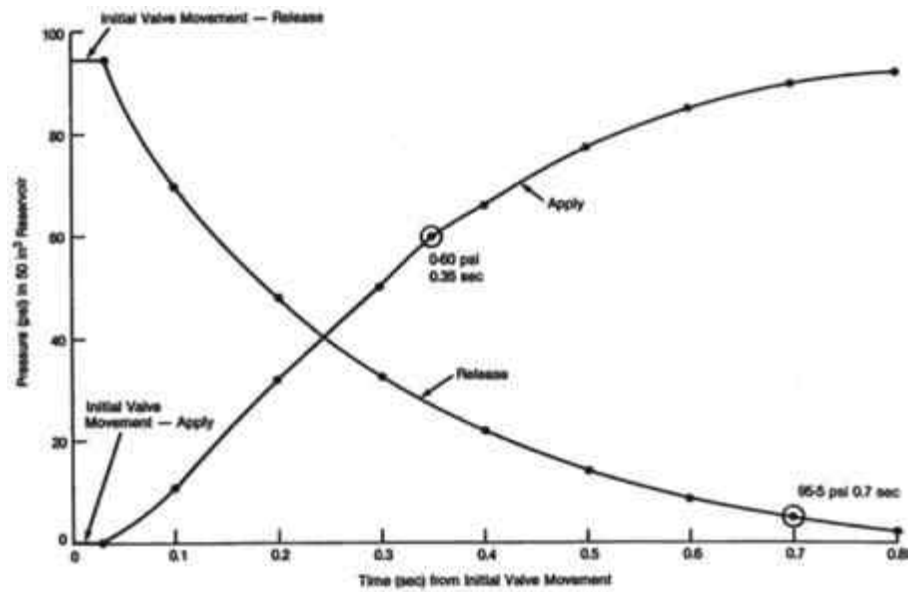


Figure 3. Pressure vs. Time for 50 in³ Test Reservoir.

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TABLE I—STOPPING SEQUENCE

	Truck tractors	Single unit trucks and buses
Burnish	1	1
Stability and Control at GVWR (PFC 0.5)	2	N/A
Stability and control at LLVW (PFC 0.5)	3	5
Manual Adjustment of Brakes	4	N/A
60 mph Service Brake Stops at GVWR (PFC 0.9)	5	2
60 mph Emergency Service Brake Stops at GVWR (PFC 0.9)	N/A	3
Parking Brake Test at GVWR	6	4
Manual Adjustment of Brakes	7	6
60 mph Service Brake Stops at LLVW (PFC 0.9)	8	7
60 mph Emergency Service Brake Stops at LLVW (PFC 0.9)	9	8
Parking Brake Test at LLVW	10	9
Final Inspection	11	10

TABLE II—STOPPING DISTANCE IN FEET

Vehicle speed in miles per hour	Service brake						Emergency brake	
	PFC 0.9	PFC 0.9	PFC 0.9	PFC 0.9	PFC 0.9	PFC 0.9	PFC 0.9	PFC 0.9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
30	70	78	65	78	84	61	170	186
35	96	106	89	106	114	84	225	250
40	125	138	114	138	149	108	288	325
45	158	175	144	175	189	136	358	409
50	195	216	176	216	233	166	435	504
55	236	261	212	261	281	199	520	608
60	280	310	250	310	335	235	613	720

Note:

- (1) Loaded and Unloaded Buses.
 (2) Loaded Single-Unit Trucks.
 (3) Loaded Tractors with Two Axles; or with Three Axles and a GVWR of 70,000 lbs. or less; or with Four or More Axles and a GVWR of 85,000 lbs. or less. Tested with an Unbraked Control Trailer.
 (4) Loaded Tractors with Three Axles and a GVWR greater than 70,000 lbs.; or with Four or More Axles and a GVWR greater than 85,000 lbs. Tested with an Unbraked Control Trailer.
 (5) Unloaded Single-Unit Trucks.
 (6) Unloaded Tractors (Bobtail).
 (7) All Vehicles except Tractors, Loaded and Unloaded.
 (8) Unloaded Tractors (Bobtail).

TABLE IIA—STOPPING DISTANCE IN FEET: OPTIONAL REQUIREMENTS FOR: (1) THREE-AXLE TRACTORS WITH A FRONT AXLE THAT HAS A GAWR OF 14,600 POUNDS OR LESS, AND WITH TWO REAR DRIVE AXLES THAT HAVE A COMBINED GAWR OF 45,000 POUNDS OR LESS, MANUFACTURED BEFORE AUGUST 1, 2011; AND (2) ALL OTHER TRACTORS MANUFACTURED BEFORE AUGUST 1, 2013

Vehicle speed in miles per hour	Service brake				Emergency brake	
	PFC 0.9 (1)	PFC 0.9 (2)	PFC 0.9 (3)	PFC 0.9 (4)	PFC 0.9 (5)	PFC 0.9 (6)
30	70	78	84	89	170	186
35	96	106	114	121	225	250
40	125	138	149	158	288	325
45	158	175	189	200	358	409
50	195	216	233	247	435	504
55	236	261	281	299	520	608
60	280	310	335	355	613	720

Note: (1) Loaded and unloaded buses; (2) Loaded single unit trucks; (3) Unloaded truck tractors and single unit trucks; (4) Loaded truck tractors tested with an unbraked control trailer; (5) All vehicles except truck tractors; (6) Unloaded truck tractors.

TABLE III—BRAKE RETARDATION FORCE

Column 1 Brake retardation force, GAWR	Column 2 Brake chamber pressure, psi
0.05	20
0.12	30
0.18	40
0.25	50
0.31	60
0.37	70
0.41	80

TABLE IV [RESERVED]

TABLE V—BRAKE CHAMBER RATED VOLUMES

Brake chamber type (nominal area of piston or diaphragm in square inches)	Column 1 Full stroke (inches)	Column 2 Rated volume (cubic inches)
Type 9	1.75/2.10	25
Type 12	1.75/2.10	30
Type 14	2.25/2.70	40
Type 16	2.25/2.70	46
Type 18	2.25/2.70	50
Type 20	2.25/2.70	54
Type 24	2.50/3.20	67
Type 30	2.50/3.20	89
Type 36	3.00/3.60	135

§571.124 Standard No. 124; Accelerator control systems.

S1. Scope. This standard establishes requirements for the return of a vehicle's throttle to the idle position when the driver removes the actuating force from the accelerator control, or in the event of a severance or disconnection in the accelerator control system.

S2. Purpose. The purpose of this standard is to reduce deaths and injuries resulting from engine over-speed caused by malfunctions in the accelerator control system.

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S3. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S4. Definitions.

S4.1 Driver-operated accelerator control system means all vehicle components, except the fuel metering device, that regulate engine speed in direct response to movement of the driver-operated control and that return the throttle to the idle position upon release of the actuating force.

Fuel metering device means the carburetor, or in the case of certain engines the fuel injector, fuel distributor or fuel injection pump.

Throttle means the component of the fuel metering device that connects to the driver-operated accelerator control system and that by input from the driver-operated accelerator control system controls the engine speed.

Idle position means the position of the throttle at which it first comes in contact with an engine idle speed control appropriate for existing conditions according to the manufacturers' recommendations. These conditions include, but are not limited to, engine speed adjustments for cold engine, air conditioning, and emission control, and the use of throttle setting devices.

Ambient temperature means the surrounding air temperature, at a distance such that it is not significantly affected by heat from the vehicle under test.

S4.2 In the case of vehicles powered by electric motors, the words **throttle** and **idle** refer to the motor speed controller and motor shutdown, respectively.

S5. Requirements. The vehicle shall meet the following requirements when the engine is running under any load condition, and at any ambient temperature between -40°F. and +125°F. after 12 hours of conditioning at any temperature within that range.

S5.1 There shall be at least two sources of energy capable of returning the throttle to the idle position within the time limit specified by S5.3 from any accelerator position or speed whenever the driver removes the opposing actuating force. In the event of failure of one source of energy by a single severance or disconnection, the throttle shall return to the idle position within the time limits specified by S5.3, from any accelerator position or speed whenever the driver removes the opposing actuating force.

S5.2 The throttle shall return to the idle position from any accelerator position or any speed of which the engine is capable whenever any one component of the accelerator control system is disconnected or severed at a single point. The return to idle shall occur within the time limit specified by S5.3, measured either from the time of severance or disconnection or from the first removal of the opposing actuating force by the driver.

S5.3 Except as provided below, maximum time to return to idle position shall be 1 second for vehicles of 10,000 pounds or less GVWR, and 2 seconds for vehicles of more than 10,000 pounds GVWR. Maximum time to return to idle position shall be 3 seconds for any vehicle that is exposed to ambient air at 0 to -40°F. during the test or for any portion of the 12-hour conditioning period.

§571.125 Standard No. 125; Warning devices.

S1. Scope. This standard establishes requirements for devices, without self-contained energy sources, that are designed to be carried in motor vehicles and used to warn approaching traffic of the presence of a stopped vehicle, except for devices designed to be permanently affixed to the vehicle.

S2. Purpose. The purpose of this standard is to reduce deaths and injuries due to rear end collisions between moving traffic and disabled vehicles.

S3. Application. This standard applies to devices, without self-contained energy sources, that are designed to be carried in buses and trucks that have a gross vehicle weight rating (GVWR) greater than 10,000 pounds. These devices are used to warn approaching traffic of the presence of a stopped vehicle, except for devices designed to be permanently affixed to the vehicle.

S4. Definitions.

Entrance angle means the angle having as its sides the line through the center, and normal to the face, of the object to be tested, and the line from the center of the object to the center of the source of illumination (Figure 2).

Fluorescent means the property of emitting visible light due to the absorption of radiation of a shorter wavelength which may be outside the visible spectrum.

Observation angle means the angle having as its sides the line from the observation point to the center of the object to be tested and the line from the center of that object to the center of the source of illumination (Figure 2).

Reflex reflective means reflective of light in directions close to the direction of incident light, over a wide range of variations in the direction of incident light.

S5. Requirements.

S5.1 Equipment.

S5.1.1 Reflex reflective material and fluorescent material that meet the requirements of this standard shall be affixed to both faces of the warning device. Alternatively, a dual purpose orange fluorescent and red reflective material that meets the requirements of this standard (hereafter referred to as "dual purpose material") may be affixed to both faces in places of the reflective and fluorescent materials.

S5.1.2 Each warning device shall be protected from damage and deterioration—

(a) By enclosure in an opaque protective reusable container, except that two or three warning devices intended to be sold for use as a set with a single vehicle may be enclosed in a single container; or

(b) By secure attachment to any light-tight, enclosed, and easily accessible compartment of a new motor vehicle with which it is supplied by the vehicle manufacturer.

S5.1.3 The warning device shall be designed to be erected, and replaced in its container, without the use of tools.

S5.1.4 The warning device shall be permanently and legibly marked with:

(a) Name of manufacturer;

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(b) Month and year of manufacture, which may be expressed numerically, as “6/72”; and

(c) The symbol DOT, or the statement that the warning device complies with all applicable Federal motor vehicle safety standards.

S5.1.5 Each warning device shall have instructions for its erection and display.

(a) The instructions shall be either indelibly printed on the warning device or attached in such a manner that they cannot be easily removed.

(b) Instructions for each warning device shall include a recommendation that the driver activate the vehicular hazard warning signal lamps before leaving the vehicle to erect the warning device.

(c) Instructions shall include the illustration depicted in Figure 3 indicating recommended positioning.

S5.2 Configuration.

S5.2.1 When the warning device is erected on level ground:

(a) Part of the warning device shall form an equilateral triangle that stands in a plane not more than 10° from the vertical, with the lower edge of the base of the triangle horizontal and not less than 1 inch above the ground.

(b) None of the required portion of the reflective material and fluorescent material shall be obscured by any other part of the warning device except for any portion of the material over which it is necessary to provide fasteners, pivoting beads or other means to allow collapsibility or support of the device. In any event, sufficient reflective and fluorescent material shall be used on the triangle to meet the requirements of S5.4 and S5.5.

S5.2.2 Each of the three sides of the triangular portion of the warning device shall not be less than 17 and not more than 22 inches long, and not less than 2 and not more than 3 inches wide (Figure 1).

S5.2.3 Each face of the triangular portion of the warning device shall have an outer border of red reflex reflective material of uniform width and not less than 0.75 and not more than 1.75 inches wide, and an inner border of orange fluorescent material of uniform width and not less than 1.25 and not more than 1.30 inches wide (Figure 1). However, this requirement shall not apply if the dual purpose material is used.

S5.2.4 Each vertex of the triangular portion of the warning device shall have a radius of not less than 0.25 inch and not more than 0.50 inch.

S5.2.5 All edges shall be rounded or chamfered, as necessary, to reduce the possibility of cutting or harm to the user.

S5.2.6 The device shall consist entirely of the triangular portion and attachments necessary for its support and enclosure, without additional visible shapes or attachments.

S5.3 Color.

S5.3.1 The color of the red reflex reflective material on the warning device shall have the following characteristics, both before and after the warning device has been conditioned in accordance with S6.1, when the source of

illumination is a lamp with a tungsten filament operating at 2856° Kelvin color temperature. Expressed in terms of the International Commission on Illumination (CIE) 1931 standard colorimetric observer system (CIE chromaticity diagram, Figure 4), the chromaticity coordinates of the red reflex reflective material shall lie within the region bounded by the spectrum locus and the lines on the diagram defined by the following equations:

Boundary	Equations
Yellow.....	$y = 0.33$
White	$x + y = 0.98$

S5.3.2 The color of the orange fluorescent material on the warning device shall have the following characteristics, both before and after the warning device has been conditioned in accordance with S6.1, when the source of illumination is a 150-watt high pressure xenon compact arc lamp. Expressed in terms of the International Commission on Illumination (CIE) 1931 standard colorimetric observer system, the chromaticity coordinates of the orange fluorescent material shall lie within the region bounded by the spectrum locus and the lines on the diagram defined by the following equations:

Boundary	Equations
Yellow.....	$y = 0.49x + 0.17$
White	$x + y = 0.93$
Red	$y = 0.35$

The 150-watt high pressure xenon compact arc lamp shall illuminate the sample using the unmodified spectrum at an angle of incidence of 45° and an angle of observation of 90°. If dual purpose material is being tested, it shall be illuminated by a 150-watt high pressure xenon compact arc lamp, whose light is diffused by an integrating sphere.

S5.4 **Reflectivity.** When the red reflex reflective material on the warning device is tested in accordance with S6.2, both before and after the warning device has been conditioned in accordance with S6.1, its total candlepower per incident foot candle shall be not less than the values specified in Table I for each of the listed entrance angles.

S5.5 **Luminance.** When the orange fluorescent material on the warning device is tested in accordance with S6.3, both before and after the warning device has been conditioned in accordance with S6.1, it shall have a minimum relative luminance of 25 percent of a flat magnesium oxide surface and a minimum product of that relative luminance and width in inches of 44.

S5.6 **Stability.** When the warning device is erected on a horizontal brushed concrete surface both with and against the brush marks and subjected to a horizontal wind of 40 miles per hour in any direction for 3 minutes—

(a) No part of it shall slide more than 3 inches from its initial position;

(b) Its triangular portion shall not tilt to a position that is more than 10° from the vertical; and

(c) Its triangular position shall not turn through a horizontal angle of more than 10° in either direction from the initial position.

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S5.7 Durability. When the warning device is conditioned in accordance with S6.1, no part of the warning device shall become warped or separated from the rest of the warning device.

S6. Test Procedures.

S6.1 Conditions.

S6.1.1 Submit the warning device to the following conditioning sequence, returning the device after each step in the sequence to ambient air at 68 °F. for at least 2 hours.

(a) Minus 40 °F. for 16 hours in a circulating air chamber using ambient air which would have not less than 30 percent and not more than 70 percent relative humidity at 70 °F.;

(b) 150 °F. for 16 hours in a circulating air oven using ambient air which would have not less than 30 percent and not more than 70 percent relative humidity at 70 °F.;

(c) 100 °F. and 90 percent relative humidity for 16 hours;

(d) Salt spray (fog) test in accordance with ASTM B117-64 (incorporated by reference, see §571.5), except that the test shall be for 4 hours rather than 40 hours; and

(e) Immersion for 2 hours in water at a temperature of 100 °F.

S6.2 Reflectivity Test. Test the red reflex reflective materials as follows:

(a) Unless dual purpose material is used, prevent the orange fluorescent material from affecting the photometric measurement of the reflectivity of the red reflex reflective material, either by separation or masking.

(b) Use a lamp with a tungsten filament operating at 2856° Kelvin color temperature as the source of illumination.

(c) Place the source of illumination 100 feet from the red reflex reflective material (Figure 2).

(d) Place the observation point directly above the source of illumination (Figure 2).

(e) Calculate the total candlepower per incident foot candle of the red reflex reflective material at each of the entrance and observation angles specified in Table 1.

S6.3 Luminance Test. Test the orange fluorescent material as follows:

(a) Unless dual purpose material is used, prevent the red reflex reflective material from affecting the photometric measurement of the luminance of the orange fluorescent material.

(b) Using a 150-watt high pressure xenon compact arc lamp as the light source, illuminate the test sample at an angle of incidence of 45° and an angle of observation of 90°. If dual purpose material is being tested, illuminate the sample diffusely through an integrating sphere.

(c) Measure the luminance of the material at a perpendicular viewing angle, with no ray of the viewing beam more than 5° from the perpendicular to the specimen.

(d) Repeat the procedure for a flat magnesium oxide surface, and compute the quotient (percentage) of the luminance of the material relative to that of the magnesium oxide surface.

Fig. 1 Dimensions of warning device (inches)

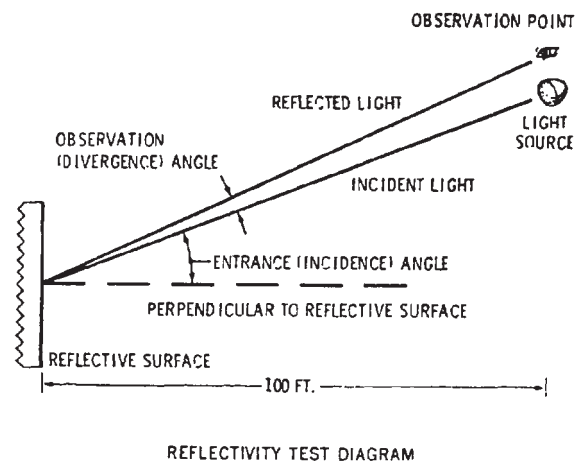
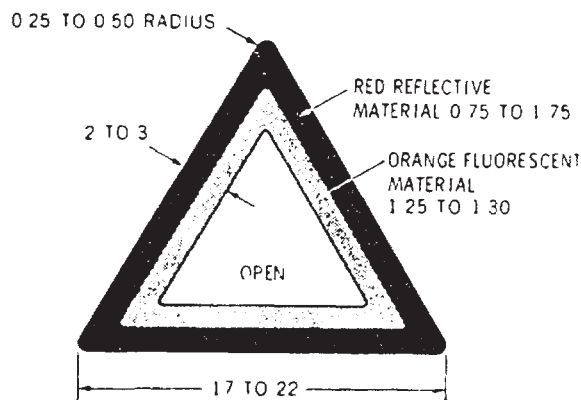
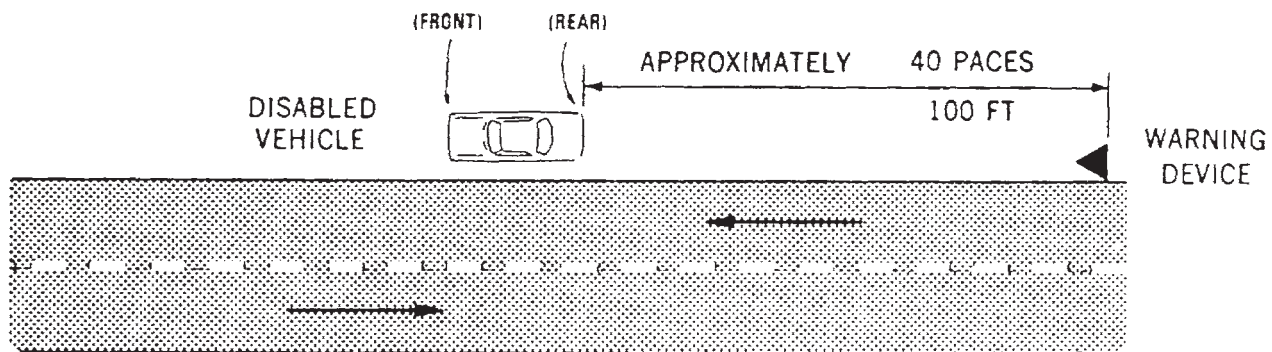


Figure 2

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RECOMMENDED WARNING DEVICE POSITIONING

Figure 3

TOTAL MINIMUM CANDLEPOWER PER INCIDENT FOOT CANDLE

Observation Angles - Degrees	Entrance Angles - Degrees						
	0	10 up	10 down	20 left	20 right	30 left	30 right
0.2	80	80	80	40	40	8.0	8.0
1.5	0.8	0.8	0.8	0.4	0.4	0.08	0.08

Table 1

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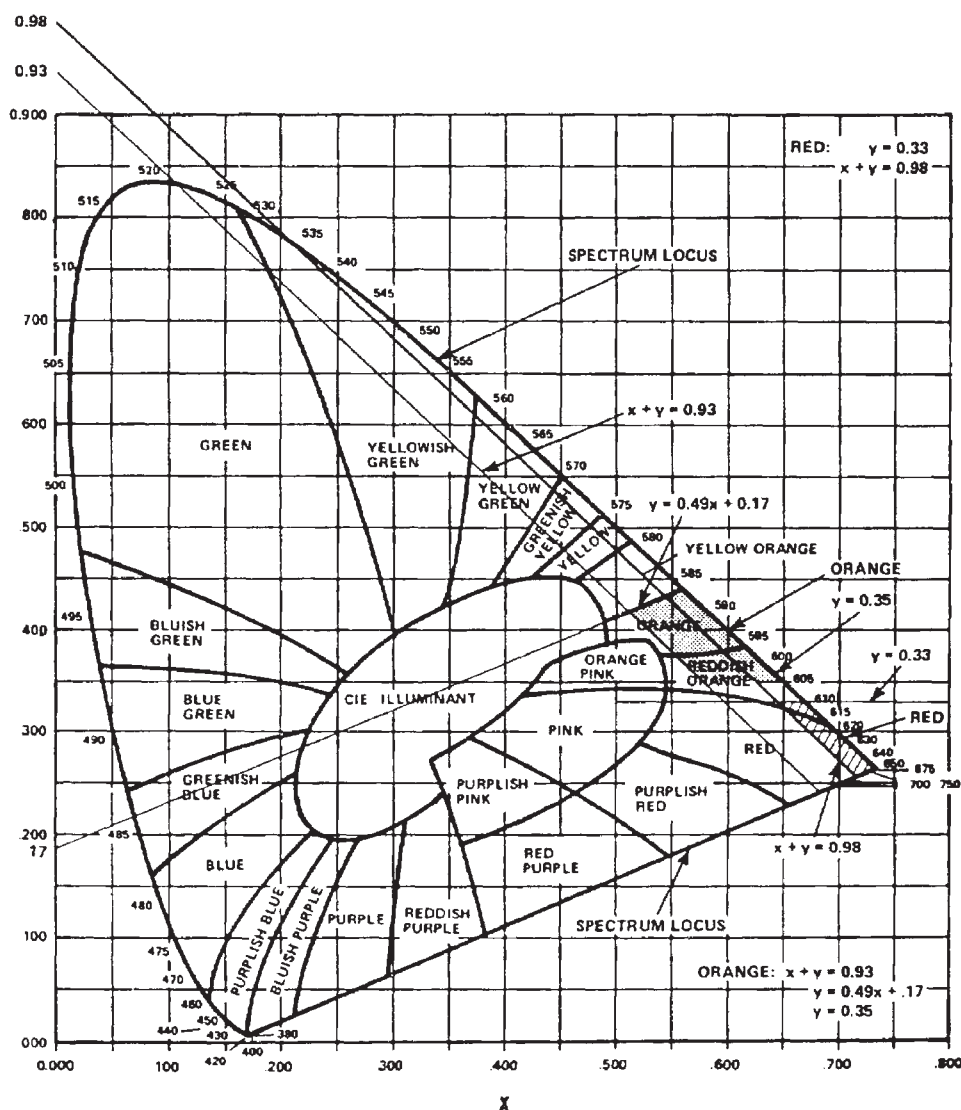


Figure 4. CIE Chromaticity Diagram.

§571.131 Standard No. 131; School bus pedestrian safety devices.

S1. Scope. This standard establishes requirements for devices that can be installed on school buses to improve the safety of pedestrians in the vicinity of stopped school buses.

S2. Purpose. The purpose of this standard is to reduce deaths and injuries by minimizing the likelihood of vehicles passing a stopped school bus and striking pedestrians in the vicinity of the bus.

S3. Application. This standard applies to school buses other than multifunction school activity buses.

S4. Definitions.

Stop signal arm means a device that can be extended outward from the side of a school bus to provide a signal to other motorists not to pass the bus because it has stopped to load or discharge passengers.

S5. Requirements. Each school bus shall be equipped with a stop signal arm meeting the requirements of S5.1 through S5.5 as depicted in Figure 1.

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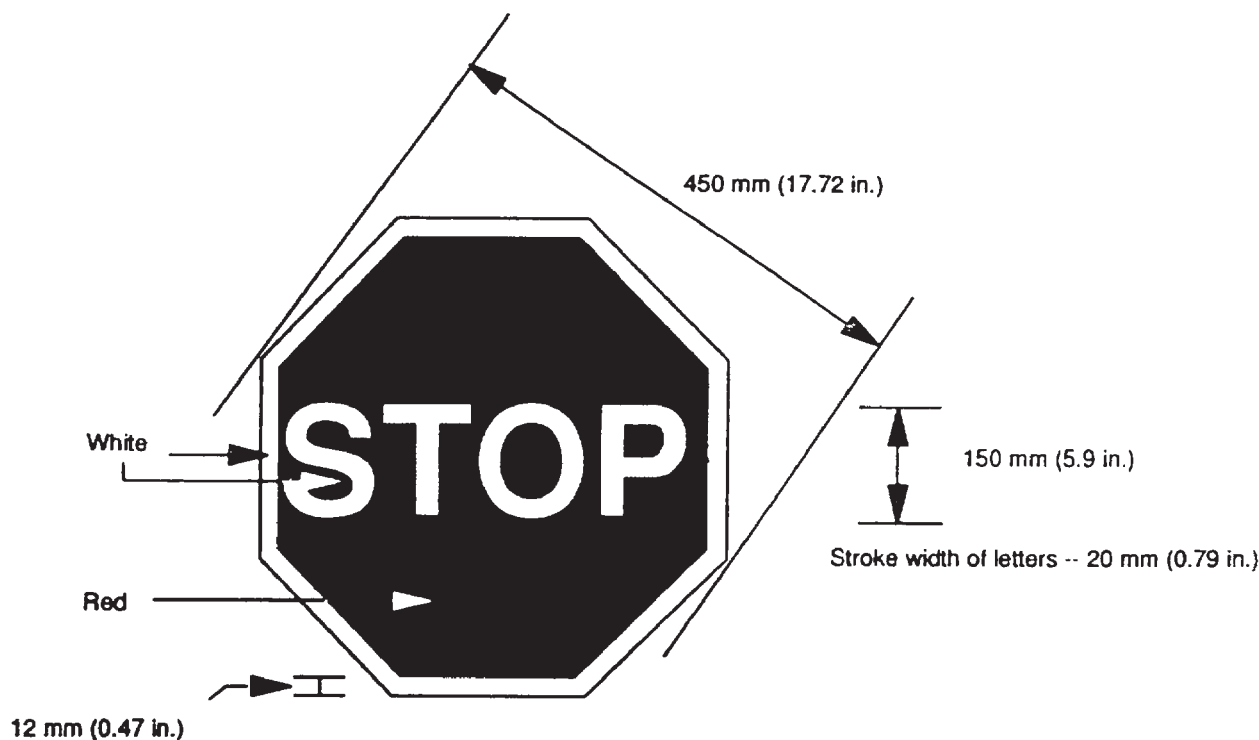


Figure 1. Characteristics of Stop Signal Device

S5.1 The stop signal arm shall be a regular octagon which is at least 450 mm × 450 mm (17.72 inches × 17.72 inches) in diameter.

S5.2 The stop signal arm shall be red on both sides, except as provided in S5.2.1 and S5.2.2, and S5.2.3.

S5.2.1 The stop signal arm shall have a white border at least 12 mm (0.47 inches) wide on both sides, except as provided in S5.2.3. Mounting brackets, clips, bolts, or other components necessary to the mechanical or electrical operation of the stop signal arm may not obscure more than 15 percent of the border on each side of the stop arm. The portion of the border that may be obscured is in addition to that portion which may be obscured by the two red lamps specified in S5.3.2.

S5.2.2 The stop signal arm shall have the word “STOP” displayed in white upper-case letters on both sides, except as provided in S5.2.3. The letters shall be at least 150 mm (5.9 inches) in height. The letters shall have a stroke width of at least 20 mm (0.79 inches), except as provided in S5.3.1.1.

S5.2.3 When two stop signal arms are installed on a school bus, the rearmost stop signal arm shall not contain any lettering, symbols, or markings on the forward side.

S5.3 **Conspicuity.** The stop signal arm shall comply with either S5.3.1 or S5.3.2, or both.

S5.3.1 Except as provided in S5.3.1.1, S5.3.1.2, or S5.3.1.3, the entire surface of both sides of each stop signal arm shall be reflectorized with Type III retroreflectorized material that meets the minimum specific intensity requirements of S6.1 and Table I.

S5.3.1.1 The legend of the retroreflective stop arm may be illuminated in a manner such that light is emitted from the surface of each letter or from the area immediately surrounding each letter. Only red lamps may be used. They shall form the complete shape of each letter of the legend, and shall be affixed to all letters (or to the areas immediately surrounding all letters) in the legend. The shape of each letter shall remain constant and, if the lamps are contained within each letter, the net stroke width (stroke width minus the width of the lamp(s)) of each letter of the legend, specified in S5.2.2, shall not be less than 15 mm (0.59 inch). When the stop arm is extended, the lamps shall flash at the rate specified in S6.2.2, with a current “on” time specified in S6.2.2.1. All lamps shall be positioned in one of the two following ways:

- (1) centered within the stroke of each letter of the legend, or
- (2) outlining each letter of the legend.

S5.3.1.2 Nonreflectorized mounting brackets, clips, bolts, or other components necessary to the mechanical or electrical operation of the stop signal arm shall not obscure more than 7.5 percent of the total surface area of either side of the stop signal arm.

S5.3.1.3 When two stop signal arms are installed on a school bus, the forward side of the rearmost stop signal arm shall not be reflectorized.

S5.3.2 Each side of the stop signal arm shall have at least two red lamps that meet the requirements of S6.2. The lamps shall be centered on the vertical centerline of the stop arm. One of the lamps shall be located at the

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extreme top of the stop arm and the other at its extreme bottom.

S5.4 The stop signal arm shall be installed on the left side of the bus.

S5.4.1 The stop signal arm shall be located such that, when in the extended position:

(a) The stop signal arm is perpendicular to the side of the bus, plus or minus five degrees;

(b) The top edge of the stop signal arm is parallel to and not more than 6 inches from a horizontal plane tangent to the lower edge of the frame of the passenger window immediately behind the driver's window; and

(c) The vertical centerline of the stop signal arm is not less than 9 inches away from the side of the school bus.

S5.4.2 A second stop signal arm may be installed on a school bus. That stop signal arm shall comply with S5.4 and S5.4.1.

S5.5 The stop signal arm shall be automatically extended in such a manner that it complies with S5.4.1, at a minimum whenever the red signal lamps required by S5.1.4 of Standard No. 108 are activated; except that a device may be installed that prevents the automatic extension of a stop signal arm. The mechanism for activating the device shall be within the reach of the driver. While the device is activated, a continuous or intermittent signal audible to the driver shall sound. The audible signal may be equipped with a timing device requiring the signal to sound for at least 60 seconds. If a timing device is used, it shall automatically recycle every time the service entry door is opened while the engine is running and the manual override is engaged.

S6 Test Procedures.

S6.1 **Reflectivity Test.** When tested under the conditions specified in S6.2 (b), (c), and (d) of Federal motor vehicle safety standard 125, Warning Devices, (49 CFR 571.125), the retroreflective materials shall meet the criteria specified in table 1.

TABLE—MINIMUM SPECIFIC INTENSITY PER UNIT AREA (SIA) (CANDELAS PER FOOTCANDLE PER SQUARE FOOT)

Observation Angle (°)	Entrance Angle (°)	White	Red
Type III Retroreflective Element Material			
A—Glass Bead Retroreflective Element Materials			
0.2	-4	250	45
0.2	+30	150	25
0.5	-4	95	15
0.5	+30	65	10
B—Prismatic Retroreflective Element Materials			
0.2	-4	250	45
0.2	+30	95	13.3
0.5	-4	200	28
0.5	+30	65	10

S6.2 Lighting Tests.

S6.2.1 **Color.** The procedure shall be done in accordance with SAE Recommended Practice J578-1988 (incorporated by reference, see §571.5). When visually compared to the light emitted from a filter/source with a combination of chromaticity coordinates as explained in SAE Recommended Practice J578-1988 within specific boundaries [$y=0.33$ (yellow boundary) and $y=0.98$ —

x (purple boundary)] the color of light emitted from the test object shall not be less saturated (paler), yellower, or purpler. The test object shall be placed perpendicular to the light source to simulate lamps on stop signal arms. In making visual comparisons, the light from the test object shall light one portion of a comparison field and the light from the filter/source standard shall light an adjacent area. To make a valid visual comparison, the two fields to be viewed shall be of near equal luminance.

S6.2.2. **Flash rate.** The lamps on each side of the stop signal arm, when operated at the manufacturer's design load, shall flash alternately at a rate of 60 to 120 flashes per minute.

S6.2.2.1 Lamps, except those subject to S6.2.2.2, shall have a current "on" time of 30 to 75 percent of the total flash cycle. The total current "on" time for the two terminals shall be between 90 and 110 percent of the total flash cycle.

S6.2.2.2 Xenon short-arc gaseous discharge lamps shall have an "off" time before each flash of at least 50 percent of the total flash cycle.

S6.2.3 **Vibration, Moisture, Dust, Corrosion, Photometry, and Warpage Tests.** The procedure shall be done in accordance with SAE Recommended Practice J575-1983 (incorporated by reference, see §571.5) and SAE Recommended Practice J1133 (1984) (incorporated by reference, see §571.5). Lamps and lighting components shall meet the criteria for vibration, moisture, dust, corrosion, photometry, and warpage in SAE Recommended Practice J575-1983 and SAE Recommended Practice J1133 (1984) under the test conditions specified herein.

§571.204 Standard No. 204; Steering control rearward displacement.

S1. **Purpose and scope.** This standard specifies requirements limiting the rearward displacement of the steering control into the passenger compartment to reduce the likelihood of chest, neck, or head injury.

S2. **Application.** This standard applies to passenger cars and to multipurpose passenger vehicles, trucks, and buses. However, it does not apply to walk-in vans.

S3. Definitions.

Steering column means a structural housing that surrounds a steering shaft.

Steering shaft means a component that transmits steering torque from the steering wheel to the steering gear.

S4 Requirements.

S4.1 **Vehicles manufactured before September 1, 1991.** When a passenger car or a truck, bus, or multipurpose passenger vehicle with a gross vehicle weight rating of 10,000 pounds or less and an unloaded vehicle weight of 4,000 pounds or less is tested under the conditions of S5 in a 30 mile per hour perpendicular impact into a fixed collision barrier, the upper end of the steering column and shaft in the vehicle shall not be displaced more than 5 inches in a horizontal rearward direction parallel to the longitudinal axis of the vehicle. The amount of displacement shall be measured relative to an undisturbed point on the vehicle and shall represent the

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maximum dynamic movement of the upper end of the steering column and shaft during the crash test.

S4.2 Vehicles manufactured on or after September 1, 1991. When a passenger car or a truck, bus or multipurpose passenger vehicle with a gross vehicle weight rating of 4,536 kg or less and an unloaded vehicle weight of 2,495 kg or less is tested under the conditions of S5 in a 48 km/h perpendicular impact into a fixed collision barrier, the upper end of the steering column and shaft in the vehicle shall not be displaced more than 127 mm in a horizontal rearward direction parallel to the longitudinal axis of the vehicle. The amount of displacement shall be measured relative to an undisturbed point on the vehicle and shall represent the maximum dynamic movement of the upper end of the steering column and shaft during the crash test.

S5 Test conditions. The requirements of S4 shall be met when the vehicle is tested in accordance with the following conditions.

S5.1 The vehicle, including test devices and instrumentation, is loaded to its unloaded vehicle weight.

S5.2 Adjustable steering controls are adjusted so that a tilting steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. A telescoping steering control is set at the adjustment position midway between the forwardmost and rearwardmost position.

S5.3 Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S5.4 Doors are fully closed and latched but not locked.

S5.5 The fuel tank is filled to any level from 90 to 95 percent of capacity.

S5.6 The parking brake is disengaged and the transmission is in neutral.

S5.7 Tires are inflated to the vehicle manufacturer's specifications.

§571.205 Standard No. 205, Glazing materials.

S1. Scope. This standard specifies requirements for glazing materials for use in motor vehicles and motor vehicle equipment.

S2. Purpose. The purpose of this standard is to reduce injuries resulting from impact to glazing surfaces, to ensure a necessary degree of transparency in motor vehicle windows for driver visibility, and to minimize the possibility of occupants being thrown through the vehicle windows in collisions.

S3. Application.

(a) This standard applies to passenger cars, multipurpose passenger vehicles, trucks, buses, motorcycles, slide-in campers, pickup covers designed to carry persons while in motion and low speed vehicles, and to glazing materials for use in those vehicles.

(b) For glazing materials manufactured before September 1, 2006, and for motor vehicles, slide-in campers and pickup covers designed to carry persons while in motion, manufactured before November 1, 2006, the manufacturer may, at its option, comply with 49 CFR 571.205(a) of this section.

S4. Definitions.

Bullet resistant shield means a shield or barrier that is installed completely inside a motor vehicle behind and separate from glazing materials that independently comply with the requirements of this standard.

Camper means a structure designed to be mounted in the cargo area of a truck, or attached to an incomplete vehicle with motive power, for the purpose of providing shelter for persons.

Glass-plastic glazing material means a laminate of one or more layers of glass and one or more layers of plastic in which a plastic surface of the glazing faces inward when the glazing is installed in a vehicle.

Pickup cover means a camper having a roof and sides but without a floor, designed to be mounted on and removable from the cargo area of a truck by the user.

Prime glazing manufacturer means a manufacturer that fabricates, laminates, or tempers glazing materials.

Slide-in camper means a camper having a roof, floor, and sides, designed to be mounted on and removable from the cargo area of a truck by the user.

S5. Requirements.

S5.1 Glazing materials for use in motor vehicles must conform to ANSI/SAE Z26.1-1996 (incorporated by reference, see §571.5), unless this standard provides otherwise. SAE Recommended Practice J673 (1993) (incorporated by reference, see §571.5) is referenced in ANSI/SAE Z26.1-1996.

S5.1.1 Multipurpose passenger vehicles. Except as otherwise specifically provided by this standard, glazing for use in multipurpose passenger vehicles shall conform to the requirements for glazing for use in trucks as specified in ANSI/SAE Z26.1-1996 (incorporated by reference, see §571.5).

S5.1.2 Aftermarket replacement glazing. Glazing intended for aftermarket replacement is required to meet the requirements of this standard or the requirements of 49 CFR 571.205(a) applicable to the glazing being replaced.

S5.1.3 Location of arrow within "AS" markings. In ANSI/SAE Z26.1-1996 (incorporated by reference, see §571.5) Section 7. "Marking of Safety Glazing Materials," on page 33, in the right column, in the first complete sentence, the example markings "AS↓1", "AS↓14" and "AS↑2" are corrected to read "A↓S1", "A↓S14" and "A↑S2". Note that the arrow indicating the portion of the material that complies with Test 2 is placed with its base adjacent to a horizontal line.

S5.2 Each of the test specimens described in ANSI/SAE Z26.1-1996 (incorporated by reference, see §571.5) Section 5.7 (fracture test) must meet the fracture test requirements of that section when tested in accordance with the test procedure set forth in that section.

S5.3 Shade Bands. Shade band areas for windshields shall comply with the requirements of either S5.3.1 or S5.3.2.

S5.3.1 Shade bands for windshields shall comply with SAE Recommended Practice J100 (1995) (incorporated by reference, see §571.5).

S5.3.2 Except as provided in S5.3.2.1, the lower boundary of shade bands for windshields shall be a plane

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inclined upwards from the X axis of the vehicle at 7 degrees, passing through point V₁, and parallel to the Y axis. The coordinate system and point V₁ shall be as specified in Annexes 18 and 19 of European Commission for Europe (ECE) Regulation No. 43 Revision 2-Amendment 1.

S5.3.2.1 In the area 300 mm wide centered on the intersection of the windshield surface and longitudinal vertical median plane of the vehicle, the lower boundary of shade bands for windshields shall be a plane inclined upwards from the X axis of the vehicle at 3 degrees, passing through point V₁, and parallel to the Y axis.

S5.4 **Low speed vehicles.** Windshields of low speed vehicles must meet the ANSI/SAE Z26.1-1996 specifications for either AS-1 or AS-4 glazing.

S5.5 Item 4A Glazing. Item 4A glazing may be used in all areas in which Item 4 safety glazing may be used, and also for side windows rearward of the “C” pillar. I.e., Item 4A glazing may be used under Item 4A paragraph (b) of ANSI/SAE Z26.1-1996 only in side windows rearward of the “C” pillar.

S6. Certification and marking.

S6.1 A prime glazing material manufacturer must certify, in accordance with 49 U.S.C. 30115, each piece of glazing material to which this standard applies that is designed—

(a) As a component of any specific motor vehicle or camper; or

(b) To be cut into components for use in motor vehicles or items of motor vehicle equipment.

S6.2 A prime glazing manufacturer certifies its glazing by adding to the marks required by section 7 of ANSI/SAE Z26.1-1996, in letters and numerals of the same size, the symbol “DOT” and a manufacturer’s code mark that NHTSA assigns to the manufacturer. NHTSA will assign a code mark to a manufacturer after the manufacturer submits a written request to the Office of Vehicle Safety Compliance, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. The request must include the company name, address, and a statement from the manufacturer certifying its status as a prime glazing manufacturer as defined in S4.

S6.3 A manufacturer or distributor who cuts a section of glazing material to which this standard applies, for use in a motor vehicle or camper, must—

(a) Mark that material in accordance with section 7 of ANSI/SAE Z26.1-1996; and

(b) Certify that its product complies with this standard in accordance with 49 U.S.C. 30115.

§571.205(a) Glazing equipment manufactured before September 1, 2006 and glazing materials used in vehicles manufactured before November 1, 2006.

S1. **Scope.** This standard specifies requirements for glazing equipment manufactured before September 1, 2006 for use in motor vehicles and motor vehicle equipment, and specifies requirements for motor vehicles manufactured before November 1, 2006 and for replacement glazing for those vehicles. A manufacturer may, at

its option, comply with 49 CFR 571.205 instead of this standard.

S2. **Purpose.** The purpose of this standard is to reduce injuries resulting from impact to glazing surfaces, to ensure a necessary degree of transparency in motor vehicle windows for driver visibility, and to minimize the possibility of occupants being thrown through the vehicle windows in collisions.

S3. **Application.** This standard applies to glazing equipment manufactured before September 1, 2006 for use in motor vehicles and motor vehicle equipment. In addition, this standard applies to the following vehicles manufactured before November 1, 2006: passenger cars, low speed vehicles, multipurpose passenger vehicles, trucks, buses, and motorcycles. This standard also applies to slide-in campers, and pickup covers designed to carry persons while in motion, manufactured before November 1, 2006.

S4. Definitions

Bullet resistant shield means a shield or barrier that is installed completely inside a motor vehicle behind and separate from glazing materials that independently comply with the requirements of this standard.

Camper means a structure designed to be mounted in the cargo area of a truck, or attached to an incomplete vehicle with motive power, for the purpose of providing shelter for persons.

Glass-plastic glazing material means a laminate of one or more layers of glass and one or more layers of plastic in which a plastic surface of the glazing faces inward when the glazing is installed in a vehicle.

Motor home means a multipurpose passenger vehicle that provides living accommodations for persons.

Pickup cover means a camper having a roof and sides but without a floor, designed to be mounted on and removable from the cargo area of a truck by the user.

Slide-in camper means a camper having a roof, floor, and sides, designed to be mounted on and removable from the cargo area of a truck by the user.

S5. Requirements

S5.1. Materials

S5.1.1 Glazing materials for use in motor vehicles, except as otherwise provided in this standard shall conform to ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5). However, Item 11B glazing as specified in that standard may not be used in motor vehicles at levels requisite for driving visibility, and Item 11B glazing is not required to pass Tests Nos. 17, 30, and 31.

S5.1.1.1 The chemicals specified for testing chemical resistance in Tests Nos. 19 and 20 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5) shall be:

(a) One percent solution of nonabrasive soap.

(b) Kerosene.

(c) Undiluted denatured alcohol, Formula SD No. 30 (1 part 100-percent methyl alcohol in 10 parts 190-proof ethyl alcohol by volume).

(d) Gasoline, ASTM Reference Fuel C, which is composed of Isooctane 50 volume percentage and Toluene 50 volume percentage. Isooctane must conform to A2.7 in

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the ASTM Motor Fuels section (incorporated by reference, see §571.5), and Toluene must conform to ASTM D362-84 (incorporated by reference, see §571.5), Standard Specification for Industrial Grade Toluene. ASTM Reference Fuel C must be used as specified in:

- (1) Paragraph A2.3.2 and A2.3.3 in the ASTM Motor Fuels section (incorporated by reference, see §571.5); and
- (2) OSHA Standard 29 CFR 1910.106—“Handling Storage and Use of Flammable Combustible Liquids.”

S5.1.1.2 The following locations are added to the lists specified in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5) in which item 4, item 5, item 8, and item 9 safety glazing may be used:

- (a)-(i) [Reserved]
- (j) Windows and doors in motor homes, except for the windshield and windows to the immediate right or left of the driver.
- (k) Windows and doors in slide-in campers and pickup covers.
- (l) Windows and doors in buses except for the windshield, windows to the immediate right or left of the driver, and rearmost windows if used for driving visibility.

(m) For Item 5 safety glazing only: Motorcycle windcreens below the intersection of a horizontal plane 380 millimeters vertically above the lowest seating position.

S5.1.1.3 The following locations are added to the lists specified in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5) in which item 6 and item 7 safety glazing may be used:

- (a)-(i) [Reserved]
- (j) Windows and doors in motor homes, except for the windshield, forward-facing windows, and windows to the immediate right or left of the driver.
- (k) Windows, except forward-facing windows, and doors in slide-in campers and pickup covers.
- (l) For item 7 safety glazing only:
 - (1) Standee windows in buses.
 - (2) Interior partitions.
 - (3) Openings in the roof.

S5.1.1.4 The following locations are added to the lists specified in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5) in which item 8 and item 9 safety glazing may be used:

- (a)-(e) [Reserved]
- (f) Windows and doors in motor homes, except for the windshield and windows to the immediate right or left of the driver.
- (g) Windows and doors in slide-in campers and pickup covers.

S5.1.1.5 The phrase “readily removable” windows as defined in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5), for the purposes of this standard, in buses having a GVWR of more than 4536 kilograms (10,000 pounds), shall include pushout windows and windows mounted in emergency exits that can be manually pushed out of their location in the vehicle without the use of tools, regardless of

whether such windows remain hinged at one side to the vehicle.

S5.1.1.6 Multipurpose passenger vehicles. Except as otherwise specifically provided by this standard, glazing for use in multipurpose passenger vehicles shall conform to the requirements for glazing for use in trucks as specified in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5).

S5.1.1.7 Test No. 17 is deleted from the list of tests specified in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5) for Item 5 glazing material and Test No. 18 is deleted from the lists of tests specified in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980, for Item 3 and Item 9 glazing material.

S5.1.2 In addition to the glazing materials specified in ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5), materials conforming to S5.1.2.1, S5.1.2.2, S5.1.2.3, S5.1.2.4, S5.1.2.5, S5.1.2.6, S5.1.2.7, S5.1.2.8, and S5.1.2.11 may be used in the locations of motor vehicles specified in those sections.

S5.1.2.1 Item 11C—Safety Glazing Material for Use in Bullet Resistant Shields. Item 11C—Safety Glazing Material for Use in Bullet Resistant Shields. Bullet resistant glazing that complies with Tests Nos. 2, 17, 19, 20, 21, 24, 27, 28, 29, 30 and 32 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5) and the labeling requirements of S5.1.2.5 may be used only in bullet resistant shields that can be removed from the motor vehicle easily for cleaning and maintenance. A bullet resistant shield may be used in areas requisite for driving visibility only if the combined parallel luminous transmittance with perpendicular incidence through both the shield and the permanent vehicle glazing is at least 60 percent.

S5.1.2.2 Item 12—Rigid Plastics. Safety plastics materials that comply with Tests Nos. 10, 13, 16, 19, 20, 21, and 24 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5), with the exception of the test for resistance to undiluted denatured alcohol Formula SD No. 30, and that comply with the labeling requirements of S5.1.2.5, may be used in a motor vehicle only in the following specified locations at levels not requisite for driving visibility.

- (a) Window and doors in slide-in campers and pickup covers.
- (b) Motorcycle windcreens below the intersection of a horizontal plane 380 millimeters vertically above the lowest seating position.
- (c) Standee windows in buses.
- (d) Interior partitions.
- (e) Openings in the roof.
- (f) Flexible curtains or readily removable windows or in ventilators used in conjunction with readily removable windows.
- (g) Windows and doors in motor homes, except for the windshield and windows to the immediate right or left of the driver.

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(h) Windows and doors in buses, except for the windshield and window to the immediate right and left of the driver.

S5.1.2.3 Item 13—Flexible plastics. Safety plastic materials that comply with Tests Nos. 16, 19, 20, 22, and 23 or 24 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5), with the exception of the test for resistance to undiluted denatured alcohol Formula SD No. 30, and that comply with the labeling requirements of S5.1.2.5 may be used in the following specific locations at levels not requisite for driving visibility.

(a) Windows, except forward-facing windows, and doors in slide-in campers and pickup covers.

(b) Motorcycle windscreens below the intersection of a horizontal plane 380 millimeters vertically above the lowest standing position.

(c) Standee windows in buses.

(d) Interior partitions.

(e) Openings in the roof.

(f) Flexible curtains or readily removable windows or in ventilators used in conjunction with readily removable windows.

(g) Windows and doors in motor homes, except for the windshield, forward-facing windows, and windows to the immediate right or left of the driver.

S5.1.2.4 Item 14—Glass Plastics. Glass-plastic glazing materials that comply with the labeling requirements of S5.1.2.10 and Tests Nos. 1, 2, 3, 4, 9, 12, 15, 16, 17, 18, 19, 24, 26, and 28, as those tests are modified in S5.1.2.9, Test Procedures for Glass-Plastics, may be used anywhere in a motor vehicle, except that it may not be used in windshields of any of the following vehicles: convertibles, vehicles that have no roof, vehicles whose roofs are completely removable.

S5.1.2.5 Item 15A—Annealed Glass-Plastic for Use in All Positions in a Vehicle Except the Windshield. Glass-plastic glazing materials that comply with Tests Nos. 1, 2, 3, 4, 9, 12, 16, 17, 18, 19, 24, and 28, as those tests are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used anywhere in a motor vehicle except the windshield.

S5.1.2.6 Item 15B—Tempered Glass-Plastic for Use in All Positions in a Vehicle Except the Windshield. Glass-plastic glazing materials that comply with Tests Nos. 1, 2, 3, 4, 6, 7, 8, 16, 17, 18, 19, 24, and 28, as those tests are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used anywhere in a motor vehicle except the windshield.

S5.1.2.7 Item 16A—Annealed Glass-Plastic for Use in All Positions in a Vehicle Not Requisite for Driving Visibility. Glass-plastic glazing materials that comply with Tests Nos. 3, 4, 9, 12, 16, 19, 24, and 28, as those tests are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used in a motor vehicle in all locations not requisite for driving visibility.

S5.1.2.8 Item 16B—Tempered Glass-Plastic for Use in All Positions in a Vehicle Not Requisite for Driving Visibility. Glass-plastic glazing materials that comply with Tests Nos. 3, 4, 6, 7, 8, 16, 19, 24, and 28, as those tests

are modified in S5.1.2.9 Test Procedures for Glass-Plastics, may be used in a motor vehicle in all locations not requisite for driving visibility.

S5.1.2.9—Test Procedures for Glass-Plastics. (a) Tests Nos. 6, 7, 8, 9, 12, 16, and 18, shall be conducted on the glass side of the specimen, i.e., the surface which would face the exterior of the vehicle. Tests Nos. 17, 19, 24, and 26 shall be conducted on the plastic side of the specimen, i.e., the surface which would face the interior of the vehicle. Test No. 15 should be conducted with the glass side of the glazing facing the illuminated box and the screen, respectively. For Test No. 19, add the following to the specified list: an aqueous solution of isopropanol and glycol ether solvents in concentration no greater than ten percent or less than five percent by weight and ammonium hydroxide no greater than five percent or less than one percent by weight, simulating typical commercial windshield cleaner.

(b) Glass-plastic specimens shall be exposed to an ambient air temperature of -40 degrees Celsius (plus or minus 5 degrees Celsius), for a period of 6 hours at the commencement of Test No. 28, rather than at the initial temperature specified in that test. After testing, the glass-plastic specimens shall show no evidence of cracking, clouding, delaminating, or other evidence of deterioration.

(c) Glass-plastic specimens tested in accordance with Test No. 17 shall be carefully rinsed with distilled water following the abrasion procedure and wiped dry with lens paper. After this procedure, the arithmetic means of the percentage of light scattered by the three specimens as a result of abrasion shall not exceed 4.0 percent.

(d) Data obtained from Test No. 1 should be used when conducting Test No. 2.

(e)(1) Except as provided in S5.1.2.9(e)(2), glass-plastic glazing specimens tested in accordance with Tests Nos. 9, 12, and 26 shall be clamped in the test fixture in Figure 1 of this standard in the manner shown in that figure. The clamping gasket shall be made of rubber 3 millimeters (mm) thick of hardness 50 IRHD (International Rubber Hardness Degrees), plus or minus five degrees. Movement of the test specimen, measured after the test, shall not exceed 2 mm at any point along the inside periphery of the fixture. Movement of the test specimen beyond the 2 mm limit shall be considered an incomplete test, not a test failure. A specimen used in such an incomplete test shall not be retested.

(2) At the option of the manufacturer, glass-plastic glazing specimens tested in accordance with Tests Nos. 9 and 12 may be tested unclamped. Such specimens shall be tested using the fixture in Figure 1 of the standard, including the upper frame (unclamped) which holds the specimen in place.

S5.1.2.10 Cleaning Instructions. (a) Each manufacturer of glazing materials designed to meet the requirements of S5.1.2.1., S5.1.2.2, S5.1.2.3, S5.1.2.4, S5.1.2.5, S5.1.2.6, S5.1.2.7, S5.1.2.8, or S5.1.2.11 shall affix a label, removable by hand without tools, to each item of glazing materials. The label shall identify the product involved, specify instructions and agents for cleaning the material that will minimize the loss of transparency, and instructions for removing frost and ice, and, at the option of the

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manufacturer, refer owners to the vehicle's Owners Manual for more specific cleaning and other instructions.

(b) Each manufacturer of glazing materials designed to meet the requirements of paragraphs S5.1.2.4, S5.1.2.5, S5.1.2.6, S5.1.2.7, or S5.1.2.8 may permanently and indelibly mark the lower center of each item of such glazing material, in letters not less than 4.5 millimeters nor more than 6 millimeters high, the following words, GLASS PLASTIC MATERIAL-SEE OWNER'S MANUAL FOR CARE INSTRUCTIONS.

S5.1.2.11 Test Procedures for Item 4A—Rigid Plastic for Use in Side Windows Rearward of the "C" Pillar. (a) Glazing materials that comply with Tests Nos. 2, 10, 13, 16, 17, as that test is modified in S5.1.2.9(c) (on the interior side only), 17, as that test is modified in paragraph (b) of this section (on the exterior side only), 19, 20, 21, and 24 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5), may be used in the following specific locations:

(1) All areas in which item 4 safety glazing may be used.

(2) Any side window that meets the criteria in S5.1.2.11(a)(2)(i) and (ii):

(i) Is in a vehicle whose rearmost designated seating position is forward-facing and cannot be adjusted so that it is side or rear-facing; and

(ii) The forwardmost point on its visible interior surface is rearward of the vertical transverse plane that passes through the shoulder reference point (as described in Figure 1 of Section 571.210 Seat belt assembly anchorages) of that rearmost seating position.

(b)(1) The initial maximum haze level shall not exceed 1.0 percent. The specimens are subjected to abrasion for 100 cycles and then carefully wiped with dry lens paper (or its equivalent). The light scattered by the abraded track is measured in accordance with Test 17. The arithmetic mean of the percentages of light scattered by the three specimens shall not exceed 4.0 percent after being subjected to abrasion for 100 cycles.

(2) The specimen is remounted on the specimen holder so that it rotates substantially in a plane and subjected to abrasion for an additional 400 cycles on the same track already abraded for 100 cycles. Specimens are carefully wiped after abrasion with dry lens paper (or its equivalent). The light scattered by the abraded track is then measured as specified in Test 17. The arithmetic mean of the percentages of light scattered by the three specimens shall not exceed 10.0 percent after being subjected to abrasion for 500 cycles.

S5.2 Edges. In vehicles except schoolbuses, exposed edges shall be treated in accordance with SAE Recommended Practice J673a (1967) (incorporated by reference, see §571.5). In schoolbuses, exposed edges shall be banded.

S6. Certification and Marking.

S6.1 Each prime glazing material manufacturer, except as specified below, shall mark the glazing materials it manufactures in accordance with section 6 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5). The materials specified in S5.1.2.1, S5.1.2.2, S5.1.2.3, S5.1.2.4, S5.1.2.5,

S5.1.2.6, S5.1.2.7, S5.1.2.8, and S5.1.2.11 shall be identified by the marks "AS 11C", "AS 12", "AS 13", "AS 14", "AS 15A", "AS 15B", "AS 16A", "AS 16B", and "AS 4", respectively. A prime glazing material manufacturer is one which fabricates, laminates, or tempers the glazing material.

S6.2 Each prime glazing material manufacturer shall certify each piece of glazing material to which this standard applies that is designed as a component of any specific motor vehicle or camper, pursuant to section 114 of the National Traffic and Motor Vehicle Safety Act of 1966 (49 U.S.C. §30115), by adding to the mark required by S6.1 in letters and numerals of the size specified in section 6 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5), the symbol "DOT" and a manufacturer's code mark, which will be assigned by NHTSA on the written request of the manufacturer.

S6.3 Each prime glazing material manufacturer shall certify each piece of glazing material to which this standard applies that is designed to be cut into components for use in motor vehicles or items of motor vehicle equipment, pursuant to section 114 of the National Traffic and Motor Vehicle Safety Act (49 U.S.C. § 30115).

S6.4 Each manufacturer or distributor who cuts a section of glazing material to which this standard applies, for use in a motor vehicle or camper, shall mark that material in accordance with section 6 of ANSI Z26.1-1977, as amended by ANSI Z26.1a-1980 (both incorporated by reference, see §571.5).

S6.5 Each manufacturer or distributor who cuts a section of glazing material to which this standard applies, for use in a motor vehicle or camper, shall certify that his product complies with this standard in accordance with section 114 of the National Traffic and Motor Vehicle Safety Act (49 U.S.C. 30115).

Figure 1.- Top view of a typical back door latch

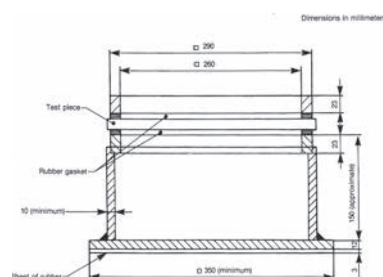


Figure 1 — Test Fixture For Clamped Specimens

§571.206 Standard No. 206; Door locks and door retention components.

S1. Scope and Purpose. This standard specifies requirements for vehicle door locks and door retention components, including latches, hinges, and other supporting means, to minimize the likelihood of occupants being ejected from a vehicle as a result of impact.

S2. Application. This standard applies to passenger cars, multipurpose passenger vehicles, and trucks, and

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buses with a gross vehicle weight rating (GVWR) of 4,536 kg or less.

S3. Definitions.

Auxiliary Door Latch is a latch equipped with a fully latched position, with or without a secondary latched position, and fitted to a door or door system equipped with a primary door latch system.

Auxiliary Door Latch System consists of door latches and strikers other than those associated with the primary door latch system.

Back Door is a door or door system on the back end of a motor vehicle through which passengers can enter or depart the vehicle or cargo can be loaded or unloaded. It does not include:

(a) A trunk lid; or

(b) A door or window composed entirely of glazing material and whose latches and/or hinge systems are attached directly to the glazing material.

Body Member is that portion of the hinge normally affixed to the body structure.

Door Closure Warning System is a system that will activate a visual signal when a door latch system is not in its fully latched position and the vehicle ignition is activated.

Door Hinge System is one or more hinges used to support a door.

Door Latch System consists of latches and strikers installed on a door system.

Door Member is that portion of the hinge normally affixed to the door structure and constituting the swinging member.

Door System is the door, latch, striker, hinges, sliding track combinations and other door retention components on a door and its surrounding doorframe. The door system of a double door includes both doors.

Double Door is a system of two doors where the front door or wing door opens first and connects to the rear door or bolted door, which opens second.

Folding Door is a movable barrier, which will close off an entranceway to a bus, multipurpose passenger vehicle or truck, consisting of two or more hinge panels that swing, slide, or rotate; does not have a striker and latch assembly.

Fork-bolt is the part of the latch that engages and retains the striker when in a latched position.

Fork-bolt Opening Direction is the direction opposite to that in which the striker enters the latch to engage the fork-bolt.

Fully Latched Position is the coupling condition of the latch that retains the door in a completely closed position.

Hinge is a device system used to position the door relative to the body structure and control the path of the door swing for passenger ingress and egress.

Hinge Pin is that portion of the hinge normally interconnecting the body and door members and establishing the swing axis.

Latch is a device employed to maintain the door in a closed position relative to the vehicle body with provisions for deliberate release (or operation).

Primary Door Latch is a latch equipped with both a fully latched position and a secondary latched position

and is designated as a “primary door latch” by the manufacturer.

Primary Door Latch System consists of a primary door latch(s) and a striker(s).

Secondary Latched Position refers to the coupling condition of the latch that retains the door in a partially closed position.

Side Front Door is a door that, in a side view, has 50 percent or more of its opening area forward of the rearmost point on the driver’s seat back, when the seat back is adjusted to its most vertical and rearward position.

Side Rear Door is a door that, in a side view, has 50 percent or more of its opening area to the rear of the rearmost point on the driver’s seat back, when the driver’s seat is adjusted to its most vertical and rearward position.

Striker is a device with which the latch engages to maintain the door in the fully latched or secondary latched position.

Trunk Lid is a movable body panel that provides access from outside the vehicle to a space wholly partitioned from the occupant compartment by a permanently attached partition or fixed or fold-down seat back.

S4. Requirements. The requirements apply to all side and back doors, that lead directly into a compartment that contains one or more seating accommodations and the associated door components, except for those on folding doors, roll-up doors, detachable doors, bus doors used only for emergency egress purposes and labeled accordingly and on bus doors to accommodate a permanently attached wheelchair lift system that when the device is in the retracted position, the lift platform retracts to a vertical orientation parallel to and in close proximity with the interior surface of the lift door and in that position, the platform completely covers the doorway opening, has fixed attachments to the vehicle and provides a barricade to the doorway. The bus wheelchair lift door must be linked to an alarm system consisting of either a flashing visible signal located in the driver’s compartment or an alarm audible to the driver that is activated when the door is not fully closed and the vehicle ignition is activated.

S4.1 Hinged Doors

S4.1.1 Primary and Auxiliary Door Latch Systems.

Each hinged door system shall be equipped with at least one primary door latch system. By the time a vehicle is certified a manufacturer shall designate the door latch system(s) that is the “primary door latch system(s).” Upon certification, a manufacturer may not thereafter alter the designation of a primary door latch system. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding such designation.

S4.1.1.1 Load Test One.

(a) Each primary door latch system and auxiliary door latch system, when in the fully latched position, shall not separate when a load of 11,000 N is applied in the direction perpendicular to the face of the latch such that the latch and the striker anchorage are not compressed against each other, when tested in accordance with S5.1.1.1.

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(b) When in the secondary latched position, the primary door latch system shall not separate when a load of 4,500 N is applied in the same direction specified in paragraph (a) of this section when tested in accordance with S5.1.1.1.

S4.1.1.2 Load Test Two.

(a) Each primary door latch system and auxiliary door latch system, when in the fully latched position, shall not separate when a load of 9,000 N is applied in the fork-bolt opening direction and parallel to the face of the latch, when tested in accordance with S5.1.1.2.

(b) When in the secondary latched position, the primary door latch system shall not separate when a load of 4,500 N is applied in the same direction specified in paragraph (a) of this section when tested in accordance with S5.1.1.2.

S4.1.1.3 Load Test Three. (Applicable only to back doors that open in a vertical direction). Each primary door latch system on back doors, when in the fully latched position, shall not separate when a load of 9,000 N is applied in a direction orthogonal to the directions specified in S4.1.1.1 and S4.1.1.2 when tested in accordance with S5.1.1.3.

S4.1.1.4 Inertial Load. Each primary door latch system and auxiliary door latch system shall meet either the dynamic requirements specified in paragraphs (a) and (b) of S4.1.1.4 or the calculation of inertial load resistance specified in paragraph (c) of S4.1.1.4.

(a) Each primary door latch and auxiliary door latch on each hinged door shall not disengage from the fully latched position when an inertia load is applied to the door latch system, including the latch and its activation device, in the directions parallel to the vehicle's longitudinal and transverse axes with the locking device disengaged, when tested as specified in S5.1.1.4(b).

(b) Each primary door latch and auxiliary door latch on each hinged back door shall also not disengage from the fully latched position when an inertia load is applied to the door latch system, including the latch and its activation device, in the direction parallel to the vehicle's vertical axis with the locking device disengaged, when tested as specified in S5.1.1.4(b).

(c) Each component or subassembly is calculated for its minimum inertial load resistance in a particular direction. The combined resistance to the unlatching operation must assure that the door latch system, when properly assembled in the vehicle door, will remain latched when subjected to an inertial load of 30 g in the vehicle directions specified in paragraph (a) of this section or paragraph (b) of this section, as applicable, when calculated in accordance with S5.1.1.4 (a).

S4.1.2 Door Hinges.

S4.1.2.1 When tested in accordance with S5.1.2, each door hinge system shall:

- (a) Support the door,
- (b) Not separate when a longitudinal load of 11,000 N is applied,
- (c) Not separate when a transverse load of 9,000 N is applied, and
- (d) For back doors,

(1) Not separate when a load of 11,000 N is applied perpendicular to the hinge face plate (longitudinal loadtest) such that the hinge plates are not compressed against each other (Load Test One).

(2) Not separate when a load of 9,000 N is applied perpendicular to the axis of the hinge pin and parallel to the hinge face plate (transverse load test) such that the hinge plates are not compressed against each other (Load Test Two).

(3) Not separate when a load of 9,000 N is applied in the direction of the axis of the hinge pin (Load Test Three—only for back doors that open in a vertical direction).

S4.1.2.2 If a single hinge within the hinge system is tested instead of the entire hinge system, the hinge must bear a load proportional to the total number of hinges in the hinge system. (For example, an individual hinge in a two-hinge system must be capable of withstanding 50% of the load requirements of the total system.)

S4.1.2.3 On side doors with rear mounted hinges that can be operated independently of other doors,

(a) The interior door handle shall be inoperative when the speed of the vehicle is greater than or equal to 4 km/h, and

(b) A door closure warning system shall be provided for those doors. The door closure warning system shall be located where it can be clearly seen by the driver.

S4.2 Sliding Side Doors.

S4.2.1 Latch System. Each sliding door system shall be equipped with either:

- (a) At least one primary door latch system, or
- (b) A door latch system with a fully latched position and a door closure warning system. The door closure warning system shall be located where it can be clearly seen by the driver. Upon certification a manufacturer may not thereafter alter the designation of a primary latch. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding such designation.

S4.2.1.1 Load Test One.

(a) At least one door latch system, when in the fully latched position, shall not separate when a load of 11,000 N is applied in the direction perpendicular to the face of the latch such that the latch and the striker anchorage are not compressed against each other, when tested in accordance with S5.2.1.1.

(b) In the case of a primary door latch system, when in the secondary latched position, the door latch system shall not separate when a load of 4,500 N is applied in the same direction specified in paragraph (a) of this section when tested in accordance with S5.2.1.1.

S4.2.1.2 Load Test Two.

(a) At least one door latch system, when in the fully latched position, shall not separate when a load of 9,000 N is applied in the fork-bolt opening direction and parallel to the face of the latch when tested in accordance with S5.2.1.2.

(b) In the case of a primary door latch system, when in the secondary latched position, the door latch system shall not separate when a load of 4,500 N is applied in

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the same direction specified in paragraph (a) of this section when tested in accordance with S5.2.1.2.

S4.2.1.3 Inertial Load. Each door latch system certified as meeting the requirements of S4.2.1.1 and S4.2.1.2 shall meet either the dynamic requirements specified in paragraph (a) of this section or the calculation of inertial load resistance specified in paragraph (b) of this section.

(a) The door latch system shall not disengage from the fully latched position when an inertial load is applied to the door latch system, including the latch and its activation mechanism, in the directions parallel to the vehicle's longitudinal and transversal axes with the locking mechanism disengaged, and when tested in accordance with S5.1.1.4(b).

(b) The minimum inertial load resistance can be calculated for each component or subassembly. Their combined resistance to the unlatching operation must assure that the door latch system, when properly assembled in the vehicle door, will remain latched when subjected to an inertia load of 30 g in the vehicle directions specified in paragraph (a) of this section, when calculated in accordance with S5.1.1.4(a).

S4.2.2 Door System.

S4.2.2.1 The track and slide combination or other supporting means for each sliding door, while in the closed fully latched position, shall not separate from the door frame when a total force of 18,000 N along the vehicle transverse axis is applied to the door as specified in S5.2.2.

S4.2.2.2 When a sliding door system is tested in accordance with S5.2.2, the following conditions shall not occur:

(a) A separation which permits a sphere with a diameter of 100 mm to pass unobstructed between the exterior of the vehicle to the interior of the vehicle, while the required force is maintained as shown in Figure 1.

(b) Either force application device reaches a total displacement of 300 mm.

S4.2.2.3 This S4.2.2 applies to vehicles manufactured on or after September 1, 2010.

S4.3 Door Locks. Each door shall be equipped with at least one locking device which, when engaged, shall prevent operation of the exterior door handle or other exterior latch release control and which has an operating means and a lock release/engagement device located within the interior of the vehicle.

S4.3.1 Rear side doors. Each rear side door shall be equipped with at least one locking device which has a lock release/engagement mechanism located within the interior of the vehicle and readily accessible to the driver of the vehicle or an occupant seated adjacent to the door, and which, when engaged, prevents operation of the interior door handle or other interior latch release control and requires separate actions to unlock the door and operate the interior door handle or other interior latch release control.

S4.3.2 Back doors. Each back door equipped with an interior door handle or other interior latch release control, shall be equipped with at least one locking device that meets the requirements of S4.3.1.

S5 Test Procedures.

S5.1 Hinged Doors.

S5.1.1 Primary and Auxiliary Door Latches.

S5.1.1.1 Load Test One Force Application. The test procedures for S4.1.1.1 and S4.2.1.1 are as follows:

(a) Fully latched position.

(1) Attach the test fixture shown in Figure 2 to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount the fixture with latch and striker in the fully latched position in the test machine so as to apply a load perpendicular to the face of the latch.

(2) Locate weights so as to apply a 900 N load tending to separate the latch and striker in the direction of the latch opening.

(b) Secondary Latched Position.

(1) Attach the test fixture shown in Figure 2 to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount the fixture with latch and striker in the secondary position in the test machine so as to apply a load perpendicular to the face of the latch.

(2) Locate weights so as to apply a 900 N load tending to separate the latch and striker in the direction of the latch opening.

(3) Apply the test load, in the direction specified in S4.1.1.1 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record maximum load achieved.

(4) The test plate to which the door latch is mounted will have a striker cut-out configuration similar to the environment in which the door latch will be mounted on normal vehicle doors.

S5.1.1.2 Load Test Two Force Application. The test procedures for S4.1.1.2 and S4.2.1.2 are as follows:

(a) Fully Latched Position.

(1) Adapt the test fixture shown in Figure 3 to the mounting provisions of the latch and striker. Mount the fixture with latch and striker in the fully latched position in the test machine so to apply a load in the direction of latch opening.

(2) Apply the test load, in the direction specified in S4.1.1.2 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record the maximum load achieved.

(b) Secondary Latched Position.

(1) Adapt the test fixture shown in Figure 3 to the mounting provisions of the latch and striker. Mount the fixture with latch and striker in the secondary latched position in the test machine so as to apply a load in the direction of latch opening.

(2) Apply the test load, in the direction specified in S4.1.1.2 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record the maximum load achieved.

S5.1.1.3 Load Test Three Force Application. The test procedures for S4.1.1.3 are as follows:

(a) Adapt the test fixture shown in Figure 4 to the mounting provisions of the latch and striker. Mount the

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fixture with latch and striker in the fully latched position in the test machine so as to apply a load in the direction specified in S4.1.1.3 and Figure 5.

(b) Apply the test load, in the direction specified in S4.1.1.3 and Figure 5, at a rate not to exceed 5 mm/min until the required load has been achieved. Record the maximum load required.

S5.1.1.4 Inertial Force Application. The test procedures for S4.1.1.4 and S4.2.1.3 are as follows:

(a) **Calculation.** The calculation is performed in accordance with paragraph 6 of SAE Recommended Practice J839 (1991) (incorporated by reference, see §571.5).

(b) **Dynamic Test.** The dynamic inertial force application is tested according to the setup specified in paragraph (1) or (2) of this section.

(1) Test Setup and Directions for Full Vehicle Test.

(i) Test Setup.

(A) Rigidly secure the full vehicle to an acceleration device that, when accelerated together, will assure that all points on the crash pulse curve are within the corridor defined in Table 1 and Figure 6.

(B) Install the equipment used to record door opening (doors may be tethered to avoid damaging the recording equipment).

(C) Close the door(s) to be tested and ensure that the door latch(es) is in the fully-latched position, that the door(s) is unlocked, and that all windows, if provided, on the door(s) are closed.

(ii) Test Directions. (See Figure 7)

(A) Longitudinal Setup 1. Orient the vehicle so that its longitudinal axis is aligned with the axis of the acceleration device, simulating a frontal impact.

(B) Longitudinal Setup 2. Orient the vehicle so that its longitudinal axis is aligned with the axis of the acceleration device, simulating a rear impact.

(C) Transverse Setup 1. Orient the vehicle so that its transverse axis is aligned with the axis of the acceleration device, simulating a driver-side impact.

(D) Transverse Setup 2. (Only for vehicles having different door arrangements on each side.) Orient the vehicle so that its transverse axis is aligned with the axis of the acceleration device, simulating a side impact in the direction opposite to that described in b(1)(ii)(C) of this paragraph.

(2) Test Setup and Directions for Door Test.

(i) Test Setup.

(A) Mount the door assemblies, consisting of at least the door latch(es), exterior door handle(s) with mechanical latch operation, interior door opening lever(s), and locking device(s), either separately or combined to a test fixture. Each door and striker is mounted to the test fixture to correspond to its orientation on the vehicle and to the directions specified in b(1)(ii) of this paragraph.

(B) Mount the test fixture to the acceleration device, and install the equipment used to record door opening.

(C) Ensure that the door latch is in the fully-latched position, that the door is unlocked (doors may be tethered to avoid damaging the recording equipment), and that any windows, if provided, are closed.

(ii) Test Directions. (See Figure 7)

(A) Longitudinal Setup 1. Orient the door subsystem(s) on the acceleration device in the direction of a frontal impact.

(B) Longitudinal Setup 2. Orient the door subsystem(s) on the acceleration device in the direction of a rear impact.

(C) Transverse Setup 1. Orient the door subsystem(s) on the acceleration device in the direction of a driver-side impact.

(D) Transverse Setup 2. Orient the door subsystem(s) on the acceleration device in the direction opposite to that described in (b)(2)(ii)(C) of this paragraph.

(E) Vertical Setup 1 (applicable only to back doors that open in a vertical direction). Orient the door subsystem(s) on the acceleration device so that its vertical axis (when mounted in the vehicle) is aligned with the axis of the acceleration device, simulating a rollover impact where the force is applied in the direction from the top to the bottom of the door (when mounted in a vehicle).

(F) Vertical Setup 2 (applicable only to back doors that open in a vertical direction). Orient the door subsystem(s) on the acceleration device so that its vertical axis (when mounted in the vehicle) is aligned with the axis of the acceleration device, simulating a rollover impact where the force is applied in the direction opposite to that described in (b)(2)(ii)(E) of this paragraph.

(3) Test Operation.

(i) The acceleration device platform shall be instrumented with an accelerometer and data processing system that conforms to the requirements specified in SAE Recommended Practice J211-1 DEC2003 (incorporated by reference, see §571.5) Channel Class 60. The accelerometer sensitive axis is parallel to the direction of test platform travel.

(ii) Maintaining a minimum acceleration level of 30 g for a period of at least 30 ms, while keeping the recorded acceleration within the pulse corridor defined in Table 1 and Figure 6, accelerate the acceleration device in the following directions:

(A) For Full Vehicle Tests, in the directions specified in S5.1.1.4(b)(1)(ii)(A) through S5.1.1.4(b)(1)(ii)(D).

(B) For Door Tests, in the directions specified in S5.1.1.4(b)(2)(ii)(A) through S5.1.1.4(b)(2)(ii)(F).

(iii) Check recording device for door opening and/or closure during the test.

(iv) If at any point in time, the pulse exceeds 36 g and the test specifications are met, the test shall be considered valid.

S5.1.2 Door Hinges. The test procedures for S4.1.2 are as follows:

S5.1.2.1 Multiple Hinge Evaluation;

S5.1.2.1.1 Longitudinal Load Test.

(a) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge in the system to the extreme end of another hinge in the system is to be set at 406 mm $\pm$ 4 mm. The load is to be applied equidistant between the linear center of the

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engaged portions of the hinge pins and through the centerline of the hinge pin in the longitudinal vehicle direction (see Figure 8).

(b) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Record maximum load achieved.

S5.1.2.1.2 Transverse Load Test

(a) Attach the test fixture shown in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge in the system to the extreme opposite end of another hinge in the system is to be set at 406 ± 4 mm. The load is to be applied equidistant between the linear center of the engaged portions of the hinge pins and through the centerline of the hinge pin in the transverse vehicle direction (see Figure 8).

(b) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Record maximum load achieved.

S5.1.2.2 Back Door Hinge Load Test

(a) Load Test One

(1) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge system in the system to the extreme opposite end of another hinge system is to be set at 406 ± 4 mm. The load is to be applied equidistant between the linear center of the engaged portions of the hinge pins and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(1). (See Figure 9).

(2) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record the maximum load achieved.

(b) Load Test Two

(1) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one hinge system in the system to the extreme opposite end of another hinge system is to be set at 406 ± 4 mm. The load is to be applied equidistant between the linear center of the engaged portions of the hinge pins and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(2). (See Figure 9).

(2) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record the maximum load achieved.

(c) Load Test Three

(1) Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge system. Hinge attitude is configured to simulate vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the distance between the extreme end of one

hinge system in the system to the extreme opposite end of another hinge system is to be set at 406 ± 4 mm. The load is to be applied through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(3). (See Figure 9).

(2) Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record the maximum load achieved.

S5.1.2.3 Single Hinge Evaluation. Individual hinges of a hinge system are tested in accordance with the procedures below:

(a) **Longitudinal Load.** Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin in the longitudinal vehicle direction. Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(b) **Transverse Load.** Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin in the transverse vehicle direction. Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(c) Back Door Hinge Load Tests.

(1) **Load Test One.** Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(1). (See Figure 9). Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(2) **Load Test Two.** Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position (door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied equidistant between the linear center of the engaged portions of the hinge pin and through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(2). (See Figure 9). Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

(3) **Load Test Three.** Attach the test fixture illustrated in Figure 8 to the mounting provisions of the hinge. Hinge attitude is configured to simulate the vehicle position

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(door fully closed) relative to the hinge centerline. For test purposes, the load is to be applied through the centerline of the hinge pin, and as specified in S4.1.2.1(d)(3). (See Figure 9). Apply the test load at a rate not to exceed 5 mm/min until the required load has been achieved. Failure consists of a separation of either hinge. Record maximum load achieved.

S5.1.2.4 For piano-type hinges, the hinge spacing requirements are not applicable and arrangement of the test fixture is altered so that the test forces are applied to the complete hinge.

S5.2 Sliding Side Doors.

S5.2.1 Door Latches.

S5.2.1.1 **Load Test One Force Application.** The requirements of S4.2.1.1 are tested in accordance with the procedures specified in S5.1.1.1.

S5.2.1.2 **Load Test Two Force Application.** The requirements of S4.2.1.2 are tested in accordance with the procedures specified in S5.1.1.2.

S5.2.1.3 [Reserved]

S5.2.1.4 [Reserved]

S5.2.2 **Door System.** The test procedures for S4.2.2 are as follows:

S5.2.2.1 Tests are conducted using a full vehicle with the sliding door and its retention components.

S5.2.2.2 The test is conducted using two force application devices capable of applying the outward transverse forces specified in S5.2.2.4. The test setup is shown in Figure 10. The force application system shall include the following:

- (a) Two force application plates,
- (b) Two force application devices capable of applying the outward transverse load requirements for a minimum displacement of 300 mm.
- (c) Two load cells of sufficient capacity to measure the applied loads specified in S5.2.2.4.
- (d) Two linear displacement measurement devices required for measuring force application device displacement during the test.
- (e) Equipment to measure for a 100 mm separation as specified in S4.2.2.2(a), while respecting all relevant safety and health requirements.

S5.2.2.3 Test Setup.

(a) Remove all interior trim and decorative components from the sliding door assembly.

(b) Remove seats and any interior components that may interfere with the mounting and operation of the test equipment and all pillar trim and any non-structural components that overlap the door and cause improper placement of the force application plates.

(c) Each force application device and associated support structure is rigidly fixed on a horizontal surface on the vehicle floor, while applying the loads.

(d) Determine the forward and aft edge of the sliding door, or its adjoining vehicle structure, that contains a latch/striker.

(e) Close the sliding door, ensuring that all door retention components are fully engaged.

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(f) For any tested door edge that contains one latch/striker, the following set-up procedures are used:

(1)(i) The force application plate is 150 mm in length, 50 mm in width, and at least 15 mm in thickness. The plate edges are rounded to a radius of $6 \text{ mm} \pm 1 \text{ mm}$.

(ii) The plates are fixed perpendicular to the force application devices and move in the transverse direction. For alignment purposes, each plate is attached to the application device in a manner that allows for rotation about the vehicle's y-axis. In this manner, the face of each plate remains parallel to the vertical plane which passes through the vehicle's longitudinal centerline.

(2) Place the force application device and force application plate against the door so that the applied force is perpendicular to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline, and vertically centered on the door-mounted portion of the latch/striker.

(3) The force application plate is positioned such that the long edge of the plate is as close to the interior edge of the door as possible, but not such that the forward edge of forward plate and the rear edge of the rear plate are more than 12.5 mm from the respective interior edges.

(g) For any tested door edge that contains more than one latch/striker, the following setup procedures are used:

(1)(i) The force application plate is 300 mm in length, 50 mm in width, and at least 15 mm in thickness. The plate edges are rounded to a radius of $6 \text{ mm} \pm 1 \text{ mm}$.

(ii) The plates are fixed perpendicular to the force application devices and move in the transverse direction. For alignment purposes, each plate is attached to the application device in a manner that allows for rotation about the vehicle's y-axis. In this manner, the face of each plate remains parallel to the vertical plane which passes through the vehicle's longitudinal centerline.

(2) Place the force application device and force application plate against the door so that the applied force is perpendicular to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline, and vertically centered on a point mid-way between the outermost edges of the latch/striker assemblies.

(3) The force application plate is positioned such that the long edge of the plate is as close to the interior edge of the door as possible, but not such that the forward edge of forward plate and the rear edge of the rear plate are more than 12.5 mm from the respective interior edges.

(h) For any tested door edge that does not contain at least one latch/striker, the following set-up procedures are used:

(1)(i) The force application plate is 300 mm in length, 50 mm in width, and at least 15 mm in thickness. The plate edges are rounded to a radius of $6 \text{ mm} \pm 1 \text{ mm}$.

(ii) The plates are fixed perpendicular to the force application devices and move in the transverse direction. For alignment purposes, each plate is attached to the application device in a manner that allows for rotation about the vehicle's y-axis. In this manner, the face of each plate remains parallel to the vertical plane which passes through the vehicle's longitudinal centerline.

(2) Place the force application device and force application plate against the door so that the applied force is perpendicular to the vertical longitudinal plane that passes through the vehicle's longitudinal centerline, and vertically centered on a point mid-way along the length of the door edge ensuring that the loading device avoids contact with the window glazing.

(3) The force application plate is positioned such that the long edge of the plate is as close to the interior edge of the door as possible, but not such that the forward edge of forward plate and the rear edge of the rear plate are more than 12.5 mm from the respective interior edges.

(i) The door is unlocked. No extra fixtures or components may be welded or affixed to the sliding door or any of its components.

(j) Place the load application structure so that the force application plates are in contact with the interior of the sliding door.

(k) Apply a preload of 500 N to each actuator and "zero" the displacement measuring device.

S5.2.2.4 Test Procedure.

(a) Increase the force on each force application device as linearly as practicable until a force of 9,000 N is achieved on each force application device in not less than 90 seconds and not more than 120 seconds, or until either force application device reaches a total displacement of 300 mm.

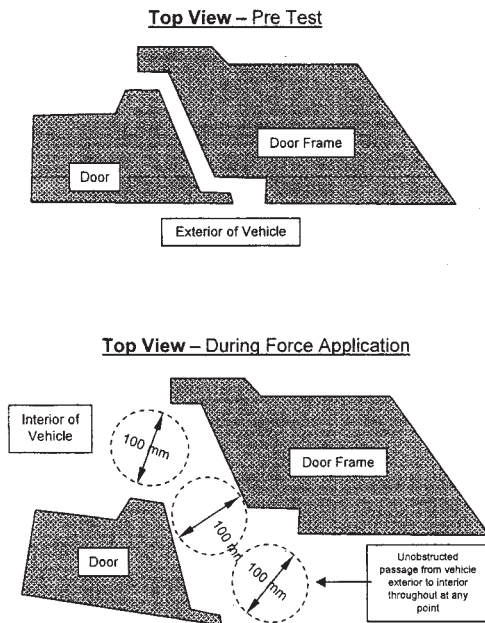
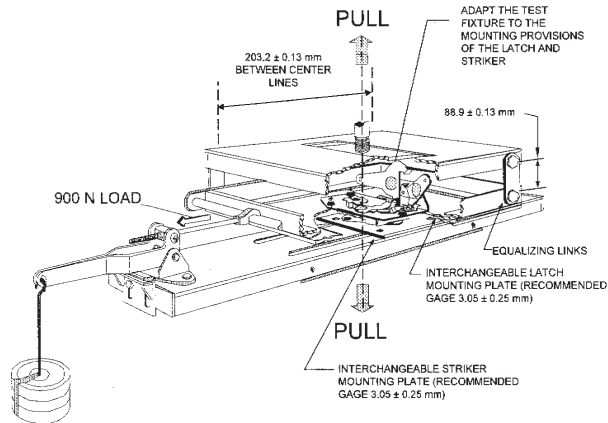
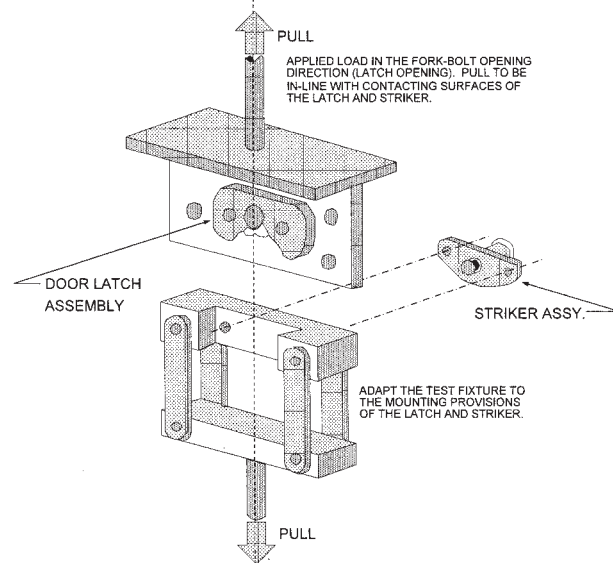
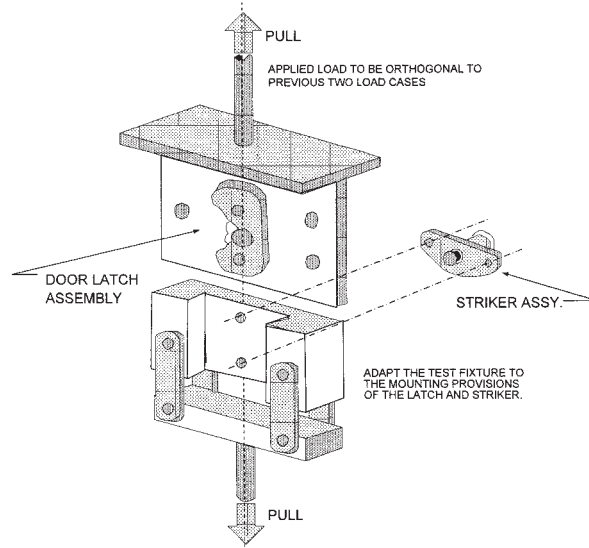
(b) If one of the force application devices reaches the target force of 9,000 N prior to the other, maintain the 9,000 N force with that force application device until the second force application device reaches the 9,000 N force.

(c) Once both force application devices have achieved 9,000 N each hold the resulting load.

(d) Maintain each force application device load as specified in paragraph (c) and within 30 seconds measure the separation between the exterior edge of the doorframe and the interior of the door along the perimeter of the door.

S5.3 [Reserved]

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FIGURE 1. EVALUATION OF SLIDING DOOR GAP SEPARATION

FIGURE 2 - DOOR LATCH – TENSILE TESTING FIXTURE FOR LOAD TEST 1

FIGURE 3 – DOOR LATCH – TENSILE TESTING FIXTURE FOR LOAD TEST 2

FIGURE 4 – DOOR LATCH – TENSILE TESTING FIXTURE FOR LOAD TEST 3 (BACK DOORS ONLY)


Upper Bound			Lower Bound		
Point	Time (ms)	Acceleration (g)	Point	Time (ms)	Acceleration (g)
A	0	6	E	5	0
B	20	36	F	25	30
C	60	36	G	55	30
D	100	0	H	70	0

ACCELERATION PULSE CORRIDOR TABLE 1

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FIGURE 5 – DOOR LATCH STATIC LOAD TEST DIRECTIONS

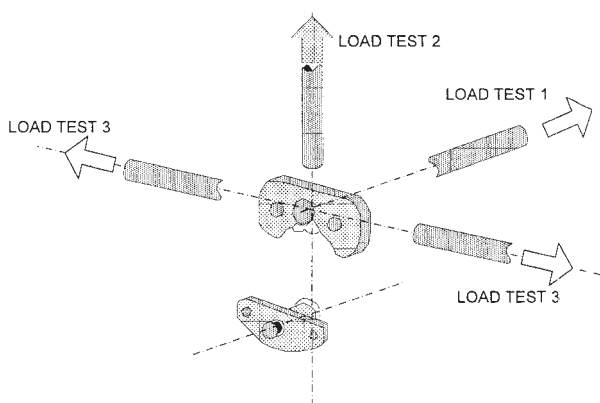


FIGURE 9 – HINGE STATIC TEST LOAD DIRECTIONS FOR BACK DOORS

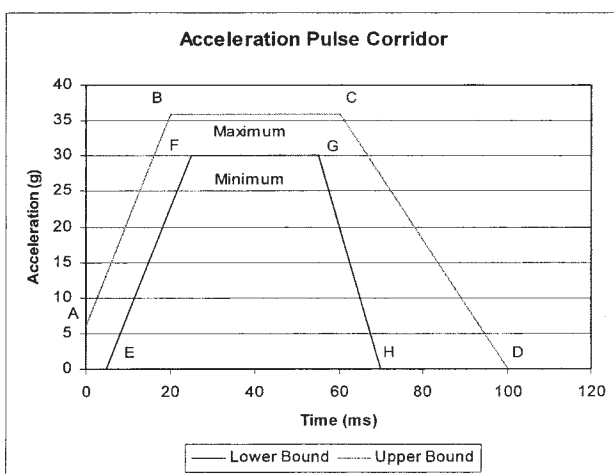
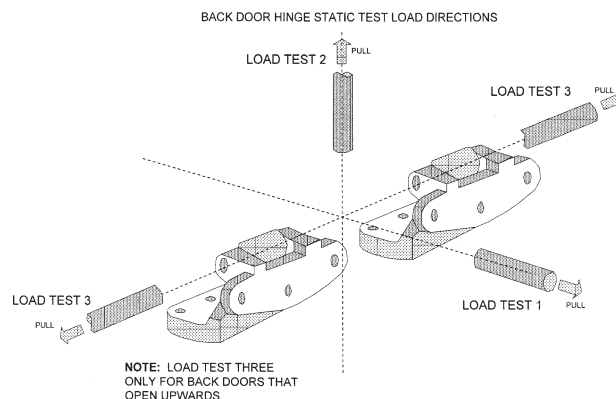


FIGURE 6 – ACCELERATION PULSE

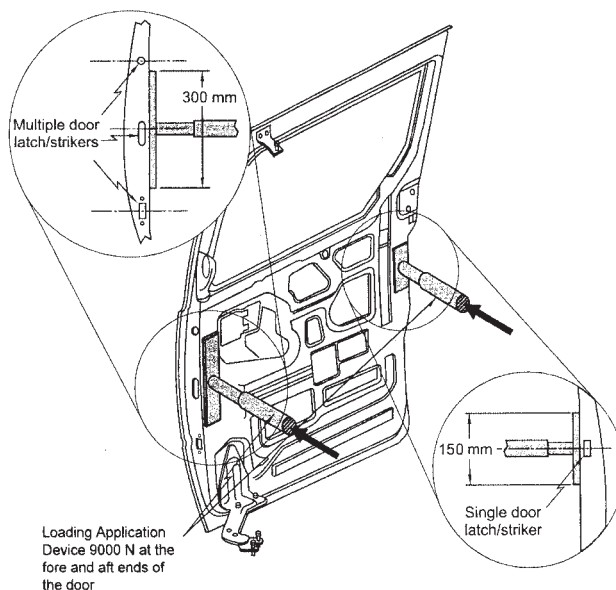
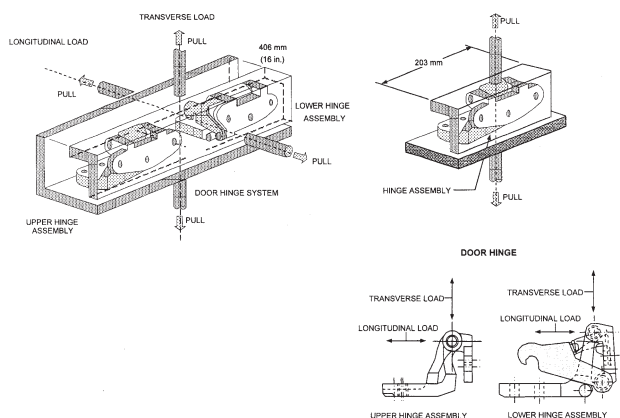
FIGURE 10 – Sliding Door Full Vehicle Test Procedure
(Note: Sliding door is shown separated from the vehicle)

FIGURE 8 – HINGE STATIC TEST FIXTURES



§571.207 Standard No. 207; Seating systems.

S1. Purpose and scope. This standard establishes requirements for seats, their attachment assemblies, and their installation to minimize the possibility of their failure by forces acting on them as a result of vehicle impact.

S2. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks and buses.

S3. Definitions.

Occupant seat means a seat that provides at least one designated seating position.

Seat adjuster means the part of the seat that provides forward and rearward positioning of the seat bench and back, and/or rotation around a vertical axis, including any fixed portion, such as a seat track. In the case of a seat equipped with seat adjusters at different levels, the term means the uppermost seat adjuster.

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S4. Requirements.

S4.1 Driver's seat. Each vehicle shall have an occupant seat for the driver.

S4.2 General performance requirements. When tested in accordance with S5, each occupant seat shall withstand the following forces, in newtons, except for: a side-facing seat; a passenger seat on a bus other than a school bus; a passenger seat on a school bus with a GVWR greater than 4,536 kilograms (10,000 pounds); and, a passenger seat on a school bus with a GVWR less than or equal to 4,536 kg manufactured before October 21, 2011.

(a) In any position to which it can be adjusted—20 times the weight of the seat applied in a forward longitudinal direction;

(b) In any position to which it can be adjusted—20 times the weight of the seat applied in a rearward longitudinal direction;

(c) For a seat belt assembly attached to the seat—the force specified in paragraph (a), if it is a forward facing seat, or paragraph (b), if it is a rearward facing seat, in each case applied simultaneously with the forces imposed on the seat by the seat belt assembly when it is loaded in accordance with S4.2 of §571.210; and

(d) In its rearmost position—a force that produces a 3,300 inch-pound moment about the seating reference point for each designated seating position that the seat provides, applied to the upper cross-member of the seat back or the upper seat back, in a rearward longitudinal direction for forward-facing seats and in a forward longitudinal direction for rearward-facing seats.

S4.2.1 Seat adjustment. Except for vertical movement of nonlocking suspension type occupant seats in trucks or buses, each seat shall remain in its adjusted position when tested in accordance with the test procedures specified in S5.

S4.3. Restraining device for hinged or folding seats or seat backs. Except for a passenger seat in a bus or a seat having a back that is adjustable only for the comfort of its occupants, a hinged or folding occupant seat or occupant seat back shall—

(a) Be equipped with a self-locking device for restraining the hinged or folding seat or seat back, and

(b) If there are any designated seating positions or auxiliary seating accommodations behind the seat, either immediately to the rear or to the sides, be equipped with a control for releasing that restraining device.

S4.3.1 Accessibility of release control. If there is a designated seating position immediately behind a seat equipped with a restraining device, the control for releasing the device shall be readily accessible to the occupant of the seat equipped with the device and, if access to the control is required in order to exit from the vehicle, to the occupant of the designated seating position immediately behind the seat.

S4.3.2 Performance of restraining device.

S4.3.2.1 Static force.

(a) Once engaged, the restraining device for forward-facing seat shall not release or fail when a forward longitudinal force equal to 20 times the weight of the

hinged or folding portion of the seat is applied through the center of gravity of that portion of the seat.

(b) Once engaged, the restraining device for a rearward facing seat shall not release or fail when a rearward longitudinal force equal to 8 times the weight of the hinged or folding portion of the seat is applied to the center of gravity of that portion of the seat.

S4.3.2.2 Acceleration. Once engaged, the restraining device shall not release or fail when the device is subjected to an acceleration of 20 g., in the longitudinal direction opposite to that in which the seat folds.

S4.4 Labeling. Seats not designated for occupancy while the vehicle is in motion shall be conspicuously labeled to that effect.

S5. Test procedures.

S5.1 Apply the forces specified in S4.2(a) and S4.2(b) as follows:

S5.1.1 For a seat whose seat back and seat bench are attached to the vehicle by the same attachments.

(a) For a seat whose seat back and seat bench are attached to the vehicle by the same attachments and whose height is adjustable, the loads are applied when the seat is in its highest adjustment position in accordance with the procedure or procedures specified in S5.1.1(a)(1), S5.1.1(a)(2), or S5.1.1(a)(3), as appropriate.

(1) For a seat whose center of gravity is in a horizontal plane that is above the seat adjuster or that passes through any part of the adjuster, use, at the manufacturer's option, either S5.1.1(b) or, if physically possible, S5.1.1(c).

(2) For a seat specified in S5.1.1(a)(1) for which it is not physically possible to follow the procedure in S5.1.1(c), use S5.1.1(b).

(3) For a seat whose center of gravity is in a horizontal plane that is below the seat adjuster, use S5.1.1(c).

(4) For all other seats whose seat back and seat bench are attached to the vehicle by the same attachments, use S5.1.1(b).

(b) Secure a strut on each side of the seat from a point on the outside of the seat frame in the horizontal plane of the seat's center of gravity to a point on the frame as far forward as possible of the seat anchorages. Between the upper ends of the struts attach a rigid cross-member, in front of the seat back frame for rearward loading and behind the seat back frame for forward loading. Apply the force specified by S4.2(a) or S4.2(b) horizontally through the rigid cross-member as shown in Figure 1.

(c) Find "cg₁," the center of gravity of the portion of the seat that is above the lowest surface of the seat adjuster. On each side of the seat, secure a strut from a point on the outside of the seat frame in the horizontal plane of cg₁ to a point on the frame as far forward as possible of the seat adjusted position. Between the upper ends of the struts attach a rigid cross-member, in front of the seat back frame for rearward loading and behind the seat back frame for forward loading. Find "Cg₂" the center of gravity of the portion of the seat that is below the seat adjuster. Apply a force horizontally through Cg₁ equal

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to 20 times the weight of the portion of the seat represented by cg_1 , and simultaneously apply a force horizontally through cg_2 equal to 20 times the weight of the portion of the seat represented by cg_2 .

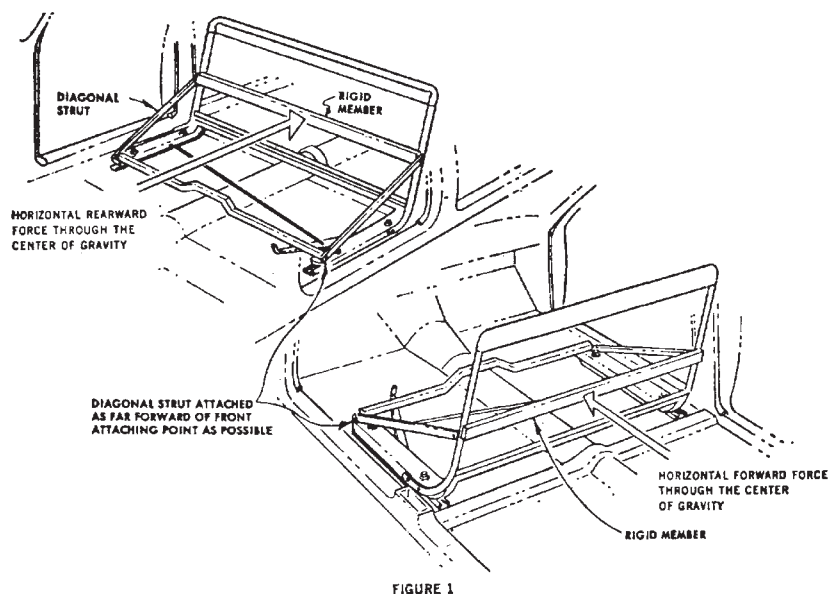
S5.1.2 If the seat back and the seat bench are attached to the vehicle by different attachments, attach to each component a fixture capable of transmitting a force to that component. Apply forces, in newtons, equal to 20 times the mass of the seat back in kilograms multiplied by 9.8 m/s^2 horizontally through the center of gravity of the seat back, as shown in Figure 2 and apply forces, in newtons, equal to 20 times the mass of the seat bench in

kilograms multiplied by 9.8 m/s^2 horizontally through the center of gravity of the seat bench, as shown in Figure 3.

S5.2 Develop the moment specified in S4.2(d) as shown in Figure 4.

S5.3 Apply the forces specified in S4.3.2.1(a) and (b) to a hinged or folding seat as shown in Figure 1 and to a hinged or folding seat back as shown in Figure 5.

S5.4 Determine the center of gravity of a seat or seat component with all cushions and upholstery in place and with the head restraint in its fully extended design position.



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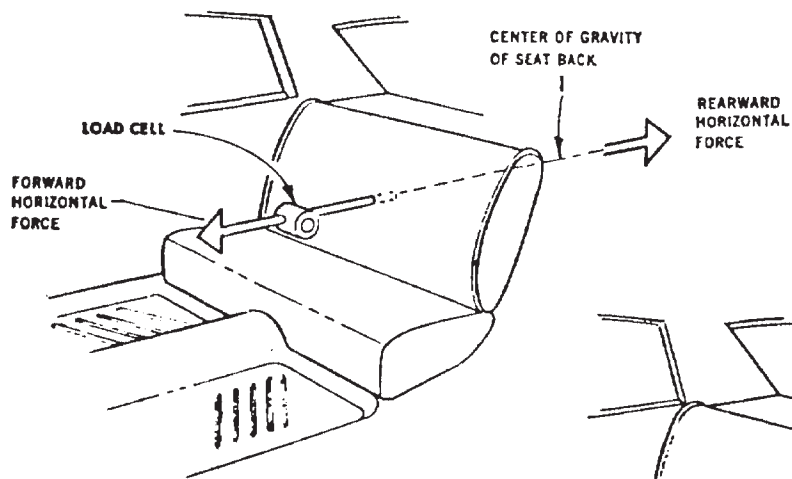


FIGURE 2

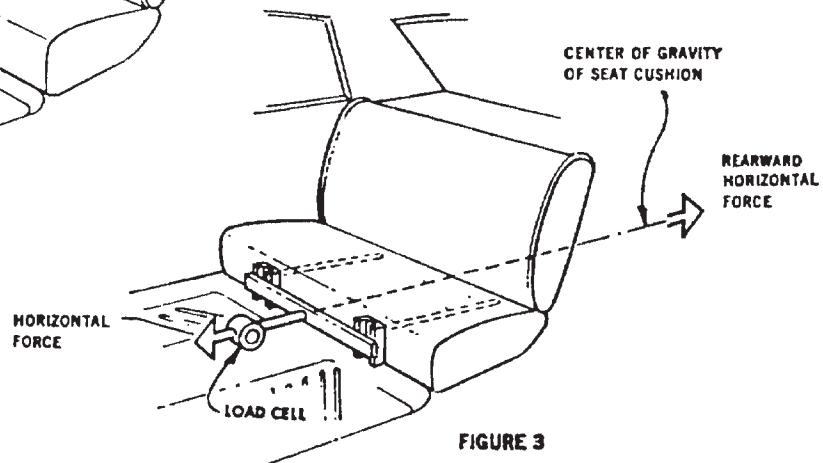


FIGURE 3

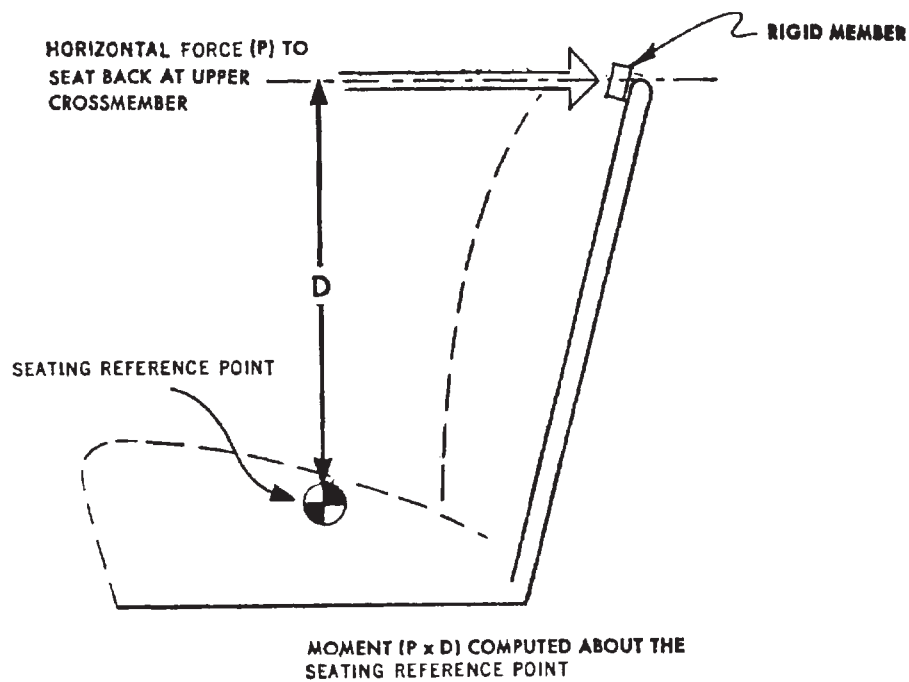


FIGURE 4

Regulations

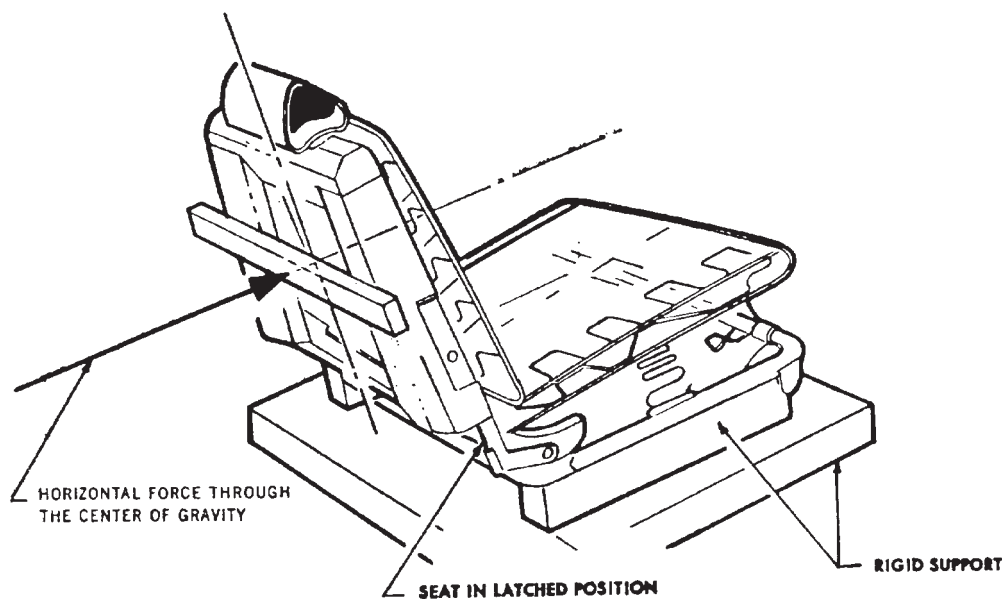


FIGURE 5

§571.208 Standard No. 208; Occupant crash protection.

S1. Scope. This standard specifies performance requirements for the protection of vehicle occupants in crashes.

S2. Purpose. The purpose of this standard is to reduce the number of deaths of vehicle occupants, and the severity of injuries, by specifying vehicle crashworthiness requirements in terms of forces and accelerations measured on anthropomorphic dummies in test crashes, and by specifying equipment requirements for active and passive restraint systems.

S3. Application. (a) This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses. In addition, S9, *Pressure vessels and explosive devices*, applies to vessels designed to contain a pressurized fluid or gas, and to explosive devices, for use in the above types of motor vehicles as part of a system designed to provide protection to occupants in the event of a crash.

(b) Notwithstanding any language to the contrary, any vehicle manufactured after March 19, 1997, and before September 1, 2006, that is subject to a dynamic crash test requirement conducted with unbelted dummies may meet the requirements specified in S5.1.2(a)(1), S5.1.2(a)(2), or S13 instead of the applicable unbelted requirement, unless the vehicle is certified to meet the requirements specified in S14.5, S15, S17, S19, S21, S23, and S25.

(c) For vehicles which are certified to meet the requirements specified in S13 instead of the otherwise applicable dynamic crash test requirement conducted with unbelted dummies, compliance with S13 shall, for purposes of Standards No. 201, 203 and 209, be deemed as compliance with the unbelted frontal barrier requirements of S5.1.2.

S4. General requirements.

S4.1 Passenger cars.

S4.1.1 Passenger cars manufactured from January 1, 1972, to August 31, 1973.

Each passenger car manufactured from January 1, 1972, to August 31, 1973, inclusive, shall meet the requirements of S4.1.1.1, S4.1.1.2, or S4.1.1.3. A protection system that meets the requirements of S4.1.1.1, or S4.1.1.2 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.1.1.3.

S4.1.1.1 First option—complete passive protection system. The vehicle shall meet the crash protection requirements of S5. by means that require no action by vehicle occupants.

S4.1.1.2 Second option—lap belt protection system with belt warning. The vehicle shall—

(a) At each designated seating position have a Type 1 seatbelt assembly or a Type 2 seatbelt assembly with a detachable upper torso portion that conforms to S7.1 and S7.2 of this standard;

(b) At each front outboard designated seating position, have a seat belt warning system that conforms to S7.3; and

(c) Meet the frontal crash protection requirements of S5.1, in a perpendicular impact, with respect to anthropomorphic test devices in each front outboard designated seating position restrained only by Type 1 seat belt assemblies.

S4.1.1.3 Third option—lap and shoulder belt protection system with belt warning.

S4.1.1.3.1 Except for convertibles and open-body vehicles, the vehicle shall—

(a) At each front outboard designated seating position have a Type 2 seatbelt assembly that conforms to §571.209

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and S7.1 and S7.2 of this standard, with either an integral or detachable upper torso portion, and a seatbelt warning system that conforms to S7.3;

(b) At each designated seating position other than the front outboard positions, have a Type 1 or Type 2 seat belt assembly that conforms to §571.209 and to S7.1 and S7.2 of this standard; and

(c) When it perpendicularly impacts a fixed collision barrier, while moving longitudinally forward at any speed up to and including 30 m.p.h., under the test conditions of S8.1 with anthropomorphic test devices at each front outboard position restrained by Type 2 seatbelt assemblies, experience no complete separation of any load-bearing element of a seatbelt assembly or anchorage.

S4.1.1.3.2 Convertibles and open-body type vehicles shall at each designated seating position have a Type 1 or Type 2 seatbelt assembly that conforms to §571.209 and to S7.1 and S7.2 of this standard, and at each front outboard designated seating position have a seatbelt warning system that conforms to S7.3.

S4.1.2 Passenger cars manufactured on or after September 1, 1973, and before September 1, 1986. Each passenger car manufactured on or after September 1, 1973, and before September 1, 1986, shall meet the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A protection system that meets the requirements of S4.1.2.1 or S4.1.2.2 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.1.2.3.

S4.1.2.1 First option—frontal/angular automatic protection system. The vehicle shall:

(a) At each front outboard designated seating position meet the frontal crash protection requirements of S5.1 by means that require no action by vehicle occupants;

(b) At the front center designated seating position and at each rear designated seating position have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and to S7.1 and S7.2; and

(c) **Either.**(1) Meet the lateral crash protection requirements of S5.2 and the rollover crash protection requirements of S5.3 by means that require no action by vehicle occupants; or

(2) At each front outboard designated seating position have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 through S7.3, and that meets the requirements of S5.1 with front test dummies as required by S5.1, restrained by the Type 1 or Type 2 seat belt assembly (or the pelvic portion of any Type 2 seat belt assembly which has a detachable upper torso belt) in addition to the means that require no action by the vehicle occupant.

S4.1.2.2 Second option—head-on automatic protection system. The vehicle shall—

(a) At each designated seating position have a Type 1 seat belt assembly or Type 2 seat belt assembly with a detachable upper torso portion that conforms to S7.1 and S7.2 of this standard.

(b) At each front outboard designated seating position, meet the frontal crash protection requirements of S5.1, in a perpendicular impact, by means that require no action by vehicle occupants;

(c) At each front outboard designated seating position, meet the frontal crash protection requirements of S5.1, in a perpendicular impact, with a test device restrained by a Type 1 seat belt assembly; and

(d) At each front outboard designated seating position, have a seat belt warning system that conforms to S7.3.

S4.1.2.3 Third option—lap and shoulder belt protection system with belt warning.

S4.1.2.3.1 Except for convertibles and open-body vehicles, the vehicle shall—

(a) At each front outboard designated seating position have a seat belt assembly that conforms to S7.1 and S7.2 of this standard, and a seat belt warning system that conforms to S7.3. The belt assembly shall be either a Type 2 seat belt assembly with a nondetachable shoulder belt that conforms to Standard No. 209 (§571.209), or a Type 1 seat belt assembly such that with a test device restrained by the assembly the vehicle meets the frontal crash protection requirements of S5.1 in a perpendicular impact.

(b) At any center front designated seating position, have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 (§571.209) and to S7.1 and S7.2 of this standard, and a seat belt warning system that conforms to S7.3; and

(c) At each other designated seating position, have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 (§571.209) and S7.1 and S7.2 of this standard.

S4.1.2.3.2 Convertibles and open-body type vehicles shall at each designated seating position have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 (§ 571.209) and to S7.1 and S7.2 of this standard, and at each front designated seating position have a seat belt warning system that conforms to S7.3.

S4.1.3 Passenger cars manufactured on or after September 1, 1986, and before September 1, 1989.

S4.1.3.1 Passenger cars manufactured on or after September 1, 1986, and before September 1, 1987.

S4.1.3.1.1 Subject to S4.1.3.1.2 and S4.1.3.4, each passenger car manufactured on or after September 1, 1986, and before September 1, 1987, shall comply with the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.3.1.2 Subject to S4.1.3.4 and S4.1.5, the amount of passenger cars, specified in S4.1.3.1.1 complying with the requirements of S4.1.2.1 shall be not less than 10 percent of:

(a) The average annual production of passenger cars manufactured on or after September 1, 1983, and before September 1, 1986, by each manufacturer, or

(b) The manufacturer's annual production of passenger cars during the period specified in S4.1.3.1.1.

S4.1.3.1.3 A manufacturer may exclude convertibles which do not comply with the requirements of S4.1.2.1,

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when it is calculating its average annual production under S4.1.3.1.2(a) or its annual production under S4.1.3.1.2(b).

S4.1.3.2 Passenger cars manufactured on or after September 1, 1987, and before September 1, 1988.

S4.1.3.2.1 Subject to S4.1.3.2.2 and S4.1.3.4, each passenger car manufactured on or after September 1, 1987, and before September 1, 1988, shall comply with the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.3.2.2 Subject to S4.1.3.4 and S4.1.5, the amount of passenger cars specified in S4.1.3.2.1 complying with the requirements of S4.1.2.1, shall be not less than 25 percent of:

(a) The average annual production of passenger cars manufactured on or after September 1, 1984, and before September 1, 1987, by each manufacturer, or

(b) The manufacturer's annual production of passenger cars during the period specified in S4.1.3.2.1.

S4.1.3.2.3 A manufacturer may exclude convertibles which do not comply with the requirements of S4.1.2.1, when it is calculating its average annual production under S4.1.3.2.2(a) or its annual production under S4.1.3.2.2(b).

S4.1.3.3 Passenger cars manufactured on or after September 1, 1988, and before September 1, 1989.

S4.1.3.3.1 Subject to S4.1.3.3.2 and S4.1.3.4, each passenger car manufactured on or after September 1, 1988, and before September 1, 1989, shall comply with the requirements of S4.1.2.1, S4.1.2.2 or S4.1.2.3. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.3.3.2 Subject to S4.1.3.4 and S4.1.5, the amount of passenger cars specified in S4.1.3.3.1 complying with the requirements of S4.1.2.1 shall be not less than 40 percent of:

(a) The average annual production of passenger cars manufactured on or after September 1, 1985, and before September 1, 1988, by each manufacturer or

(b) The manufacturer's annual production of passenger cars during the period specified in S4.1.3.3.1.

S4.1.3.3.3 A manufacturer may exclude convertibles which do not comply with the requirements of S4.1.2.1, when it is calculating its average annual production under S4.1.3.3.2(a) or its annual production under S4.1.3.3.2(b).

S4.1.3.4 Calculation of complying passenger cars.(a) For the purposes of calculating the numbers of cars manufactured under S4.1.3.1.2, S4.1.3.2.2, or S4.1.3.3.2 to comply with S4.1.2.1:

(1) Each car whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose front right seating position will comply with the requirements of S4.1.2.1(a) by any means is counted as 1.5 vehicles, and

(2) Each car whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose right front seat seating position is equipped with a manual Type 2 seat belt is counted as one vehicle.

(b) For the purposes of complying with S4.1.3.1.2, a passenger car may be counted if it:

(1) Is manufactured on or after September 1, 1985, but before September 1, 1986, and

(2) Complies with S4.1.2.1.

(c) For the purposes of complying with S4.1.3.2.2, a passenger car may be counted if it:

(1) Is manufactured on or after September 1, 1985, but before September 1, 1987,

(2) Complies with S4.1.2.1, and

(3) Is not counted toward compliance with S4.1.3.1.2

(d) For the purposes of complying with S4.1.3.3.2, a passenger car may be counted if it:

(1) Is manufactured on or after September 1, 1985, but before September 1, 1988,

(2) Complies with S4.1.2.1, and

(3) Is not counted toward compliance with S4.1.3.1.2 or S4.1.3.2.2.

S4.1.3.5 Passenger cars produced by more than one manufacturer.

S4.1.3.5.1 For the purposes of calculating average annual production of passenger cars for each manufacturer and the amount of passenger cars manufactured by each manufacturer under S4.1.3.1.2, S4.1.3.2.2 or S4.1.3.3.2, a passenger car produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.1.3.5.2:

(a) A passenger car which is imported shall be attributed to the importer.

(b) A passenger car manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer which markets the vehicle.

S4.1.3.5.2 A passenger car produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S4.1.3.5.1.

S4.1.4 Passenger cars manufactured on or after September 1, 1989, but before September 1, 1996.

S4.1.4.1 Except as provided in S4.1.4.2, each passenger car manufactured on or after September 1, 1989 shall comply with the requirements of S4.1.2.1. Any passenger car manufactured on or after September 1, 1989 and before September 1, 1993 whose driver's designated seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose right front designated seating position is equipped with a manual Type 2 seat belt so that the seating position complies with the occupant crash protection requirements of S5.1, with the Type 2 seat belt assembly adjusted in

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accordance with S7.4.2, shall be counted as a vehicle complying with S4.1.2.1. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not know in the exercise of due care that such vehicle is not in conformity with this standard.

S4.1.4.2 (a) Each passenger car, other than a convertible, manufactured before December 11, 1989 may be equipped with, and each passenger car, other than a convertible, manufactured on or after December 11, 1989 and before September 1, 1990 shall be equipped with a Type 2 seat belt assembly at every forward-facing rear outboard designated seating position. Type 2 seat belt assemblies installed pursuant to this provision shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1.1 of this standard.

(b) Except as provided in S4.1.4.2.1 and S4.1.4.2.2, each passenger car, other than a convertible, manufactured on or after September 1, 1990 and each convertible passenger car manufactured on or after September 1, 1991 shall be equipped with an integral Type 2 seat belt assembly at every forward-facing rear outboard designated seating position. Type 2 seat belt assemblies installed in compliance with this requirement shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

(c) As used in this section, "rear outboard designated seating position" means any "outboard designated seating position" (as that term is defined at 49 CFR 571.3) that is rearward of the front seat(s), except any designated seating position adjacent to a walkway that is located between the seat and the rear side of the vehicle and is designed to allow access to more rearward seating positions.

S4.1.4.2.1 Any rear outboard designated seating position with a seat that can be adjusted to be forward-facing and to face some other direction shall either:

(i) Meet the requirements of S4.1.4.2 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(ii) When the seat is in its forward-facing position, have a Type 2 seat belt assembly with an upper torso restraint that conforms to S7.1 and S7.2 of this standard and that adjusts by means of an emergency locking retractor that conforms with Standard No. 209 (49 CFR 571.209), which upper torso restraint may be detachable at the buckle, and, when the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.1.4.2.2 Any rear outboard designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) in a vehicle manufactured on or after September 1, 1992 shall meet the requirements of S4.1.4.2 and may use an upper torso

belt that detaches at either its upper or lower anchorage points, but *not* both anchorage points, to meet those requirements. The means for detaching the upper torso belt may use a pushbutton action.

S4.1.5 Passenger cars manufactured on or after September 1, 1996.

S4.1.5.1 **Frontal/angular automatic protection system.**(a) Each passenger car manufactured on or after September 1, 1996 shall:

(1) At each front outboard designated seating position meet the frontal crash protection requirements of S5.1 by means that require no action by vehicle occupants;

(2) At any front designated seating positions that are not "outboard designated seating positions," as that term is defined at 49 CFR 571.3, and at any rear designated seating positions that are not "rear outboard designated seating positions," as that term is defined at S4.1.4.2(c) of this standard, have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 and S7.2 of this standard; and

(3) At each front designated seating position that is an "outboard designated seating position," as that term is defined at 49 CFR 571.3, and at each forward-facing rear designated seating position that is a "rear outboard designated seating positions," as that term is defined at S4.1.4.2(c) of this standard, have a Type 2 seat belt assembly that conforms to Standard No. 209 and S7.1 through S7.3 of this standard, and, in the case of the Type 2 seat belt assemblies installed at the front outboard designated seating positions, meet the frontal crash protection requirements with the appropriate anthropomorphic test dummy restrained by the Type 2 seat belt assembly in addition to the means that requires no action by the vehicle occupant.

(b) For the purposes of sections S4.1.5 through S4.1.5.3 and S4.2.6 through S4.2.6.2 of this standard, an **inflatable restraint system** means an air bag that is activated in a crash.

S4.1.5.2 Passenger cars manufactured on or after September 1, 1996 and before September 1, 1997.

S4.1.5.2.1 The amount of passenger cars complying with the requirement of S4.1.5.1(a)(1) by means of an inflatable restraint system at the driver's and right front passenger's position shall be not less than 95 percent of the manufacturer's total production of passenger cars manufactured on or after September 1, 1996, and before September 1, 1997. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.5.2.2 Passenger cars produced by more than one manufacturer.

S4.1.5.2.2.1 For the purpose of calculating the production of passenger cars by each manufacturer during the period specified in S4.1.5.2, a passenger car produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.1.5.2.2.2:

(a) A passenger car that is imported into the United States shall be attributed to the importer.

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(b) A passenger car manufactured within the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S4.1.5.2.2.2 A passenger car produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers, as specified in an express written contract, reported to the National Highway Traffic Safety Administration pursuant to part 585 of this chapter, between the manufacturer so specified and the manufacturer to which the vehicle otherwise would be attributed, pursuant to S4.1.5.2.2.1.

S4.1.5.3 Passenger cars manufactured on or after September 1, 1997. Each passenger car manufactured on or after September 1, 1997 shall comply with the requirement of S4.1.5.1(a)(1) by means of an inflatable restraint system at the driver's and right front passenger's position. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.1.5.4 Passenger cars certified to S14. Each passenger car certified to S14 shall, at each front outboard designated seating position, meet the applicable frontal crash protection requirements of S5.1.2(b) by means of an inflatable restraint system that requires no action by vehicle occupants.

S4.1.5.5 Passenger cars manufactured on or after September 1, 2007.

S4.1.5.5.1 Except as provided in S4.1.5.5.2, each passenger car shall have a Type 2 seat belt assembly that conforms to Standard No. 209 and to S7.1 and S7.2 of this standard at each rear designated seating position, except that side-facing designated seating positions shall have a Type 1 or Type 2 seat belt assembly that conforms to Standard No. 209 and to S7.1 and S7.2 of this standard.

S4.1.5.5.2 Any inboard designated seating position on a seat for which the entire seat back can be folded (including the head restraints and any other part of the vehicle attached to the seat back) such that no part of the seat back extends above a horizontal plane located 250 mm above the highest SRP located on the seat may meet the requirements of S4.1.5.5.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.2 Trucks and multipurpose passenger vehicles with a GVWR of 10,000 pounds or less. As used in this section, *vehicles manufactured for operation by persons with disabilities* means vehicles that incorporate a level change device (e.g., a wheelchair lift or a ramp) for onloading or offloading an occupant in a wheelchair, an interior element of design intended to provide the vertical clearance necessary to permit a person in a wheelchair to move between the lift or ramp and the driver's position or to occupy that position, and either an adaptive control or special driver seating accommodation to enable persons who have limited use of their arms or legs to operate a vehicle. For purposes of this defini-

tion, special driver seating accommodations include a driver's seat easily removable with means installed for that purpose or with simple tools, or a driver's seat with extended adjustment capability to allow a person to easily transfer from a wheelchair to the driver's seat.

S4.2.1 Trucks and multipurpose passenger vehicles with a GVWR of 10,000 pounds or less, manufactured on or after January 1, 1976 and before September 1, 1991. Each truck and multipurpose passenger vehicle, with a gross vehicle weight rating of 10,000 pounds or less, manufactured before September 1, 1991, shall meet the requirements of S4.1.2.1, or at the option of the manufacturer, S4.1.2.2 or S4.1.2.3 (as specified for passenger cars), except that forward control vehicles manufactured prior to September 1, 1981, convertibles, open-body type vehicles, walk-in van-type trucks, motor homes, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles carrying chassis-mount campers may instead meet the requirements of S4.2.1.1 or S4.2.1.2.

S4.2.1.1 First option—complete automatic protection system. The vehicle shall meet the crash protection requirements of S5 by means that require no action by vehicle occupants.

S4.2.1.2 Second option—belt system. The vehicle shall have seat belt assemblies that conform to Standard 209 (49 CFR 571.209) installed as follows:

(a) A Type 1 or Type 2 seat belt assembly shall be installed for each designated seating position in convertibles, open-body type vehicles, and walk-in van-type trucks.

(b) In vehicles manufactured for operation by persons with disabilities, a Type 2 or Type 2A seat belt assembly shall be installed for the driver's seating position, a Type 2 seat belt assembly shall be installed for each other outboard designated seating position that includes the windshield header within the head impact area, and a Type 1 or Type 2 seat belt assembly shall be installed for each other designated seating position.

(c) In all vehicles except those for which requirements are specified in S4.2.1.2 (a) or (b), a Type 2 seat belt assembly shall be installed for each outboard designated seating position that includes the windshield header within the head impact area, and a Type 1 or Type 2 seat belt assembly shall be installed for each other designated seating position.

S4.2.2 Trucks and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less, manufactured on or after September 1, 1991 and before September 1, 1997. Except as provided in S4.2.4, each truck and multipurpose passenger vehicle, with a gross vehicle weight rating of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less, manufactured on or after September 1, 1991 and before September 1, 1997, shall meet the requirements of S4.1.2.1, or at the option of the manufacturer, S4.1.2.2 or S4.1.2.3 (as specified for passenger cars), except that convertibles, open-body type vehicles, walk-in van-type trucks, motor homes, vehicles designed to be exclusively sold to the U.S. Postal Service, vehicles carrying chassis-mount campers, and vehicles manufactured for operation

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by persons with disabilities may instead meet the requirements of S4.2.1.1 or S4.2.1.2. Each Type 2 seat belt assembly installed in a front outboard designated seating position in accordance with S4.1.2.3 shall meet the requirements of S4.6.

S4.2.3 Trucks and multipurpose passenger vehicles manufactured on or after September 1, 1991 with either a GVWR of more than 8,500 pounds but not greater than 10,000 pounds or with an unloaded vehicle weight greater than 5,500 pounds and a GVWR of 10,000 pounds or less. Except as provided in S4.2.4, each truck and multipurpose passenger vehicle manufactured on or after September 1, 1991, that has either a gross vehicle weight rating which is greater than 8,500 pounds, but not greater than 10,000 pounds, or has an unloaded vehicle weight greater than 5,500 pounds and a GVWR of 10,000 pounds or less, shall meet the requirements of S4.1.2.1, or at the option of the manufacturer, S4.1.2.2 or S4.1.2.3 (as specified for passenger cars), except that convertibles, open-body type vehicles, walk-in van-type trucks, motor homes, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles carrying chassis-mount campers may instead meet the requirements of S4.2.1.1 or S4.2.1.2.

S4.2.4 Rear outboard seating positions in trucks and multipurpose passenger vehicles manufactured on or after September 1, 1991 with a GVWR of 10,000 pounds or less. Except as provided in S4.2.4.2 and S4.2.4.3, each truck and each multipurpose passenger vehicle, other than a motor home, manufactured on or after September 1, 1991 that has a gross vehicle weight rating of 10,000 pounds or less shall be equipped with an integral Type 2 seat belt assembly at every forward-facing rear outboard designated seating position. Type 2 seat belt assemblies installed in compliance with this requirement shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.2.4.1 As used in this section—

(a) [Reserved]

(b) **Rear outboard designated seating position** means any “outboard designated seating position” (as that term is defined at 49 CFR 571.3) that is rearward of the front seat(s), except any designated seating positions adjacent to a walkway located between the seat and the side of the vehicle, which walkway is designed to allow access to more rearward seating positions.

S4.2.4.2 Any rear outboard designated seating position with a seat that can be adjusted to be forward-facing and to face some other direction shall either:

(i) Meet the requirements of S4.2.4 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(ii) When the seat is in its forward-facing position, have a Type 2 seat belt assembly with an upper torso restraint that conforms to S7.1 and S7.2 of this standard

and that adjusts by means of an emergency locking retractor that conforms with Standard No. 209 (49 CFR 571.209), which upper torso restraint may be detachable at the buckle, and, when the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.2.4.3 Any rear outboard designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) in a vehicle manufactured on or after September 1, 1992 shall meet the requirements of S4.2.4 and may use an upper torso belt that detaches at either its upper or lower anchorage point, but not both anchorage points, to meet those requirements. The means for detaching the upper torso belt may use a pushbutton action.

S4.2.5 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1994, and before September 1, 1997.

S4.2.5.1 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1994, and before September 1, 1995.

S4.2.5.1.1 Subject to S4.2.5.1.2 and S4.2.5.5 and except as provided in S4.2.4, each truck, bus and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1994 and before September 1, 1995, shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars). A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of standard.

S4.2.5.1.2 Subject to S4.2.5.5, the amount of trucks, buses, and multipurpose passenger vehicles specified in S4.2.5.1.1 complying with S4.1.2.1 (as specified for passenger cars) shall be not less than 20 percent of:

(a) The average annual production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1991, and before September 1, 1994, by each manufacturer that produced such vehicles during each of those annual production periods, or

(b) The manufacturer's total production of trucks, buses, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less during the period specified in S4.2.5.1.1.

S4.2.5.2 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less

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and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1995 and before September 1, 1996.

S4.2.5.2.1 Subject to S4.2.5.2.2 and S4.2.5.5 and except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1995 and before September 1, 1996, shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars). A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.2.5.2.2 Subject to S4.2.5.5, the amount of trucks, buses, and multipurpose passenger vehicles specified in S4.2.5.2.1 complying with S4.1.2.1 (as specified for passenger cars) shall be not less than 50 percent of:

(a) The average annual production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1992, and before September 1, 1995, by each manufacturer that produced such vehicles during each of those annual production periods, or

(b) The manufacturer's total production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less during the period specified in S4.2.5.2.1.

S4.2.5.3 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1996 and before September 1, 1997.

S4.2.5.3.1 Subject to S4.2.5.3.2 and S4.2.5.5 and except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1996 and before September 1, 1997, shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars). A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.2.5.3.2 Subject to S4.2.5.5, the amount of trucks, buses, and multipurpose passenger vehicles specified in S4.2.5.3.1 complying with S4.1.2.1 (as specified for passenger cars) shall be not less than 90 percent of:

(a) The average annual production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of

5,500 pounds or less manufactured on or after September 1, 1993, and before September 1, 1996, by each manufacturer that produced such vehicles during each of those annual production periods, or

(b) The manufacturer's total production of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less during the period specified in S4.2.5.3.1.

S4.2.5.4 Alternative phase-in schedule. A manufacturer may, at its option, comply with the requirements of this section instead of complying with the requirements set forth in S4.2.5.1, S4.2.5.2, and S4.2.5.3.

(a) Except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1994 and before September 1, 1995 shall comply with the requirements of S4.1.2.1, S4.1.2.2, or S4.1.2.3 (as specified for passenger cars).

(b) Except as provided in S4.2.4, each truck, bus, and multipurpose passenger vehicle, other than walk-in van-type trucks, vehicles designed to be exclusively sold to the U.S. Postal Service, and vehicles manufactured for operation by persons with disabilities, with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured on or after September 1, 1995 shall comply with the requirements of S4.1.2.1 (as specified for passenger cars) of this standard. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

(c) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1995, but before September 1, 1998, whose driver's seating position complies with the requirements of S4.1.2.1(a) of this standard by means not including any type of seat belt and whose right front passenger's seating position is equipped with a manual Type 2 seat belt that complies with S5.1 of this standard, with the seat belt assembly adjusted in accordance with S7.4.2, shall be counted as a vehicle complying with S4.1.2.1.

S4.2.5.5 Calculation of complying trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less.

(a) For the purposes of the calculations required in S4.2.5.1.2, S4.2.5.2.2, and S4.2.5.3.2 of the number of trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that comply with S4.1.2.1 (as specified for passenger cars):

(1) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded

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vehicle weight of 5,500 pounds or less whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose front right seating position complies with the requirements of S4.1.2.1(a) by any means is counted as 1.5 vehicles, and

(2) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less whose driver's seating position complies with the requirements of S4.1.2.1(a) by means not including any type of seat belt and whose right front passenger's seating position is equipped with a manual Type 2 seat belt that complies with S5.1 of this standard, with the seat belt assembly adjusted in accordance with S7.4.2, is counted as one vehicle.

(3) Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less that is manufactured in two or more stages or that is altered (within the meaning of §567.7 of this chapter) after having previously been certified in accordance with part 567 of this chapter is not subject to the requirements of S4.2.5.1.2, S4.2.5.2.2, and S4.2.5.3.2. Such vehicles may be excluded from all calculations of compliance with S4.2.5.1.2, S4.2.5.2.2, and S4.2.5.3.2.

(b) For the purposes of complying with S4.2.5.1.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less may be counted if it:

(1) Is manufactured on or after September 1, 1992, but before September 1, 1994, and

(2) Is certified as complying with S4.1.2.1 (as specified for passenger cars).

(c) For the purposes of complying with S4.2.5.2.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less may be counted if it:

(1) Is manufactured on or after September 1, 1992, but before September 1, 1995,

(2) Is certified as complying with S4.1.2.1 (as specified for passenger cars), and

(3) Is not counted toward compliance with S4.2.5.1.2.

(d) For the purposes of complying with S4.2.5.3.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less may be counted if it:

(1) Is manufactured on or after September 1, 1992, but before September 1, 1996,

(2) Is certified as complying with S4.1.2.1 (as specified for passenger cars), and

(3) Is not counted toward compliance with S4.2.5.1.2 or S4.2.5.2.2.

S4.2.5.6 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer.

S4.2.5.6.1 For the purposes of calculating average annual production for each manufacturer and the amount of vehicles manufactured by each manufacturer under

S4.2.5.1.2, S4.2.5.2.2, or S4.2.5.3.2, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.2.5.6.2:

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle that is manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S4.2.5.6.2 A truck, bus, or multipurpose passenger vehicle with, GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified in an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S4.2.5.6.1 of this standard.

S4.2.6 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1997.

Each truck, bus, and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less, which is manufactured on or after September 1, 1997, shall comply with the requirements of S4.1.5.1 of this standard (as specified for passenger cars), except that walk-in van-type trucks and vehicles designed to be sold exclusively to the U.S. Postal Service may meet the requirements of S4.2.1.1 or S4.2.1.2 of this standard instead of the requirements of S4.1.5.1.

S4.2.6.1 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1997 and before September 1, 1998.

S4.2.6.1.1 The amount of trucks, buses, and multipurpose passenger vehicles complying with the requirements of S4.1.5.1(a)(1) of this standard by means of an inflatable restraint system shall be not less than 80 percent of the manufacturer's total combined production of subject vehicles manufactured on or after September 1, 1997 and before September 1, 1998. Each truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1997 and before September 1, 1998, whose driver's seating position complies with S4.1.5.1(a)(1) by means of an inflatable restraint system and whose right front passenger's seating position is equipped with a manual Type 2 seat belt assembly that complies with S5.1 of this standard, with the seat belt assembly adjusted in accordance with S7.4.2 of this standard, shall be counted as a vehicle complying with S4.1.5.1(a)(1) by means of an inflatable restraint system. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due

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care that such vehicle is not in conformity with the requirement of this standard.

S4.2.6.1.2 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer.

S4.2.6.1.2.1 For the purpose of calculating the production by each manufacturer during the period specified in S4.2.6.1.1, a truck, bus, or multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S4.2.6.1.2.2:

(a) A vehicle that is imported into the United States shall be attributed to the importer.

(b) A vehicle manufactured within the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S4.2.6.1.2.2 A truck, bus, or multipurpose passenger vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers, as specified in an express written contract, reported to the National Highway Traffic Safety Administration pursuant to part 585 of this chapter, between the manufacturer so specified and the manufacturer to which the vehicle otherwise would be attributed, pursuant to S4.2.6.1.2.1.

S4.2.6.2 Trucks, buses, and multipurpose passenger vehicles with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1998. Each truck, bus, or multipurpose vehicle with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1998 shall comply with the requirement of S4.1.5.1(a)(1) by means of an inflatable restraint system at the driver's and right front passenger's position. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.2.6.3 Trucks, buses, and multipurpose passenger vehicles certified to S14. Each truck, bus, or multipurpose passenger vehicle with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less certified to S14 shall, at each front outboard designated seating position, meet the applicable frontal crash protection requirements of S5.1.2(b) by means of an inflatable restraint system that requires no action by vehicle occupants.

S4.2.7 Rear seating positions in trucks, and multipurpose passenger vehicles manufactured on or after September 1, 2007 with a GVWR of 10,000 lbs. (4,536 kg) or less.

S4.2.7.1 Except as provided in S4.2.7.2, S4.2.7.3, S4.2.7.4, S4.2.7.5, and S4.2.7.6, each truck and each multipurpose passenger vehicle, other than a motor home, a walk-in van-type truck, or a vehicle designed to be sold exclusively to the U.S. Postal Service with a GVWR of

10,000 lbs. (4,536 kg) or less, or a vehicle carrying chassis-mount camper with a gross vehicle weight rating of 8,500-10,000 lbs. (3,855-4,536 kg), shall be equipped with a Type 2 seat belt assembly at every rear designated seating position other than a side-facing position, except that Type 2 seat belt assemblies installed in compliance with this requirement shall conform to Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in conformity to this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall conform to S7.4.2(c) of this standard. Side-facing designated seating positions shall be equipped, at the manufacturer's option, with a Type 1 or Type 2 seat belt assembly that conforms with S7.1 and S7.2 of this standard.

S4.2.7.2 Any rear designated seating position with a seat that can be adjusted to be forward-or rear-facing and to face some other direction shall either:

(a) Meet the requirements of S4.2.7.1 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(b) When the seat is in its forward-facing and/or rear-facing position or within ± 30 degrees of either position, have a Type 2 seat belt assembly with an upper torso restraint that conforms to S7.1 and S7.2 of this standard and that adjusts by means of an emergency locking retractor that conforms to Standard No. 209 (49 CFR 571.209), which upper torso restraint may be detachable at either the buckle or the upper anchorage, but not both, and, when the seat is in any other position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.2.7.3 Any rear designated seating position on a readily removable seat (i.e., a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) may meet the requirements of S4.2.7.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.2.7.4 Any inboard designated seating position on a seat for which the entire seat back can be folded such that no part of the seat back extends above a horizontal plane located 250 mm above the highest SRP located on the seat may meet the requirements of S4.2.7.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.2.7.5 Any rear designated seating position adjacent to a walkway located between the seat and the side of the vehicle, which walkway is designed to allow access to more rearward designated seating positions may meet the requirements of S4.2.7.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

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S4.2.7.6 Any rear side-facing designated seating position shall have a Type 1 or Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.3 Trucks and multipurpose passenger vehicles, with GVWR of more than 10,000 pounds.

S4.3.1 Trucks and multipurpose passenger vehicles with a GVWR of more than 10,000 pounds, manufactured in or after January 1, 1972 and before September 1, 1990. Each truck and multipurpose passenger vehicle with a gross vehicle weight rating of more than 10,000 pounds, manufactured on or after January 1, 1972 and before September 1, 1990, shall meet the requirements of S4.3.1.1 or S4.3.1.2. A protection system that meets the requirements of S4.3.1.1 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.3.1.2.

S4.3.1.1 First option—complete passenger protection system. The vehicle shall meet the crash protection requirements of S5 by means that require no action by vehicle occupants.

S4.3.1.2 Second option—belt system. The vehicle shall, at each designated seating position, have either a Type 1 or a Type 2 seat belt assembly that conforms to §571.209.

S4.3.2 Trucks and multipurpose passenger vehicles with a GVWR of more than 10,000 pounds, manufactured on or after September 1, 1990. Each truck and multipurpose passenger vehicle with a gross vehicle weight rating of more than 10,000 pounds, manufactured on or after September 1, 1990, shall meet the requirements of S4.3.2.1 or S4.3.2.2. A protection system that meets the requirements of S4.3.2.1 may be installed at one or more designated seating positions of a vehicle that otherwise meets the requirements of S4.3.2.2.

S4.3.2.1 First option—complete passenger protection system. The vehicle shall meet the crash protection requirements of S5 by means that require no action by vehicle occupants.

S4.3.2.2 Second option—belt system. The vehicle shall, at each designated seating position, have either a Type 1 or a Type 2 seat belt assembly that conforms to §571.209 of this part and S7.2 of this Standard. A Type 1 belt assembly or the pelvic portion of a dual retractor Type 2 belt assembly installed at a front outboard seating position shall include either an emergency locking retractor or an automatic locking retractor. If a seat belt assembly installed at a front outboard seating position includes an automatic locking retractor for the lap belt or the lap belt portion, that seat belt assembly shall comply with the following:

(a) An automatic locking retractor used at a front outboard seating position that has some type of suspension system for the seat shall be attached to the seat structure that moves as the suspension system functions.

(b) The lap belt or lap belt portion of a seat belt assembly equipped with an automatic locking retractor that is installed at a front outboard seating position must allow at least $\frac{3}{4}$ inch, but less than 3 inches, of webbing movement before retracting webbing to the next locking position.

(c) Compliance with S4.3.2.2(b) of this standard is determined as follows:

(1) The seat belt assembly is buckled and the retractor end of the seat belt assembly is anchored to a horizontal surface. The webbing for the lap belt or lap belt portion of the seat belt assembly is extended to 75 percent of its length and the retractor is locked after the initial adjustment.

(2) A load of 20 pounds is applied to the free end of the lap belt or the lap belt portion of the belt assembly (i.e., the end that is not anchored to the horizontal surface) in the direction away from the retractor. The position of the free end of the belt assembly is recorded.

(3) Within a 30 second period, the 20 pound load is slowly decreased, until the retractor moves to the next locking position. The position of the free end of the belt assembly is recorded again.

(4) The difference between the two positions recorded for the free end of the belt assembly shall be at least $\frac{3}{4}$ inch but less than 3 inches.

S4.4 Buses.

S4.4.1 Buses manufactured on or after January 1, 1972 and before September 1, 1990. Each bus manufactured on or after January 1, 1972 and before September 1, 1990, shall meet the requirements of S4.4.1.1 or S4.4.1.2.

S4.4.1.1 First option—complete passenger protection system-driver only. The vehicle shall meet the crash protection requirements of S5, with respect to an anthropomorphic test dummy in the driver's designated seating position, by means that require no action by vehicle occupants.

S4.4.1.2 Second option—belt system- driver only. The vehicle shall, at the driver's designated seating position, have either a Type 1 or a Type 2 seat belt assembly that conforms to S571.209.

S4.4.2 Buses manufactured on or after September 1, 1990. Each bus manufactured on or after September 1, 1990, shall meet the requirements of S4.4.2.1 or S4.4.2.2.

S4.4.2.1 First option—complete passenger protection system-driver only. The vehicle shall meet the crash protection requirements of S5, with respect to an anthropomorphic test dummy in the driver's designated seating position, by means that require no action by vehicle occupants.

S4.4.2.2 Second option—belt system- driver only. The vehicle shall, at the driver's designated seating position, have either a Type 1 or a Type 2 seat belt assembly that conforms to §571.209 of this part and S7.2 of this Standard. A Type 1 belt assembly or the pelvic portion of a dual retractor Type 2 belt assembly installed at the driver's seating position shall include either an emergency locking retractor or an automatic locking retractor. If a seat belt assembly installed at the driver's seating position includes an automatic locking retractor for the lap belt or the lap belt portion, that seat belt assembly shall comply with the following:

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(a) An automatic locking retractor used at a driver's seating position that has some type of suspension system for the seat shall be attached to the seat structure that moves as the suspension system functions.

(b) The lap belt or lap belt portion of a seat belt assembly equipped with an automatic locking retractor that is installed at the driver's seating position must allow at least $\frac{3}{4}$ inch, but less than 3 inches, of webbing movement before retracting webbing to the next locking position.

(c) Compliance with S4.4.2.2(b) of this standard is determined as follows:

(1) The seat belt assembly is buckled and the retractor end of the seat belt assembly is anchored to a horizontal surface. The webbing for the lap belt or lap belt portion of the seat belt assembly is extended to 75 percent of its length and the retractor is locked after the initial adjustment.

(2) A load of 20 pounds is applied to the free end of the lap belt or the lap belt portion of the belt assembly (i.e., the end that is not anchored to the horizontal surface) in the direction away from the retractor. The position of the free end of the belt assembly is recorded.

(3) Within a 30 second period, the 20 pound load is slowly decreased, until the retractor moves to the next locking position. The position of the free end of the belt assembly is recorded again.

(4) The difference between the two positions recorded for the free end of the belt assembly shall be at least $\frac{3}{4}$ inch but less than 3 inches.

S4.4.3 Buses manufactured on or after September 1, 1991.

S4.4.3.1 Each bus with a gross vehicle weight rating of more than 10,000 pounds shall comply with the requirements S4.4.2.1 or S4.4.2.2.

S4.4.3.2 Except as provided in S4.4.3.2.2 and S4.4.3.2.3, each bus with a gross vehicle weight rating of 10,000 pounds or less, except a school bus, shall be equipped with an integral Type 2 seat belt assembly at the driver's designated seating position and at the front and every rear forward-facing outboard designated seating position, and with a Type 1 or Type 2 seat belt assembly at all other designated seating positions. Type 2 seat belt assemblies installed in compliance with this requirement shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.3.2.1 As used in this section, a "rear outboard designated position" means any "outboard designated seating position" (as that term is defined at 49 CFR 571.3) that is rearward of the front seat(s), except any designated seating positions adjacent to a walkway located between the seat and the side of the vehicle, which walkway is designed to allow access to more rearward seating positions.

S4.4.3.2.2 Any rear outboard designated seating position with a seat that can be adjusted to be forward-facing and to face some other direction shall either:

(i) Meet the requirements of S4.4.3.2 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(ii) When the seat is in its forward-facing position, have a Type 2 seat belt assembly with an upper torso restraint that conforms to S7.1 and S7.2 of this standard and that adjusts by means of an emergency locking retractor that conforms with Standard No. 209 (49 CFR 571.209), which upper torso restraint may be detachable at the buckle, and, when the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.4.3.2.3 Any rear outboard designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) in a vehicle manufactured on or after September 1, 1992 shall meet the requirements of S4.4.3.2 and may use an upper torso belt that detaches at either its upper or lower anchorage point, but not both anchorage points, to meet those requirements. The means for detaching the upper torso belt may use a pushbutton action.

S4.4.3.3 School buses with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or less.

(a) Each school bus with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or less manufactured before October 21, 2011 must be equipped with an integral Type 2 seat belt assembly at the driver's designated seating position and at the right front passenger's designated seating position (if any), and with a Type 1 or Type 2 seat belt assembly at all other seating positions. Type 2 seat belt assemblies installed in compliance with this requirement must comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. The lap belt portion of a Type 2 seat belt assembly installed at the driver's designated seating position and at the right front passenger's designated seating position (if any) must meet the requirements specified in S4.4.3.3(c).

(b) Each school bus with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or less manufactured on or after October 21, 2011 must be equipped with an integral Type 2 seat belt assembly at all seating positions. The seat belt assembly at the driver's designated seating position and at the right front passenger's designated seating position (if any) shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. The lap belt portion of a Type 2 seat belt assembly installed at the driver's designated seating position and at the right front passenger's designated seating position (if any) shall meet the requirements specified in S4.4.3.3(c). Type 2 seat belt assemblies installed on the rear seats of school buses must meet the requirements of S7.1.1.5, S7.1.5 and S7.2 of this standard.

(c) The lap belt portion of a Type 2 seat belt assembly installed at the driver's designated seating position and

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at the right front passenger's designated seating position (if any) shall include either an emergency locking retractor or an automatic locking retractor, which retractor shall not retract webbing to the next locking position until at least $\frac{3}{4}$ inch of webbing has moved into the retractor. In determining whether an automatic locking retractor complies with this requirement, the webbing is extended to 75 percent of its length and the retractor is locked after the initial adjustment. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.4 Buses with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1994. Each bus with a GVWR of 8,500 pounds or less and an unloaded vehicle weight of 5,500 pounds or less manufactured on or after September 1, 1984 shall comply with the requirements of S4.2.5 and S4.2.6 of this standard, as applicable, for front seating positions, and with the requirements of S4.4.3.2 or S4.4.3.3 of this standard, as applicable, for all rear seating positions.

S4.4.5 Buses with a GVWR of 10,000 lbs. (4,536 kg) or less manufactured on or after September 1, 2007.

S4.4.5.1 Except as provided in S4.4.5.2, S4.4.5.3, S4.4.5.4, S4.4.5.5 and S4.4.5.6 each bus with a gross vehicle weight rating of 10,000 lbs. (4,536 kg) or less shall be equipped with a Type 2 seat belt assembly at every designated seating position other than a side-facing position. Type 2 seat belt assemblies installed in compliance with this requirement shall conform to Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates a webbing tension relieving device, the vehicle owner's manual shall include the information specified in S7.3.1(b) of this standard for the tension relieving device, and the vehicle shall conform to S7.4.2(c) of this standard. Side-facing designated seating positions shall be equipped, at the manufacturer's option, with a Type 1 or Type 2 seat belt assembly.

S4.4.5.2 Any rear designated seating position with a seat that can be adjusted to be forward- or rear-facing and to face some other direction shall either:

(a) Meet the requirements of S4.4.5.1 with the seat in any position in which it can be occupied while the vehicle is in motion; or

(b) (1) When the seat is in its forward-facing and/or rear-facing position, or within ± 30 degrees of either position, have a Type 2 seat belt assembly with an upper torso restraint that

(i) Conforms to S7.1 and S7.2 of this standard,

(ii) Adjusts by means of an emergency locking retractor conforming to Standard No. 209 (49 CFR 571.209), and

(iii) May be detachable at the buckle or upper anchorage, but not both, and

(2) When the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.4.5.3 Any rear designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) may meet the requirements of S4.4.5.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.5.4 Any inboard designated seating position on a seat for which the entire seat back can be folded such that no part of the seat back extends above a horizontal plane located 250 mm above the highest SRP located on the seat may meet the requirements of S4.4.5.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.5.5 Any rear designated seating position adjacent to a walkway located between the seat, which walkway is designed to allow access to more rearward designated seating positions, and not adjacent to the side of the vehicle may meet the requirements of S4.4.5.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.5.6 Any rear side-facing designated seating position shall have a Type 1 or Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

Editor's Note: Paragraph S4.4 is revised effective November 28, 2016. Optional early compliance is permitted.

S4.4 Buses manufactured on or after November 28, 2016.

S4.4.1 Definitions. For purposes of S4.4, the following definitions apply:

Over-the-road bus means a bus characterized by an elevated passenger deck located over a baggage compartment, except a school bus.

Perimeter-seating bus means a bus with 7 or fewer designated seating positions rearward of the driver's seating position that are forward-facing or can convert to forward-facing without the use of tools and is not an over-the-road bus.

Prison bus means a bus manufactured for the purpose of transporting persons subject to involuntary restraint or confinement and has design features consistent with that purpose.

Stop-request system means a vehicle-integrated system for passenger use to signal to a vehicle operator that they are requesting a stop.

Transit bus means a bus that is equipped with a

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stop-request system sold for public transportation provided by, or on behalf of, a State or local government and that is not an over-the-road bus.

S4.4.2 Buses with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less.

S4.4.2.1 Each bus with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less, except a school bus, shall comply with the requirements of S4.2.6 of this standard for front seating positions and with the requirements of S4.4.3.1 of this standard for all rear seating positions.

S4.4.2.2 Each school bus with a GVWR of 3,855 kg (8,500 lb) or less and an unloaded vehicle weight of 2,495 kg (5,500 lb) or less shall comply with the requirements of S4.2.6 of this standard for front seating positions and with the requirements of S4.4.3.2 of this standard for all rear seating positions.

S4.4.3 Buses with a GVWR of 4,536 kg (10,000 lb) or less.

S4.4.3.1 Except as provided in S4.4.3.1.1, S4.4.3.1.2, S4.4.3.1.3, S4.4.3.1.4 and S4.4.3.1.5, each bus with a gross vehicle weight rating of 4,536 kg (10,000 lb) or less, except a school bus or an over-the-road bus, shall be equipped with a Type 2 seat belt assembly at every designated seating position other than a side-facing position. Type 2 seat belt assemblies installed in compliance with this requirement shall conform to Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a Type 2 seat belt assembly installed in compliance with this requirement incorporates a webbing tension relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension relieving device, and the vehicle shall conform to S7.4.2(c) of this standard. Side-facing designated seating positions shall be equipped, at the manufacturer's option, with a Type 1 or Type 2 seat belt assembly.

S4.4.3.1.1 Any rear designated seating position with a seat that can be adjusted to be forward- or rear-facing and to face some other direction shall either:

(a) Meet the requirements of S4.4.3.1 with the seat in any position in which it can be occupied while the vehicle is in motion, or meet S4.4.3.1.1(b)(1) and S4.4.3.1.1(b)(2).

(b)(1) When the seat is in its forward-facing and/or rear-facing position, or within ± 30 degrees of either position, have a Type 2 seat belt assembly with an upper torso restraint that

- (i) Conforms to S7.1 and S7.2 of this standard,
- (ii) Adjusts by means of an emergency locking retractor conforming to Standard No. 209 (49 CFR 571.209), and
- (iii) May be detachable at the buckle or upper anchorage, but not both.

(2) When the seat is in any position in which it can be occupied while the vehicle is in motion, have a Type 1 seat belt or the pelvic portion of a Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.4.3.1.2 Any rear designated seating position on a readily removable seat (that is, a seat designed to be easily removed and replaced by means installed by the manufacturer for that purpose) may meet the requirements of S4.4.3.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.3.1.3 Any inboard designated seating position on a seat for which the entire seat back can be folded such that no part of the seat back extends above a horizontal plane located 250 mm above the highest SRP located on the seat may meet the requirements of S4.4.3.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.3.1.4 Any rear designated seating position adjacent to a walkway located between the seat, which walkway is designed to allow access to more rearward designated seating positions, and not adjacent to the side of the vehicle may meet the requirements of S4.4.3.1 by use of a belt incorporating a release mechanism that detaches both the lap and shoulder portion at either the upper or lower anchorage point, but not both. The means of detachment shall be a key or key-like object.

S4.4.3.1.5 Any rear side-facing designated seating position shall be equipped with a Type 1 or Type 2 seat belt assembly that conforms to S7.1 and S7.2 of this standard.

S4.4.3.2 Each school bus with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or less shall comply with the requirements of S4.4.3.2.1 and S4.4.3.2.2.

S4.4.3.2.1 The driver's designated seating position and any outboard designated seating position not rearward of the driver's seating position shall be equipped with a Type 2 seat belt assembly. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. The lap belt portion of the seat belt assembly shall include either an emergency locking retractor or an automatic locking retractor. An automatic locking retractor shall not retract webbing to the next locking position until at least $\frac{3}{4}$ inch of webbing has moved into the retractor. In determining whether an automatic locking retractor complies with this requirement, the webbing is extended to 75 percent of its length and the retractor is locked after the initial adjustment. If the seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.3.2.2 Passenger seating positions, other than any outboard designated seating position not rearward of the driver's seating position, shall be equipped with Type 2 seat belt assemblies that comply with the requirements of S7.1.1.5, S7.1.5 and S7.2 of this standard.

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S4.4.3.3 Each over-the-road-bus with a GVWR of 4,536 kg (10,000 lb) or less shall meet the requirements of S4.4.5.1 (as specified for buses with a GVWR or more than 11,793 kg (26,000 lb)).

S4.4.4 Buses with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb).

S4.4.4.1 Each bus with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb), except a school bus or an over-the-road bus, shall meet the requirements of S4.4.4.1.1 or S4.4.4.1.2.

S4.4.4.1.1 First option—complete passenger protection system—driver only. The vehicle shall meet the crash protection requirements of S5, with respect to an anthropomorphic test dummy in the driver's designated seating position, by means that require no action by vehicle occupants.

S4.4.4.1.2 Second option—belt system—driver only. The vehicle shall, at the driver's designated seating position, be equipped with either a Type 1 or a Type 2 seat belt assembly that conforms to §571.209 of this part and S7.2 of this Standard. A Type 1 belt assembly or the pelvic portion of a dual retractor Type 2 belt assembly installed at the driver's seating position shall include either an emergency locking retractor or an automatic locking retractor. If a seat belt assembly installed at the driver's seating position includes an automatic locking retractor for the lap belt or the lap belt portion, that seat belt assembly shall comply with the following:

(a) An automatic locking retractor used at a driver's seating position that has some type of suspension system for the seat shall be attached to the seat structure that moves as the suspension system functions.

(b) The lap belt or lap belt portion of a seat belt assembly equipped with an automatic locking retractor that is installed at the driver's seating position must allow at least $\frac{3}{4}$ inch, but less than 3 inches, of webbing movement before retracting webbing to the next locking position.

(c) Compliance with S4.4.4.2.1(b) of this standard is determined as follows:

(1) The seat belt assembly is buckled and the retractor end of the seat belt assembly is anchored to a horizontal surface. The webbing for the lap belt or lap belt portion of the seat belt assembly is extended to 75 percent of its length and the retractor is locked after the initial adjustment.

(2) A load of 20 pounds is applied to the free end of the lap belt or the lap belt portion of the belt assembly (i.e., the end that is not anchored to the horizontal surface) in the direction away from the retractor. The position of the free end of the belt assembly is recorded.

(3) Within a 30 second period, the 20 pound load is slowly decreased, until the retractor moves to the next locking position. The position of the free end of the belt assembly is recorded again.

(4) The difference between the two positions recorded for the free end of the belt assembly shall be at least $\frac{3}{4}$ inch but less than 3 inches.

S4.4.4.2 Each school bus with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg

(26,000 lb) shall be equipped with a Type 2 seat belt assembly at the driver's designated seating position. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a seat belt assembly installed in compliance with this requirement includes an automatic locking retractor for the lap belt portion, that seat belt assembly shall comply with paragraphs (a) through (c) of S4.4.4.1.2 of this standard. If a seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.4.3 Each over-the-road-bus with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb) shall meet the requirements of S4.4.5.1 (as specified for buses with a GVWR or more than 11,793 kg (26,000 lb)).

S4.4.5 Buses with a GVWR of more than 11,793 kg (26,000 lb).

S4.4.5.1 Each bus with a GVWR of more than 11,793 kg (26,000 lb), except a perimeter-seating bus, transit bus, or school bus, shall comply with the requirements of S4.4.5.1.1 and S4.4.5.1.2.

S4.4.5.1.1 The driver's designated seating position and any outboard designated seating position not rearward of the driver's seating position shall be equipped with a Type 2 seat belt assembly. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a seat belt assembly installed in compliance with this requirement includes an automatic locking retractor for the lap belt portion, that seat belt assembly shall comply with paragraphs (a) through (c) of S4.4.4.1.2 of this standard. If a seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.4.5.1.2 Passenger seating positions, other than any outboard designated seating position not rearward of the driver's seating position and seating positions on prison buses rearward of the driver's seating position, shall:

(a) Other than for over-the-road buses:

(i) Be equipped with a Type 2 seat belt assembly at any seating position that is not a side-facing position;

(ii) Be equipped with a Type 1 or Type 2 seat belt assembly at any seating position that is a side-facing position;

(c) For over-the-road buses, be equipped with a Type 2 seat belt assembly;

(d) Have the seat belt assembly attached to the seat structure at any seating position that has another seating position, wheelchair position, or side emergency door behind it; and

(e) Comply with the requirements of S7.1.1.5, S7.1.3, S7.1.6 and S7.2 of this standard.

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S4.4.5.2 Each perimeter-seating bus and transit bus with a GVWR of more than 11,793 kg (26,000 lb) shall meet the requirements of S4.4.4.1.1 or S4.4.4.1.2 (as specified for buses with a GVWR of more than 4,536 kg (10,000 lb) but not greater than 11,793 kg (26,000 lb)).

S4.4.5.3 Each school bus with a GVWR of more than 11,793 kg (26,000 lb) shall be equipped with a Type 2 seat belt assembly at the driver's designated seating position. The seat belt assembly shall comply with Standard No. 209 (49 CFR 571.209) and with S7.1 and S7.2 of this standard. If a seat belt assembly installed in compliance with this requirement includes an automatic locking retractor for the lap belt portion, that seat belt assembly shall comply with paragraphs (a) through (c) of S4.4.4.1.2 of this standard. If a seat belt assembly installed in compliance with this requirement incorporates any webbing tension-relieving device, the vehicle owner's manual shall include the information specified in S7.4.2(b) of this standard for the tension-relieving device, and the vehicle shall comply with S7.4.2(c) of this standard.

S4.5 Other general requirements.

S4.5.1 Labeling and owner's manual information.

(a) **Air bag maintenance or replacement information.** If the vehicle manufacturer recommends periodic maintenance or replacement of an inflatable restraint system, as that term is defined in S4.1.5.1(b) of this standard, installed in a vehicle, that vehicle shall be labeled with the recommended schedule for maintenance or replacement. The schedule shall be specified by month and year, or in terms of vehicle mileage, or by intervals measured from the date appearing on the vehicle certification label provided pursuant to 49 CFR Part 567. The label shall be permanently affixed to the vehicle within the passenger compartment and lettered in English in block capital and numerals not less than three thirty-seconds of an inch high. This label may be combined with the label required by S4.5.1(b) of this standard to appear on the sun visor. If some regular maintenance or replacement of the inflatable restraint system(s) in a vehicle is recommended by the vehicle manufacturer, the owner's manual shall also set forth the recommended schedule for maintenance or replacement.

(b) **Sun visor air bag warning label.** (1) Except as provided in S4.5.1(b)(2), each vehicle shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown in either Figure 6a or 6b of this standard, as appropriate, and shall comply with the requirements of S4.5.1(b)(1)(i) through S4.5.1(b)(1)(iv).

(i) The heading area shall be yellow with the word "WARNING" and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm² (4.7 in²).

(iii) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 30 mm (1.2 in) in diameter.

(iv) If the vehicle does not have a back seat, the label shown in Figure 6a or 6b may be modified by omitting

the statements: "The BACK SEAT is the SAFEST place for children."

(2) Vehicles certified to meet the requirements specified in S19, S21, or S23 before September 1, 2003 shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown either in Figure 8 or Figure 11 of this standard, at the manufacturer's option, and shall comply with the requirements of S4.5.1(b)(2)(i) through S4.5.1(b)(2)(iv).

(i) The heading area shall be yellow with the word "WARNING" and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm² (4.7 in²).

(iii) The pictogram shall be black on a white background. The pictogram shall be no less than 30 mm (1.2 in) in length.

(iv) If the vehicle does not have a back seat, the label shown in the figure may be modified by omitting the statement: "The BACK SEAT is the SAFEST place for CHILDREN."

(v) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the label shown in the figure may be modified by omitting the statement: "Never put a rear-facing child seat in the front."

(3) Vehicles certified to meet the requirements specified in S19, S21, or S23 on or after September 1, 2003 shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown in Figure 11 of this standard and shall comply with the requirements of S4.5.1(b)(3)(i) through S4.5.1(b)(3)(iv).

(i) The heading area shall be yellow with the word "WARNING" and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm² (4.7 in²).

(iii) The pictogram shall be black on a white background. The pictogram shall be no less than 30 mm (1.2 in) in length.

(iv) If the vehicle does not have a back seat, the label shown in the figure may be modified by omitting the statement: "The BACK SEAT is the SAFEST place for CHILDREN."

(v) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the label shown in the figure may be modified by omitting the statement: "Never put a rear-facing child seat in the front."

(4) Design-specific information.

(i) A manufacturer may request in writing that the Administrator authorize additional design-specific information to be placed on the air bag sun visor label for vehicles certified to meet the requirements specified in S19, S21, or S23. The label shall conform in content to the label shown in Figure 11 of this standard and shall

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comply with the requirements of S4.5.1(b)(3)(i) through S4.5.1(b)(3)(iv), except that the label may contain additional, design-specific information, if authorized by the Administrator.

(ii) The request must meet the following criteria:

(A) The request must provide a mock-up of the label with the specific language or pictogram the manufacturer requests permission to add to the label.

(B) The additional information conveyed by the requested label must be specific to the design or technology of the air bag system in the vehicle and not applicable to all or most air bag systems.

(C) The additional information conveyed by the requested label must address a situation in which foreseeable occupant behavior can affect air bag performance.

(iii) The Administrator shall authorize or reject a request by a manufacturer submitted under S4.5.1(b)(4)(i) on the basis of whether the additional information could result in information overload or would otherwise make the label confusing or misleading. No determination will be made as to whether, in light of the above criteria, the particular information best prevents information overload or whether the information best addresses a particular air bag risk. Moreover, the Administrator will not verify or vouch for the accuracy of the information.

(5) Limitations on additional labels.

(i) Except for the information on an air bag maintenance label placed on the sun visor pursuant to S4.5.1(a) of this standard, or on a utility vehicle warning label placed on the sun visor that conforms in content, form, and sequence to the label shown in Figure 1 of 49 CFR 575.105, no other information shall appear on the same side of the sun visor to which the sun visor air bag warning label is affixed.

(ii) Except for the information in an air bag alert label placed on the sun visor pursuant to S4.5.1(c) of this standard, or on a utility vehicle warning label placed on the sun visor that conforms in content, form, and sequence to the label shown in Figure 1 of 49 CFR 575.105, no other information about air bags or the need to wear seat belts shall appear anywhere on the sun visor.

(c) **Air bag alert label.** If the label required by S4.5.1(b) is not visible when the sun visor is in the stowed position, an air bag alert label shall be permanently affixed to that visor so that the label is visible when the visor is in that position. The label shall conform in content to the sun visor label shown in Figure 6(c) of this standard, and shall comply with the requirements of S4.5.1(c)(1) through S4.5.1(c)(3).

(1) The message area shall be black with yellow text. The message area shall be no less than 20 square cm.

(2) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 20 mm in diameter.

(3) If a vehicle does not have an inflatable restraint at any front seating position other than that for the driver, the pictogram may be omitted from the label shown in Figure 6c.

(d) At the option of the manufacturer, the requirements in S4.5.1(b) and S4.5.1(c) for labels that are permanently affixed to specified parts of the vehicle may instead be met by permanent marking or molding of the required information.

(e) **Label on the dashboard.**(1) Except as provided in S4.5.1(e)(2) or S4.5.1(e)(3), each vehicle that is equipped with an inflatable restraint for the passenger position shall have a label attached to a location on the dashboard or the steering wheel hub that is clearly visible from all front seating positions. The label need not be permanently affixed to the vehicle. This label shall conform in content to the label shown in Figure 7 of this standard, and shall comply with the requirements of S4.5.1(e)(1)(i) through S4.5.1(e)(1)(iii).

(i) The heading area shall be yellow with the word "WARNING" and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm² (4.7 in²).

(iii) If the vehicle does not have a back seat, the label shown in Figure 7 may be modified by omitting the statement: "The back seat is the safest place for children 12 and under."

(2) Vehicles certified to meet the requirements specified in S19, S21, and S23 before December 1, 2003, that are equipped with an inflatable restraint for the passenger position shall have a label attached to a location on the dashboard or the steering wheel hub that is clearly visible from all front seating positions. The label need not be permanently affixed to the vehicle. This label shall conform in content to the label shown in either Figure 9 or Figure 12 of this standard, at manufacturer's option, and shall comply with the requirements of S4.5.1(e)(2)(i) through S4.5.1(e)(2)(iv).

(i) The heading area shall be yellow with black text.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm² (4.7 in²).

(iii) If the vehicle does not have a back seat, the labels shown in Figures 9 and 12 may be modified by omitting the statement: "The back seat is the safest place for children."

(iv) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the label shown in Figure 12 may be modified by omitting the statement: "Never put a rear-facing child seat in the front."

(3) Vehicles certified to meet the requirements specified in S19, S21, and S23 on or after December 1, 2003, that are equipped with an inflatable restraint for the passenger position shall have a label attached to a location on the dashboard or the steering wheel hub that is clearly visible from all front seating positions. The label need not be permanently affixed to the vehicle. This label shall conform in content to the label shown in Figure 12 of this standard and shall comply with the requirements of S4.5.1(e)(3)(i) through S4.5.1(e)(3)(iv).

(i) The heading area shall be yellow with black text.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm² (4.7 in²).

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(iii) If the vehicle does not have a back seat, the label shown in Figure 12 may be modified by omitting the statement: “The back seat is the safest place for children.”

(iv) If the vehicle does not have a back seat or the back seat is too small to accommodate a rear-facing child restraint consistent with S4.5.4.1, the label shown in Figure 12 may be modified by omitting the statement: “Never put a rear-facing child seat in the front.”

(f) **Information to appear in owner’s manual.**(1) The owner’s manual for any vehicle equipped with an inflatable restraint system shall include an accurate description of the vehicle’s air bag system in an easily understandable format. The owner’s manual shall include a statement to the effect that the vehicle is equipped with an air bag and lap/ shoulder belt at both front outboard seating positions, and that the air bag is a supplemental restraint at those seating positions. The information shall emphasize that all occupants, including the driver, should always wear their seat belts whether or not an air bag is also provided at their seating position to minimize the risk of severe injury or death in the event of a crash. The owner’s manual shall also provide any necessary precautions regarding the proper positioning of occupants, including children, at seating positions equipped with air bags to ensure maximum safety protection for those occupants. The owner’s manual shall also explain that no objects should be placed over or near the air bag on the instrument panel, because any such objects could cause harm if the vehicle is in a crash severe enough to cause the air bag to inflate.

(2) For any vehicle certified to meet the requirements specified in S14.5, S15, S17, S19, S21, S23, and S25, the manufacturer shall also include in the vehicle owner’s manual a discussion of the advanced passenger air bag system installed in the vehicle. The discussion shall explain the proper functioning of the advanced air bag system and shall provide a summary of the actions that may affect the proper functioning of the system. The discussion shall include, at a minimum, accurate information on the following topics:

(i) A presentation and explanation of the main components of the advanced passenger air bag system.

(ii) An explanation of how the components function together as part of the advanced passenger air bag system.

(iii) The basic requirements for proper operation, including an explanation of the actions that may affect the proper functioning of the system.

(iv) For vehicles certified to meet the requirements of S19.2, S21.2 or S23.2, a complete description of the passenger air bag suppression system installed in the vehicle, including a discussion of any suppression zone.

(v) An explanation of the interaction of the advanced passenger air bag system with other vehicle components, such as seat belts, seats or other components.

(vi) A summary of the expected outcomes when child restraint systems, children and small teenagers or adults are both properly and improperly positioned in the passenger seat, including cautionary advice against improper placement of child restraint systems.

(vii) For vehicles certified to meet the requirements of S19.2, S21.2 or S23.2, a discussion of the telltale light, specifying its location in the vehicle and explaining when the light is illuminated.

(viii) Information on how to contact the vehicle manufacturer concerning modifications for persons with disabilities that may affect the advanced air bag system.

(g) **Additional labels placed elsewhere in the vehicle interior.** The language on additional air bag warning labels placed elsewhere in the vehicle interior shall not cause confusion or contradiction of any of the statements required in the air bag sun visor label, and shall be expressed in symbols, words and abbreviations required by this standard.

S4.5.2 Readiness indicator. An occupant protection system that deploys in the event of a crash shall have a monitoring system with a readiness indicator. The indicator shall monitor its own readiness and shall be clearly visible from the driver’s designated seating position. If the vehicle is equipped with a single readiness indicator for both a driver and passenger air bag, and if the vehicle is equipped with an on-off switch permitted by S4.5.4 of this standard, the readiness indicator shall monitor the readiness of the driver air bag when the passenger air bag has been deactivated by means of the on-off switch, and shall not illuminate solely because the passenger air bag has been deactivated by the manual on-off switch. A list of the elements of the system being monitored by the indicator shall be included with the information furnished in accordance with S4.5.1 but need not be included on the label.

S4.5.3 Automatic belts. Except as provided in S4.5.3.1, a seat belt assembly that requires no action by vehicle occupants (hereinafter referred to as an “automatic belt”) may be used to meet the crash protection requirements of any option under S4. and in place of any seat belt assembly otherwise required by that option.

S4.5.3.1 An automatic belt that provides only pelvic restraint may not be used pursuant to S4.5.3 to meet the requirements of an option that requires a Type 2 seat belt assembly. An automatic belt may not be used pursuant to S4.5.3 to meet the requirements of S4.1.5.1(a)(3) for a Type 2 seat belt assembly at any seating position equipped with an inflatable restraint system pursuant to S4.1.5.2, S4.1.5.3, S4.2.6.1, or S4.2.6.2 of this standard.

S4.5.3.2 An automatic belt, furnished pursuant to S4.5.3, that provides both pelvic and upper torso restraint may have either a detachable or nondetachable upper torso portion, notwithstanding provisions of the option under which it is furnished.

S4.5.3.3 An automatic belt furnished pursuant to S4.5.3 shall:

(a) Conform to S7.1 and have a single emergency release mechanism whose components are readily accessible to a seated occupant.

(b) In place of a warning system that conforms to S7.3 of this standard, be equipped with the following warning system: At the left front designated seating position (driver’s position), a warning system that activates a continuous or intermittent audible signal for a period of

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not less than 4 seconds and not more than 8 seconds and that activates a continuous or flashing warning light visible to the driver for not less than 60 seconds (beginning when the vehicle ignition switch is moved to the "on" or the "start" position) when condition (A) exists simultaneously with condition (B), and that activates a continuous or flashing warning light, visible to the driver, displaying the identifying symbol for the seat belt telltale shown in Table 2 of Standard No. 101 (49 CFR 571.101), or, at the option of the manufacturer if permitted by Standard No. 101, displaying the words "Fasten Seat Belts" or "Fasten Belts," for as long as condition (A) exists simultaneously with condition (C).

(A) The vehicle's ignition switch is moved to the "on" position or to the "start" position.

(B) The driver's automatic belt is not in use, as determined by the belt latch mechanism not being fastened, or, if the automatic belt is non-detachable, by the emergency release mechanism being in the released position. In the case of motorized automatic belts, the determination of use shall be made once the belt webbing is in its locked protective mode at the anchorage point.

(C) The belt webbing of a motorized automatic belt system is not in its locked, protective mode at the anchorage point.

S4.5.3.4 An automatic belt furnished pursuant to S4.5.3 that is not required to meet the perpendicular frontal crash protection requirements of S5.1 shall conform to the webbing, attachment hardware, and assembly performance requirements of Standard No. 209.

S4.5.3.5 A replacement automatic belt shall meet the requirements of S4.1(k) of Standard No. 209.

S4.5.4 Passenger air bag manual cut-off device. Passenger cars, trucks, buses, and multipurpose passenger vehicles manufactured before September 1, 2012 may be equipped with a device that deactivates the air bag installed at the right front outboard seating position in the vehicle, if all the conditions in S4.5.4.1 through S4.5.4.4 are satisfied.

S4.5.4.1 The vehicle complies with either S4.5.4.1(a) or S4.5.4.1(b).

(a) The vehicle has no forward-facing designated seating positions to the rear of the front seating positions.

(b) With the seats and seat backs adjusted as specified in S8.1.2 and S8.1.3, the distance, measured along a longitudinal horizontal line tangent to the highest point of the rear seat bottom in the longitudinal vertical plane described in either S4.5.4.1(b)(1) or S4.5.4.1(b)(2), between the rearward surface of the front seat back and the forward surface of the rear seat back is less than 720 millimeters.

(1) In a vehicle equipped with front bucket seats, the vertical plane at the centerline of the driver's seat cushion.

(2) In a vehicle equipped with front bench seating, the vertical plane which passes through the center of the steering wheel rim.

S4.5.4.2 The device is operable by means of the ignition key for the vehicle. The device shall be separate from the ignition switch for the vehicle, so that the driver must take some action with the ignition key

other than inserting it or turning it in the ignition switch to deactivate the passenger air bag. Once deactivated, the passenger air bag shall remain deactivated until it is reactivated by means of the device.

S4.5.4.3 A telltale light in the interior of the vehicle shall be illuminated whenever the passenger air bag is turned off by means of the on-off switch. The telltale shall be clearly visible to occupants of all front seating positions. "Clearly visible" means within the normal range of vision throughout normal driving operations. The telltale:

(a) Shall be yellow;

(b) Shall have the identifying words "PASSENGER AIR BAG OFF" or "PASS AIR BAG OFF" on the telltale or within 25 millimeters of the telltale;

(c) Shall remain illuminated for the entire time that the air bag is "off";

(d) Shall not be illuminated at any time when the air bag is "on"; and,

(e) Shall not be combined with the readiness indicator required by S4.5.2 of this standard.

S4.5.4.4 The vehicle owner's manual shall provide, in a readily understandable format:

(a) Complete instructions on the operation of the on-off switch;

(b) A statement that the on-off switch should only be used when a member of a passenger risk group identified in the request form in Appendix B to part 595 of this chapter is occupying the right front passenger seating position; and,

(c) A warning about the safety consequences of using the on-off switch at other times.

S4.5.5 Rear seat belt requirements for passenger cars and for trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lbs.) or less.

S4.5.5.1 Vehicles manufactured on or after September 1, 2005 and before September 1, 2007.

(a) For vehicles manufactured for sale in the United States on or after September 1, 2005, and before September 1, 2007, a percentage of the manufacturer's production as specified in S4.5.5.2, shall meet the requirements specified in either S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.5 for complying buses.

Editor's Note: Paragraph S4.5.5.1(a) is revised effective November 28, 2016. Optional early compliance is permitted.

(a) For vehicles manufactured for sale in the United States on or after September 1, 2005, and before September 1, 2007, a percentage of the manufacturer's production as specified in S4.5.5.2, shall meet the requirements specified in either S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.3.1 for complying buses.

(b) A manufacturer that sells two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the

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requirements of this paragraph, instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2006, and before September 1, 2007, shall meet the requirements specified in S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks & multipurpose passenger vehicles, and S4.4.5 for complying buses. Credits for vehicles manufactured before September 1, 2006 are not to be applied to the requirements of this paragraph.

Editor's Note: Paragraph S4.5.5.1(b) is revised effective November 28, 2016. Optional early compliance is permitted.

(b) A manufacturer that sells two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph, instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2006, and before September 1, 2007, shall meet the requirements specified in S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks & multipurpose passenger vehicles, and S4.4.3.1 for complying buses. Credits for vehicles manufactured before September 1, 2006 are not to be applied to the requirements of this paragraph.

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with part 567 of this chapter are not subject to the requirements of S4.5.5.1.

(d) Vehicles that are manufactured by a manufacturer that produces fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S4.5.5.1.

S4.5.5.2 Phase-in schedule.

(a) **Vehicles manufactured on or after September 1, 2005, and before September 1, 2006.** Subject to S4.5.5.3(a), for vehicles manufactured on or after September 1, 2005, and before September 1, 2006, the amount of vehicles complying with S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.5 for complying buses shall be not less than 50 percent of:

Editor's Note: Paragraph S4.5.5.2(a) introductory text is revised effective November 28, 2016. Optional early compliance is permitted.

(a) Vehicles manufactured on or after September 1, 2005, and before September 1, 2006. Subject to S4.5.5.3(a), for vehicles manufactured on or after September 1, 2005, and before September 1, 2006, the amount of vehicles complying with S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.3.1 for complying buses shall be not less than 50 percent of:

(1) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years immediately prior to September 1, 2005, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2003, and before September 1, 2006, or

(2) The manufacturer's production on or after September 1, 2005, and before September 1, 2006.

(b) **Vehicles manufactured on or after September 1, 2006, and before September 1, 2007.** Subject to S4.5.5.3(b), for vehicles manufactured on or after September 1, 2006, and before September 1, 2007, the amount of vehicles complying with S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.5 for complying buses shall be not less than 80 percent of:

Editor's Note: Paragraph S4.5.5.2(b) introductory text is revised effective November 28, 2016. Optional early compliance is permitted.

(b) Vehicles manufactured on or after September 1, 2006, and before September 1, 2007. Subject to S4.5.5.3(b), for vehicles manufactured on or after September 1, 2006, and before September 1, 2007, the amount of vehicles complying with S4.1.5.5 for complying passenger cars, S4.2.7 for complying trucks and multipurpose passenger vehicles, or S4.4.3.1 for complying buses shall be not less than 80 percent of:

(1) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years immediately prior to September 1, 2006, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2004, and before September 1, 2007, or

(2) The manufacturer's production on or after September 1, 2006, and before September 1, 2007.

S4.5.5.3 Calculation of complying vehicles.

(a) For the purposes of complying with S4.5.5.2(a), a manufacturer may count a vehicle if it is manufactured on or after February 7, 2005, but before September 1, 2006.

(b) For the purposes of complying with S4.5.5.2(b), a manufacturer may count a vehicle if it:

(1) Is manufactured on or after February 7, 2005, but before September 1, 2007, and

(2) Is not counted toward compliance with S4.5.5.2(a).

S4.5.5.4 Vehicles produced by more than one manufacturer.

(a) For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S4.5.5.2, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to paragraph (b) of this section.

(1) A vehicle that is imported shall be attributed to the importer.

(2) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

(b) A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the

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vehicle would otherwise be attributed under paragraph (a) of this section.

S4.6 Dynamic testing of manual belt systems.

S4.6.1 Each truck and multipurpose passenger vehicle with a GVWR of 8,500 pounds or less and an unloaded weight of less than 5,500 pounds that is manufactured on or after September 1, 1991, and is equipped with a Type 2 seat belt assembly at a front outboard designated seating position pursuant to S4.1.2.3 shall meet the frontal crash protection requirements of S5.1 at those designated seating positions with a test dummy restrained by a Type 2 seat belt assembly that has been adjusted in accordance with S7.4.2. A vehicle shall not be deemed to be in noncompliance with this standard if its manufacturer establishes that it did not have reason to know in the exercise of due care that such vehicle is not in conformity with the requirement of this standard.

S4.6.2 Any manual seat belt assembly subject to the requirements of S5.1 of this standard by virtue of any provision of this standard other than S4.1.2.1(c)(2) does not have to meet the requirements of S4.2(a)-(f) and S4.4 of Standard No. 209 (§571.209).

S4.6.3 Any manual seat belt assembly subject to the requirements of S5.1 of this standard by virtue of S4.1.2.1(c)(2) does not have to meet the elongation requirements of S4.2(c), S4.4(a)(2), S4.4(b)(4), and S4.4(b)(5) of Standard No. 209 (§571.209).

S4.8 **Selection of compliance options.** Where manufacturer options are specified, the manufacturer shall select the option by the time it certifies the vehicle and may not thereafter select a different option for the vehicle. Each manufacturer shall, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S4.9 **Values and tolerances.** Wherever a range of values or tolerances are specified, requirements shall be met at all values within the range of values or tolerances. With respect to the positioning of anthropomorphic dummies, torso and spine angle tolerances shall be ± 2 degrees unless otherwise stated, and leg, thigh, foot, and arm angle tolerances shall be ± 5 degrees unless otherwise stated.

S4.10 **Metric values.** Specifications and requirements are given in metric units with English units provided for reference. The metric values are controlling.

S4.11 Test duration for purpose of measuring injury criteria.

(a) For all barrier crashes, the injury criteria specified in this standard shall be met when calculated based on data recorded for 300 milliseconds after the vehicle strikes the barrier.

(b) For the 3-year-old and 6-year-old child dummy low risk deployment tests, the injury criteria specified in this standard shall be met when calculated on data recorded for 100 milliseconds after the initial deployment of the air bag.

(c) For 12-month-old infant dummy low risk deployment tests, the injury criteria specified in the standard shall be met when calculated on data recorded for 125

milliseconds after the initiation of the final stage of air bag deployment designed to deploy in any full frontal rigid barrier crash up to 64 km/h (40 mph).

(d) For driver-side low risk deployment tests, the injury criteria shall be met when calculated based on data recorded for 125 milliseconds after the initiation of the final stage of air bag deployment designed to deploy in any full frontal rigid barrier crash up to 26 km/h (16 mph).

(e) The requirements for dummy containment shall continue until both the vehicle and the dummies have ceased moving.

S4.12 **Suppression systems that do not detect dummies.** For vehicles with occupant sensing systems that recognize humans and not dummies, such that the air bag or bags would not function in crash tests, the manufacturer shall provide NHTSA with information and equipment necessary to circumvent the suppression system for the crash test such that the restraint system operates as if 5th percentile adult female humans and 50th percentile adult male humans are seated in the vehicle.

S4.13 **Data channels.** For vehicles manufactured on or after September 1, 2001, all data channels used in injury criteria calculations shall be filtered using a phaseless digital filter, such as the Butterworth four-pole phaseless digital filter specified in appendix C of SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5).

S5 Occupant crash protection requirements for the 50th percentile adult male dummy.

S5.1 Frontal barrier crash test.

S5.1.1 Belted test. (a) Vehicles not certified to S14.

Impact a vehicle traveling longitudinally forward at any speed, up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(a), S6.3, S6.4(a), and S6.5 of this standard.

(b) **Vehicles certified to S14—(1) Vehicles certified to S14.1 or S14.2.** Impact a vehicle traveling longitudinally forward at any speed, up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle under the applicable conditions of S8 and S10. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

(2) **Vehicles certified to S14.3 or S14.4.** Impact a vehicle traveling longitudinally forward at any speed, up to and including 56 km/h (35 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle under the applicable conditions of S8 and S10. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury

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criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

S5.1.2 Unbelted test.(a) Vehicles not certified to the requirements of S13 or S14. At the manufacturer's option, either one of the following unbelted tests shall be met:

(1) Impact a vehicle traveling longitudinally forward at any speed up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10, excluding S10.7, S10.8, and S10.9. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(a), S6.3, S6.4(a), and S6.5 of this standard.

(2) Impact a vehicle traveling longitudinally forward at any speed between 32 km/h (20 mph) and 40 km/h (25 mph), inclusive, into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10, excluding S10.7, S10.8, and S10.9. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

(b) **Vehicles certified to the requirements of S14.** Impact a vehicle traveling longitudinally forward at any speed between 32 km/h (20 mph) and 40 km/h (25 mph), inclusive, into a fixed rigid barrier that is perpendicular to the line of travel of the vehicle, and at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, under the applicable conditions of S8 and S10, excluding S10.7, S10.8, and S10.9. The test dummy specified in S8.1.8 placed in each front outboard designated seating position shall meet the injury criteria of S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 of this standard.

S5.2 Lateral moving barrier crash test. Impact a vehicle laterally on either side by a barrier moving at 20 mph under the applicable conditions of S8. The test dummy specified in S8.1.8 positioned in the front outboard designated seating position adjacent to the impacted side shall meet the injury criteria of S6.2 and S6.3 of this standard.

S5.3 Rollover. Subject a vehicle to a rollover test in either lateral direction at 30 mph under the applicable conditions of S8 of this standard with a test dummy specified in S8.1.8 placed in the front outboard designated seating position on the vehicle's lower side as mounted on the test platform. The test dummy shall meet the injury criteria of S6.1 of this standard.

S6. Injury criteria for the part 572, subpart E, Hybrid III test dummy.

S6.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S6.2 Head injury criteria.(a)(1) For any two points in time, t_1 and t_2 , during the event which are separated

by not more than a 36 millisecond time interval and where t_1 is less than t_2 , the head injury criterion (HIC_{36}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r , expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$HIC = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 - t_1)$$

(2) The maximum calculated HIC_{36} value shall not exceed 1,000.

(b)(1) For any two points in time, t_1 and t_2 , during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2 , the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r , expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$HIC = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 - t_1)$$

(2) The maximum calculated HIC_{15} value shall not exceed 700.

S6.3 The resultant acceleration calculated from the output of the thoracic instrumentation shown in drawing 78051.218, revision R incorporated by reference in part 572, subpart E of this chapter shall not exceed 60 g 's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S6.4 Chest deflection.(a) Compressive deflection of the sternum relative to the spine shall not exceed 76 mm (3.0 in).

(b) Compressive deflection of the sternum relative to the spine shall not exceed 63 mm (2.5 in).

S6.5 The force transmitted axially through each upper leg shall not exceed 2250 pounds.

S6.6 Neck injury. When measuring neck injury, each of the following injury criteria shall be met.

(a) **Nij.**

(1) The shear force (F_x), axial force (F_z), and bending moment (M_y) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for N_{ij} purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (F_z) can be either in tension or compression while the occipital condyle bending moment (M_{ocy}) can be in either flexion or extension. This results in four possible loading conditions for N_{ij} : tension-extension (N_{te}), tension-flexion (N_{tf}), compression-extension (N_{ce}), or compression-flexion (N_{cf}).

(3) When calculating N_{ij} using equation S6.6(a)(4), the critical values, F_{zc} and M_{yc} , are:

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- (i) $F_{zc} = 6806 \text{ N}$ (1530 lbf) when F_z is in tension
- (ii) $F_{zc} = 6160 \text{ N}$ (1385 lbf) when F_z is in compression
- (iii) $M_{yc} = 310 \text{ Nm}$ (229 lbf-ft) when a flexion moment exists at the occipital condyle
- (iv) $M_{yc} = 135 \text{ Nm}$ (100 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each N_{ij} loading condition is given by:

$$N_{ij} = (F_z/F_{zc}) + (M_{yc}/M_{yc})$$

(5) None of the four N_{ij} values shall exceed 1.0 at any time during the event.

(b) **Peak tension.** Tension force (F_z), measured at the upper neck load cell, shall not exceed 4170 N (937 lbf) at any time.

(c) **Peak compression.** Compression force (F_z), measured at the upper neck load cell, shall not exceed 4000 N (899 lbf) at any time.

S6.7 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR Part 572, Subpart E Hybrid III test dummy.

S7. Seat belt assembly requirements. As used in this section, a law enforcement vehicle means any vehicle manufactured primarily for use by the United States or by a State or local government for police or other law enforcement purposes.

S7.1 Adjustment.

S7.1.1 Except as specified in S7.1.1.1 and S7.1.1.2, the lap belt of any seat belt assembly furnished in accordance with S4.1.2 shall adjust by means of any emergency-locking or automatic-locking retractor that conforms to §571.209 to fit persons whose dimensions range from those of a 50th percentile 6-year-old child to those of a 95th percentile adult male and the upper torso restraint shall adjust by means of an emergency-locking retractor or a manual adjusting device that conforms to §571.209 to fit persons whose dimensions range from those of a 5th percentile adult female to those of a 95th percentile adult male, with the seat in any position, the seat back in the manufacturer's nominal design riding position, and any adjustable anchorages adjusted to the manufacturer's nominal design position for a 50th percentile adult male occupant. However, an upper torso restraint furnished in accordance with S4.1.2.3.1(a) shall adjust by means of an emergency-locking retractor that conforms to §571.209.

S7.1.1.1 A seat belt assembly installed at the driver's seating position shall adjust to fit persons whose dimensions range from those of a 5th-percentile adult female to those of a 95th-percentile adult male.

S7.1.1.2 (a) A seat belt assembly installed in a motor vehicle other than a forward control vehicle at any designated seating position other than the outboard positions of the front and second seats shall adjust either by a retractor as specified in S7.1.1 or by a manual adjusting device that conforms to §571.209.

(b) A seat belt assembly installed in a forward control vehicle at any designated seating position other than

the front outboard seating positions shall adjust either by a retractor as specified in S7.1.1 or by a manual adjusting device that conforms to §571.209.

(c) A seat belt assembly installed in a forward-facing rear outboard seating position in a law enforcement vehicle shall adjust either by a retractor as specified in S7.1.1 or by a manual adjusting device that conforms to §571.209.

S7.1.1.3 A Type 1 lap belt or the lap belt portion of any Type 2 seat belt assembly installed at any forward-facing outboard designated seating position of a vehicle with a gross vehicle weight rating of 10,000 pounds or less to comply with a requirement of this standard, except walk-in van-type vehicles and school buses, and except in rear seating positions in law enforcement vehicles, shall meet the requirements of S7.1 by means of an emergency locking retractor that conforms to Standard No. 209 (49 CFR 571.209).

S7.1.1.4 Notwithstanding the other provisions of S7.1—S7.1.1.3, emergency-locking retractors on belt assemblies located in positions other than front outboard designated seating positions may be equipped with a manual webbing adjustment device capable of causing the retractor that adjusts the lap belt to lock when the belt is buckled.

S7.1.1.5 Passenger cars, and trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lb) or less manufactured on or after September 1, 1995 shall meet the requirements of S7.1.1.5(a), S7.1.1.5(b) and S7.1.1.5(c).

Editor's Note: Paragraph S7.1.1.5 introductory text is revised effective November 28, 2016. Optional early compliance is permitted.

S7.1.1.5 Passenger cars, and trucks, buses, and multipurpose passenger vehicles with a GVWR of 4,536 kg (10,000 lb) or less manufactured on or after September 1, 1995 and buses with a GVWR of more than 11,793 kg (26,000 pounds) manufactured on or after November 28, 2016, except a perimeter-seating bus, prison bus, school bus, or transit bus, shall meet the requirements of S7.1.1.5(a), S7.1.1.5(b) and S7.1.1.5(c).

(a) Each designated seating position, except the driver's position, and except any right front seating position that is equipped with an automatic belt, that is in any motor vehicle, except walk-in van-type vehicles and vehicles manufactured to be sold exclusively to the U.S. Postal Service, and that is forward-facing or can be adjusted to be forward-facing, shall have a seat belt assembly whose lap belt portion is lockable so that the seat belt assembly can be used to tightly secure a child restraint system. The means provided to lock the lap belt or lap belt portion of the seat belt assembly shall not consist of any device that must be attached by the vehicle user to the seat belt webbing, retractor, or any other part of the vehicle. Additionally, the means provided to lock the lap belt or lap belt portion of the seat belt assembly shall not require any inverting, twisting or otherwise deforming of the belt webbing.

(b) If the means provided pursuant to S7.1.1.5(a) to lock the lap belt or lap belt portion of any seat belt assembly makes it necessary for the vehicle user to take

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some action to activate the locking feature, the vehicle owner's manual shall include a description in words and/or diagrams describing how to activate the locking feature so that the seat belt assembly can tightly secure a child restraint system and how to deactivate the locking feature to remove the child restraint system.

(c) Except for seat belt assemblies that have no retractor or that are equipped with an automatic locking retractor, compliance with S7.1.1.5(a) is demonstrated by the following procedure:

(1) With the seat in any adjustment position, buckle the seat belt assembly. Complete any procedures recommended in the vehicle owner's manual, pursuant to S7.1.1.5(b), to activate any locking feature for the seat belt assembly.

(2) Locate a reference point A on the safety belt buckle. Locate a reference point B on the attachment hardware or retractor assembly at the other end of the lap belt or lap belt portion of the seat belt assembly. Adjust the lap belt or lap belt portion of the seat belt assembly pursuant to S7.1.1.5(c)(1) as necessary so that the webbing between points A and B is at the maximum length allowed by the belt system. Measure and record the distance between points A and B along the longitudinal centerline of the webbing for the lap belt or lap belt portion of the seat belt assembly.

(3) Readjust the belt system so that the webbing between points A and B is at any length that is 5 inches or more shorter than the maximum length of the webbing.

(4) Apply a pre-load of 10 pounds, using the webbing tension pull device described in Figure 5 of this standard, to the lap belt or lap belt portion of the seat belt assembly in a vertical plane parallel to the longitudinal axis of the vehicle and passing through the seating reference point of the designated seating position whose belt system is being tested. Apply the pre-load in a horizontal direction toward the front of the vehicle with a force application angle of not less than 5 degrees nor more than 15 degrees above the horizontal. Measure and record the length of belt between points A and B along the longitudinal centerline of the webbing for the lap belt or lap belt portion of the seat belt assembly while the pre-load is being applied.

(5) Apply a load of 50 pounds, using the webbing tension pull device described in Figure 5 of this standard, to the lap belt or lap belt portion of the seat belt assembly in a vertical plane parallel to the longitudinal axis of the vehicle and passing through the seating reference point of the designated seating position whose belt system is being tested. The load is applied in a horizontal direction toward the front of the vehicle with a force application angle of not less than 5 degrees nor more than 15 degrees above the horizontal at an onset rate of not more than 50 pounds per second. Attain the 50 pound load in not more than 5 seconds. If webbing sensitive emergency locking retroactive are installed as part of the lap belt assembly or lap belt portion of the seat belt assembly, apply the load at a rate less than the threshold value for lock-up specified by the manufacturer. Maintain the 50 pound load for at least 5 seconds

before the measurements specified in S7.1.1.5(c)(6) are obtained and recorded.

(6) Measure and record the length of belt between points A and B along the longitudinal centerline of the webbing for the lap belt or lap belt portion of the seat belt assembly.

(7) The difference between the measurements recorded under S7.1.1.5(c) (6) and (4) shall not exceed 2 inches.

(8) The difference between the measurements recorded under S7.1.1.5(c) (6) and (2) shall be 3 inches or more.

S7.1.2 Except as provided in S7.1.2.1, S7.1.2.2, and S7.1.2.3, for each Type 2 seat belt assembly which is required by Standard No. 208 (49 CFR 571.208), the upper anchorage, or the lower anchorage nearest the intersection of the torso belt and the lap belt, shall include a movable component which has a minimum of two adjustment positions. The distance between the geometric center of the movable component at the two extreme adjustment positions shall be not less than five centimeters, measured linearly. If the component required by this paragraph must be manually moved between adjustment positions, information shall be provided in the owner's manual to explain how to adjust the seat belt and warn that misadjustment could reduce the effectiveness of the safety belt in a crash.

S7.1.2.1 As an alternative to meeting the requirement of S7.1.2, a Type 2 seat belt assembly shall provide a means of automatically moving the webbing in relation to either the upper anchorage, or the lower anchorage nearest the intersection of the torso belt and the lap belt. The distance between the midpoint of the webbing at the contact point of the webbing and the anchorage at the extreme adjustment positions shall be not less than five centimeters, measured linearly.

S7.1.2.2 The requirements of S7.1.2 do not apply the anchorages of a Type 2 seat belt assembly installed:

(a) At a seat which is adjustable fore and aft while the vehicle is in motion and whose seat frame above the fore-and-aft adjuster is part of each of the assembly's seat belt anchorages, as defined in S3 of Standard No. 210 (49 CFR 571.210).

(b) At a seat that is not adjustable fore and aft while the vehicle is in motion.

S7.1.2.3 The requirements of S7.1.2 do not apply to any truck with a gross vehicle weight rating of more than 8,500 pounds manufactured before January 1, 1998.

S7.1.3 The intersection of the upper torso belt with the lap belt in any Type 2 seat belt assembly furnished in accordance with S4.1.1 or S4.1.2, with the upper torso manual adjusting device, if provided, adjusted in accordance with the manufacturer's instructions, shall be at least 6 inches from the front vertical centerline of a 50th-percentile adult male occupant, measured along the centerline of the lap belt, with the seat in its rear-most and lowest adjustable position and with the seat back in the manufacturer's nominal design riding position.

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S7.1.4 THE WEIGHTS AND DIMENSIONS OF THE VEHICLE OCCUPANTS REFERRED TO IN THIS STANDARD ARE AS FOLLOWS:

	50th-percentile 6-year-old child	50th-percentile 10-year-old child	5th-percentile adult female	50th-percentile adult male	95th-percentile adult male
Weight	47.3 pounds.....	82.1 pounds.....	102 pounds	164 pounds±3.....	215 pounds.
Erect sitting height ...	25.4 inches.....	28.9 inches.....	30.9 inches.....	35.7 inches±.1	38 inches.
Hip breadth (sitting) ...	8.4 inches	10.1 inches	12.8 inches.....	14.7 inches±.7	16.5 inches.
Hip circumference (sitting)	23.9 inches.....	27.4 inches (standing).	36.4 inches.....	42 inches.....	47.2 inches.
Waist circumference (sitting)	20.8 inches.....	25.7 inches (standing).	23.6 inches.....	32 inches±.6	42.5 inches.
Chest depth.....	6.0 inches	7.5 inches	9.3 inches±.2.....	10.5 inches.	
Chest circumference: (nipple).....	30.5 inches.....				
(upper).....	26.3 inches.....	29.8 inches.....	37.4 inches±.6	44.5 inches.	
(lower)	26.6 inches.....				

S7.1.5 School bus bench seats. The seat belt assemblies on school bus bench seats will operate by means of any emergency-locking retractor that conforms to 49 CFR 571.209 to restrain persons whose dimensions range from those of a 50th percentile 6-year-old child to those of a 50th percentile 10-year-old, for small occupant seating positions, as defined in 49 CFR 571.222, and to those of a 50th percentile adult male for all other seating positions. The seat back may be in any position.

Editor's Note: Paragraph S7.1.6 is added effective November 28, 2016. Optional early compliance is permitted.

S7.1.6 Passenger seats, other than any outboard designated seating position not rearward of the driver's seating position, in buses with a GVWR of more than 11,793 kg (26,000 lb) manufactured on or after November 28, 2016. The lap belt of any seat belt assembly on any passenger seat in each bus with a GVWR of more than 11,793 kg (26,000 lb), except a perimeter-seating bus, prison bus, school bus, or transit bus, shall adjust by means of any emergency-locking retractor that conforms to 49 CFR 571.209 to fit persons whose dimensions range from those of a 50th percentile 6-year-old child to those of a 95th percentile adult male and the upper torso restraint shall adjust by means of an emergency-locking retractor that conforms to 49 CFR 571.209 to fit persons whose dimensions range from those of a 5th percentile adult female to those of a 95th percentile adult male, with the seat in any position, the seat back in the manufacturer's nominal design riding position, and any adjustable anchorages adjusted to the manufacturer's nominal design position for a 50th percentile adult male occupant.

S7.2 Latch mechanism. Except as provided in S7.2(e), each seat belt assembly installed in any vehicle shall have a latch mechanism that complies with the requirements specified in S7.2(a) through (d).

(a) The components of the latch mechanism shall be accessible to a seated occupant in both the stowed and operational positions;

(b) The latch mechanism shall release both the upper torso restraint and the lap belt simultaneously, if the assembly has a lap belt and an upper torso restraint that require unlatching for release of the occupant;

(c) The latch mechanism shall release at a single point; and

(d) The latch mechanism shall release by a pushbutton action.

(e) The requirements of S7.2 do not apply to any automatic belt assembly. The requirements specified in S7.2(a) through (c) do not apply to any safety belt assembly installed at a forward-facing rear outboard seating position in a law enforcement vehicle.

S7.3 (a) A seat belt assembly provided at the driver's seating position shall be equipped with a warning system that, at the option of the manufacturer, either—

(1) Activates a continuous or intermittent audible signal for a period of not less than 4 seconds and not more than 8 seconds and that activates a continuous or flashing warning light visible to the driver displaying the identifying symbol for the seat belt telltale shown in Table 2 of FMVSS 101 or, at the option of the manufacturer if permitted by FMVSS 101, displaying the words "Fasten Seat Belts" or "Fasten Belts", for not less than 60 seconds (beginning when the vehicle ignition switch is moved to the "on" or the "start" position) when condition (b) exists simultaneously with condition (c), or that

(2) Activates, for a period of not less than 4 seconds and not more than 8 seconds (beginning when the vehicle ignition switch is moved to the "on" or the "start" position), a continuous or flashing warning light visible to the driver, displaying the identifying symbol of the seat belt telltale shown in Table 2 of FMVSS 101 or, at the option of the manufacturer if permitted by FMVSS 101, displaying the words "Fasten Seat Belts" or "Fasten Belts", when condition (b) exists, and a continuous or intermittent audible signal when condition (b) exists simultaneously with condition (c).

(b) The vehicle's ignition switch is moved to the "on" position or to the "start" position.

(c) The driver's lap belt is not in use, as determined, at the option of the manufacturer, either by the belt latch mechanism not being fastened, or by the belt not being extended at least 4 inches from its stowed position.

S7.4 Seat belt comfort and convenience.

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(a) **Automatic seat belts.** Automatic seat belts installed in any vehicle, other than walk-in van-type vehicles, which has a gross vehicle weight rating of 10,000 pounds or less, and which is manufactured on or after September 1, 1986, shall meet the requirements of S7.4.1, S7.4.2, and S7.4.3.

(b) **Manual seat belts.**

(1) **Vehicles manufactured after September 1, 1986.** Manual seat belts installed in any vehicle, other than manual Type 2 belt systems installed in the front outboard seating positions in passenger cars or manual belts in walk-in van-type vehicles, which have a gross vehicle weight rating of 10,000 pounds or less, shall meet the requirements of S7.4.3, S7.4.4, S7.4.5, and S7.4.6.

(2) **Vehicles manufactured after September 1, 1989.**

(i) If the automatic restraint requirement of S4.1.4 is rescinded pursuant to S4.1.5, then manual seat belts installed in a passenger car shall meet the requirements of S7.1.1.3(a), S7.4.2, S7.4.3, S7.4.4, S7.4.5, and S7.4.6.

(ii) Manual seat belts installed in a bus, multipurpose passenger vehicle and truck with a gross vehicle weight rating of 10,000 pounds or less, except for walk-in van-type vehicles, shall meet the requirements of S7.4.3, S7.4.4, S7.4.5, and S7.4.6.

S7.4.1 Convenience hooks. Any manual convenience hook or other device that is provided to stow seat belt webbing to facilitate entering or exiting the vehicle shall automatically release the webbing when the automatic belt system is otherwise operational and shall remain in the released mode for as long as (a) exists simultaneously with (b), or, at the manufacturer's option, for as long as (a) exists simultaneously with (c)—

(a) The vehicle ignition switch is moved to the “on” or “start” position;

(b) The vehicle's drive train is engaged;

(c) The vehicle's parking brake is in the released mode (nonengaged).

S7.4.2 Webbing tension-relieving device. Each vehicle with an automatic seat belt assembly or with a Type 2 manual seat belt assembly that must meet the occupant crash protection requirements of S5.1 of this standard installed at a front outboard designated seating position, and each vehicle with a Type 2 manual seat belt assembly installed at a rear outboard designated seating position in compliance with a requirement of this standard, that has either automatic or manual tension-relieving devices permitting the introduction of slack in the webbing of the shoulder belt (e.g., “comfort clips” or “window-shade” devices) shall:

(a) Comply with the requirements of S5.1 with the shoulder belt webbing adjusted to introduce the maximum amount of slack recommended by the vehicle manufacturer pursuant to S7.4.2(b).

(b) Have a section in the vehicle owner's manual that explains how the tension-relieving device works and specifies the maximum amount of slack (in inches) recommended by the vehicle manufacturer to be introduced into the shoulder belt under normal use conditions. The explanation shall also warn that intro-

ducing slack beyond the amount specified by the manufacturer could significantly reduce the effectiveness of the shoulder belt in a crash; and

(c) Have, except for open-body vehicles with no doors, an automatic means to cancel any shoulder belt slack introduced into the belt system by a tension-relieving device. In the case of an automatic safety belt system, cancellation of the tension-relieving device shall occur each time the adjacent vehicle door is opened. In the case of a manual seat belt required to meet S5.1, cancellation of the tension-relieving device shall occur, at the manufacturer's option, either each time the adjacent door is opened or each time the latchplate is released from the buckle. In the case of a Type 2 manual seat belt assembly installed at a rear outboard designated seating position, cancellation of the tension-relieving device shall occur, at the manufacturer's option either each time the door designed to allow the occupant of that seating position entry and egress of the vehicle is opened or each time the latchplate is released from the buckle. In the case of open-body vehicles with no doors, cancellation of the tension-relieving device may be done by a manual means.

S7.4.3 Belt contact force. Except for manual or automatic seat belt assemblies that incorporate a webbing tension-relieving device, the upper torso webbing of any seat belt assembly shall not exert more than 0.7 pounds of contact force when measured normal to and one inch from the chest of an anthropomorphic test dummy, positioned in accordance with S10 of this standard in the seating position for which that seat belt assembly is provided, at the point where the centerline of the torso belt crosses the midsagittal line on the dummy's chest.

S7.4.4 Latchplate access. Any seat belt assembly latchplate that is located outboard of a front outboard seating position in accordance with S4.1.2 shall also be located within the outboard reach envelope of either the outboard arm or the inboard arm described in S10.7 and Figure 3 of this standard, when the latchplate is in its normal stowed position and any adjustable anchorages are adjusted to the manufacturer's nominal design position for a 50th percentile adult male occupant. There shall be sufficient clearance between the vehicle seat and the side of the vehicle interior to allow the test block defined in Figure 4 of this standard unhindered transit to the latchplate or buckle.

S7.4.5 Retraction. When tested under the conditions of S8.1.2 and S8.1.3, with anthropomorphic dummies whose arms have been removed and which are positioned in accordance with S10 of this standard in the front outboard seating positions and restrained by the belt systems for those positions, the torso and lap belt webbing of any of those seat belt systems shall automatically retract to a stowed position either when the adjacent vehicle door is in the open position and the seat belt latchplate is released, or, at the option of the manufacturer, when the latchplate is released. That stowed position shall prevent any part of the webbing or hardware from being pinched when the adjacent vehicle door is closed. A belt system with a tension-relieving device in an open-bodied vehicle with no doors shall fully retract when the tension-relieving device is deactivated. For the purposes of these

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retraction requirements, outboard armrests, which are capable of being stowed, on vehicle seats shall be placed in their stowed position.

S7.4.6 Seat belt guides and hardware.

S7.4.6.1(a) Any manual seat belt assembly whose webbing is designed to pass through the seat cushion or between the seat cushion and seat back shall be designed to maintain one of the following three seat belt parts (the seat belt latchplate, the buckle, or the seat belt webbing) on top of or above the seat cushion under normal conditions (i.e., conditions other than when belt hardware is intentionally pushed behind the seat by a vehicle occupant). In addition, the remaining two seat belt parts must be accessible under normal conditions.

(b) The requirements of S7.4.6.1(a) do not apply to: (1) seats whose seat cushions are movable so that the seat back serves a function other than seating, (2) seats which are removable, or (3) seats which are movable so that the space formerly occupied by the seat can be used for a secondary function.

S7.4.6.2 The buckle and latchplate of a manual seat belt assembly subject to S7.4.6.1 shall not pass through the guides or conduits provided for in S7.4.6.1 and fall behind the seat when the events listed below occur in the order specified: (a) The belt is completely retracted or, if the belt is non-retractable, the belt is unlatched; (b) the seat is moved to any position to which it is designed to

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be adjusted; and (c) the seat back, if foldable, is folded forward as far as possible and then moved backward into position. The inboard receptacle end of a seat belt assembly installed at a front outboard designated seating position shall be accessible with the center arm rest in any position to which it can be adjusted (without having to move the armrest).

S8. Test conditions.

S8.1 General conditions. The following conditions apply to the frontal, lateral, and rollover tests. Except for S8.1.1(d), the following conditions apply to the alternative unbelted sled test set forth in S13 from March 19, 1997 until September 1, 2001.

S8.1.1 Except as provided in paragraph (c) of S8.1.1, the vehicle, including test devices and instrumentation, is loaded as follows:

(a) **Passenger cars.** A passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the weight of the necessary anthropomorphic test devices.

(b) **Multipurpose passenger vehicles, trucks, and buses.** A multipurpose passenger vehicle, truck, or bus is loaded to its unloaded vehicle weight plus 300 pounds or its rated cargo and luggage capacity weight, whichever is less, secured in the load carrying area and distributed as nearly as possible in proportion to its gross axle weight ratings, plus the weight of the necessary anthropomorphic test devices. For the purposes of § 8.1.1, unloaded vehicle weight does not include the weight of work-performing accessories. Vehicles are tested to a maximum unloaded vehicle weight of 5,500 pounds.

(c) **Fuel system capacity.** With the test vehicle on a level surface, pump the fuel from the vehicle's fuel tank and then operate the engine until it stops. Then, add Stoddard solvent to the test vehicle's fuel tank in an amount which is equal to not less than 92 and not more than 94 percent of the fuel tank's usable capacity stated by the vehicle's manufacturer. In addition, add the amount of Stoddard solvent needed to fill the entire fuel system from the fuel tank through the engine's induction system.

(d) **Vehicle test attitude.** Determine the distance between a level surface and a standard reference point on the test vehicle's body, directly above each wheel opening, when the vehicle is in its "as delivered" condition. The "as delivered" condition is the vehicle as received at the test site, with 100 percent of all fluid capacities and all tires inflated to the manufacturer's specifications as listed on the vehicle's tire placard. Determine the distance between the same level surface and the same standard reference points in the vehicle's "fully loaded condition." The "fully loaded condition" is the test vehicle loaded in accordance with S8.1.1 (a) or (b), as applicable. The load placed in the cargo area shall be center over the longitudinal centerline of the vehicle. The pretest vehicle attitude shall be equal to either the as delivered or fully loaded attitude or between the as delivered attitude and the fully loaded attitude.

S8.1.2 Adjustable seats are in the adjustment position midway between the forwardmost and rearmost positions, and if separately adjustable in a vertical direction,

are at the lowest position. If an adjustment position does not exist midway between the forwardmost and rearmost positions, the closest adjustment position to the rear of the midpoint is used.

S8.1.3 Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer. Place any adjustable anchorages at the manufacturer's nominal design position for a 50th percentile adult male occupant. Place each adjustable head restraint in its highest adjustment position. Adjustable lumbar supports are positioned so that the lumbar support is in its lowest adjustment position.

S8.1.4 Adjustable steering controls are adjusted so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions.

S8.1.5 Movable vehicle windows and vents are placed in the fully closed position, unless the vehicle manufacturer chooses to specify a different adjustment position prior to the time it certifies the vehicle.

S8.1.6 Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S8.1.7 Doors are fully closed and latched but not locked.

S8.1.8 Anthropomorphic test dummies.

S8.1.8.1 The anthropomorphic test dummies used for evaluation of occupant protection systems manufactured pursuant to applicable portions of S4.1.2, S4.1.3, and S4.1.4 of this standard shall conform to the requirements of subpart E of part 572 of this chapter.

S8.1.8.2 Each test dummy is clothed in a form fitting cotton stretch short sleeve shirt with above-the-elbow sleeves and above-the-knee length pants. The weight of the shirt or pants shall not exceed 0.25 pounds each. Each foot of the test dummy is equipped with a size 11XW shoe which meets the configuration size, sole, and heel thickness specifications of MIL-S-13192P (incorporated by reference, see §571.5) change "P" and whose weight is 1.25 ± 0.2 pounds.

S8.1.8.3 Limb joints are set at 1g, barely restraining the weight of the limb when extended horizontally. Leg joints are adjusted with the torso in the supine position.

S8.1.8.4 Instrumentation does not affect the motion of the dummies during impact or rollover.

S8.1.8.5 The stabilized test temperature of the test dummy is at any temperature level between 69 degrees F and 72 degrees F, inclusive.

S8.2 Lateral moving barrier crash test conditions. The following conditions apply to the lateral moving barrier crash test.

S8.2.1 The moving barrier, including the impact surface, supporting structure, and carriage, weighs 4,000 pounds.

S8.2.2 The impact surface of the barrier is a vertical, rigid, flat rectangle, 78 inches wide and 60 inches high, perpendicular to its direction of movement, with its lower edge horizontal and 5 inches above the ground surface.

S8.2.3 During the entire impact sequence the barrier undergoes no significant amount of dynamic or static deformation, and absorbs no significant portion of the

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energy resulting from the impact, except for energy that results in translational rebound movement of the barrier.

S8.2.4 During the entire impact sequence the barrier is guided so that it travels in a straight line, with no significant lateral, vertical or rotational movement.

S8.2.5 The concrete surface upon which the vehicle is tested is level, rigid and of uniform construction, with a skid number of 75 when measured in accordance with ASTM E274-65T (incorporated by reference, see §571.5) at 40 m.p.h., omitting water delivery as specified in paragraph 7.1 of that method.

S8.2.6 The tested vehicle's brakes are disengaged and the transmission is in neutral.

S8.2.7 The barrier and the test vehicle are positioned so that at impact—

- (a) The vehicle is at rest in its normal attitude;
- (b) The barrier is traveling in a direction perpendicular to the longitudinal axis of the vehicle at 20 m.p.h.; and
- (c) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface passes through the driver's seating reference point in the tested vehicle.

S8.3 **Rollover test conditions.** The following conditions apply to the rollover test.

S8.3.1 The tested vehicle's brakes are disengaged and the transmission is in neutral.

S8.3.2 The concrete surface on which the test is conducted is level, rigid, of uniform construction, and of a sufficient size that the vehicle remains on it throughout the entire rollover cycle. It has a skid number of 75 when measured in accordance with ASTM E274-65T (incorporated by reference, see §571.5) at 40 m.p.h. omitting water delivery as specified in paragraph 7.1 of that method.

S8.3.3 The vehicle is placed on a device, similar to that illustrated in Figure 2, having a platform in the form of a flat, rigid plane at an angle of 23° from the horizontal. At the lower edge of the platform is an unyielding flange, perpendicular to the platform with a height of 4 inches and a length sufficient to hold in place the tires that rest against it. The intersection of the inner face of the flange with the upper face of the platform is 9 inches above the rollover surface. No other restraints are used to hold the vehicle in position during the deceleration of the platform and the departure of the vehicle.

S8.3.4 With the vehicle on the test platform, the test devices remain as nearly as possible in the posture specified in S8.1.

S8.3.5 Before the deceleration pulse, the platform is moving horizontally, and perpendicularly to the longitudinal axis of the vehicle, at a constant speed of 30 m.p.h. for a sufficient period of time for the vehicle to become motionless relative to the platform.

S8.3.6 The platform is decelerated from 30 to 0 m.p.h. in a distance of not more than 3 feet, without change of direction and without transverse or rotational movement during the deceleration of the platform and the departure of the vehicle. The deceleration rate is at least 20g for a minimum of 0.04 seconds.

S8.4 **Frontal test condition.** If the vehicle is equipped with a cutoff device permitted by S4.5.4 of this standard, the device is deactivated.

S9. Pressure vessels and explosive devices.

S9.1 **Pressure vessels.** A pressure vessel that is continuously pressurized shall conform to the requirements of §§178.65(a), 178.65(c)(2), 178.65(d), 178.65(e)(1), and 178.65(e)(2) of this title; and to the pressure relief device requirements of §§173.301(a)(2), 173.301(a)(3) and 173.301(f) of this title. It shall not leak or evidence visible distortion when tested in accordance with §178.65(f)(1) of this title and shall not fail in any of the ways enumerated in §178.65(f)(2) of this title when hydrostatically tested to destruction. It shall not crack when flattened in accordance with §178.65(g) of this title to the limit specified in §178.65(g)(4) of this title.

S9.2 **Explosive devices.** An explosive device shall not exhibit any of the characteristics prohibited by §173.54 of this title. All explosive material shall be enclosed in a structure that is capable of containing the explosive energy without sudden release of pressure except through overpressure relief devices or parts designed to release the pressure during actuation.

S10. Test dummy positioning procedures.

S10.1 **Head.** The transverse instrumentation platform of the head shall be level within ½ degree. To level the head of the test dummy, the following sequences must be followed. First, adjust the position of the H point within the limits set forth in S10.4.2.1 to level the transverse instrumentation platform of the head of the test dummy. If the transverse instrumentation platform of the head is still not level, then adjust the pelvic angle of the test dummy within the limits specified in S10.4.2.2 of this standard. If the transverse instrumentation platform of the head is still not level, then adjust the neck bracket of the dummy the minimum amount necessary from the non-adjusted "0" setting to ensure that the transverse instrumentation platform of the head is horizontal within ½ degree. The test dummy shall remain within the limits specified in S10.4.2.1 and S10.4.2.2. after any adjustment of the neck bracket.

S10.2 Upper Arms.

S10.2.1 The driver's upper arms shall be adjacent to the torso with the centerlines as close to a vertical plane as possible.

S10.2.2 The passenger's upper arms shall be in contact with the seat back and the sides of the torso.

S10.3 Hands.

S10.3.1 The palms of the drivers test dummy shall be in contact with the outer part of the steering wheel rim at the rim's horizontal centerline. The thumbs shall be over the steering wheel rim and shall be lightly taped to the steering wheel rim so that if the hand of the test dummy is pushed upward by a force of not less than 2 pounds and not more than 5 pounds, the tape shall release the hand from the steering wheel rim.

S10.3.2 The palms of the passenger test dummy shall be in contact with the outside of the thigh. The little finger shall be in contact with the seat cushion.

S10.4 Torso.

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S10.4.1 Upper Torso.

S10.4.1.1 In vehicles equipped with bench seats, the upper torso of the driver and passenger test dummies shall rest against the seat back. The midsagittal plane of the driver dummy shall be vertical and parallel to the vehicle's longitudinal centerline, and pass through the center of the steering wheel rim. The midsagittal plane of the passenger dummy shall be vertical and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the midsagittal plane of the driver dummy.

S10.4.1.2 In vehicles equipped with bucket seats, the upper torso of the driver and passenger test dummies shall rest against the seat back. The midsagittal plane of the driver and the passenger dummy shall be vertical and shall coincide with the longitudinal centerline of the bucket seat.

S10.4.2 Lower Torso.

S10.4.2.1 **H-point.** The H-points of the driver and passenger test dummies shall coincide within $\frac{1}{2}$ inch in the vertical dimension and $\frac{1}{2}$ inch in the horizontal dimension of a point $\frac{1}{4}$ inch below the position of the H-point determined by using the equipment and procedures specified in SAE Standard J826-1980 (incorporated by reference, see §571.5), except that the length of the lower leg and thigh segments of the H-point machine shall be adjusted to 16.3 and 15.8 inches, respectively, instead of the 50th percentile values specified in Table 1 of SAE Standard J826-1980.

S10.4.2.2 **Pelvic angle.** As determined using the pelvic angle gage (GM drawing 78051-532, incorporated by reference in part 572, subpart E of this chapter) which is inserted into the H-point gaging hole of the dummy, the angle measured from the horizontal on the three inch flat surface of the gage shall be $22\frac{1}{2}$ degrees plus or minus $2\frac{1}{2}$ degrees.

S10.5 **Legs.** The upper legs of the driver and passenger test dummies shall rest against the seat cushion to the extent permitted by placement of the feet. The initial distance between the outboard knee clevis flange surfaces shall be 10.6 inches. To the extent practicable, the left leg of the driver dummy and both legs of the passenger dummy shall be in vertical longitudinal planes. To the extent practicable, the right leg of the driver dummy shall be in a vertical plane. Final adjustment to accommodate the placement of feet in accordance with S10.6 for various passenger compartment configurations is permitted.

S10.6 Feet.

S10.6.1 Driver's position.

S10.6.1.1 If the vehicle has an adjustable accelerator pedal, adjust it to the full forward position. Rest the right foot of the test dummy on the undepressed accelerator pedal with the rearmost point of the heel on the floor pan in the plane of the pedal. If the foot cannot be placed on the accelerator pedal, set it initially perpendicular to the lower leg and then place it as far forward as possible in the direction of the pedal centerline with the rearmost point of the heel resting on the floor pan. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when posi-

tioned as above, move the pedal rearward until it touches the right foot. If the accelerator pedal still does not touch the foot in the full rearward position, leave the pedal in that position.

S10.6.1.2 Place the left foot on the toeboard with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toeboard and the floor pan and not on the wheelwell projection. If the foot cannot be positioned on the toeboard, set it initially perpendicular to the lower leg and place it as far forward as possible with the heel resting on the floor pan. If necessary to avoid contact with the vehicle's brake or clutch pedal, rotate the test dummy's left foot about the lower leg. If there is still pedal interference, rotate the left leg outboard about the hip the minimum distance necessary to avoid the pedal interference. For vehicles with a foot rest that does not elevate the left foot above the level of the right foot, place the left foot on the foot rest so that the upper and lower leg centerlines fall in a vertical plane.

S10.6.2 Passenger's position.

S10.6.2.1 Vehicles with a flat floor pan/ toeboard.

Place the right and left feet on the vehicle's toeboard with the heels resting on the floor pan as close as possible to the intersection point with the toeboard. If the feet cannot be placed flat on the toeboard, set them perpendicular to the lower leg centerlines and place them as far forward as possible with the heels resting on the floor pan.

S10.6.2.2 **Vehicles with wheelhouse projections in passenger compartment.** Place the right and left feet in the well of the floor pan/toeboard and not on the wheelhouse projection. If the feet cannot be placed flat on the toeboard, initially set them perpendicular to the lower leg centerlines and then place them as far forward as possible with the heels resting on the floor pan.

S10.7 **Test dummy positioning for latchplate access.** The reach envelopes specified in S7.4.4 of this standard are obtained by positioning a test dummy in the driver's or passenger's seating position and adjusting that seating position to its forwardmost adjustment position. Attach the lines for the inboard and outboard arms to the test dummy as described in Figure 3 of this standard. Extend each line backward and outboard to generate the compliance arcs of the outboard reach envelope of the test dummy's arms.

S10.8 **Test dummy positioning for belt contact force.** To determine compliance with S7.4.3 of this standard, position the test dummy in the vehicle in accordance with S10.1 through S10.6 of this standard and adjust the seating position in accordance with S8.1.2 and S8.1.3 of this standard. Pull the belt webbing three inches from the test dummy's chest and release until the webbing is within one inch of the test dummy's chest and measure the belt contact force.

S10.9 **Manual belt adjustment for dynamic testing.** With the test dummy positioned in accordance with S10.1 through S10.6 of this standard and the seating position adjusted in accordance with S8.1.2 and S8.1.3 of this standard, place the Type 2 manual belt around the test dummy and fasten the latch. Remove all slack from the lap belt portion. Pull the upper torso webbing out of

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the retractor and allow it to retract; repeat this four times. Apply a 2 to 4 pound tension load to the lap belt. If the belt system is equipped with a tension-relieving device, introduce the maximum amount of slack into the upper torso belt that is recommended by the vehicle manufacturer in the vehicle's owner's manual. If the belt system is not equipped with a tension-relieving device, allow the excess webbing in the upper torso belt to be retracted by the retractive force of the retractor.

S11. [Reserved]

S12. Temporary Exemption from Requirement for Inflatable Restraint System.

S12.1 Scope. This section establishes procedures for filing and processing applications for temporary exemption from the requirements in this standard that vehicles be equipped with inflatable restraint systems.

S12.2 Definitions.

Line means a name that a manufacturer applies to a group of motor vehicles of the same make which have the same body or chassis, or otherwise are similar in construction or design. A *line* may, for example, include 2-door, 4-door, station wagon, and hatchback vehicles of the same make.

S12.3 Standard of review. In order to receive a temporary exemption from the inflatable restraint requirement, a vehicle manufacturer must demonstrate in its application that there has been a disruption in the supply of one or more inflatable restraint system components, or a disruption in the use and installation by the manufacturer of any such component due to unavoidable events not under the control of the manufacturer, which will prevent a manufacturer from meeting its anticipated production volume of vehicles with inflatable restraint systems.

S12.4 Exemption applications—General requirements. Each application for a temporary exemption from the inflatable restraint requirements must—

- (a) Be written in the English language;
- (b) Be submitted in three copies to: Administrator, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590;
- (c) State the full name and address of the manufacturer, the nature of its organization (individual, partnership, corporation, etc.), and the name of the State or country under the laws of which it is organized;
- (d) Identify the motor vehicle line or lines for which the temporary exemption is being sought;
- (e) Set forth in full the data, views, and arguments of the manufacturer that would support granting the temporary exemption, including the specific information required by S12.5; and
- (f) Specify and segregate any part of the information and data submitted in the application that should be withheld from public disclosure in accordance with part 512 of this chapter.

S12.5 Exemption applications—Specific content requirements. Each application for a temporary exemption from the inflatable restraint requirement must include:

(a) A clear and specific identification of any component in the inflatable restraint system that has become unavailable due to circumstances beyond the manufacturer's control, and a diagram showing the location of such component within the restraint system and within the vehicle;

(b) A clear and specific explanation of the cause or causes of the disruption in the supply of the component, and a showing that such disruption is beyond the control of the manufacturer;

(c) An estimate of the length of time that will be needed to correct the disruption and again incorporate the subject components into current production, or an explanation of why it is not possible to provide such an estimate;

(d) A complete statement of the bases for the manufacturer's belief that NHTSA should grant a temporary exemption in response to this application;

(e) An unconditional statement by the manufacturer that it will recall every vehicle for which a temporary exemption is requested in the application, to install all missing inflatable restraint systems;

(f) A plan setting forth steps the manufacturer will take to ensure that as many exempted vehicles as possible will be returned for installation of missing inflatable restraint systems;

(g) A proposed reasonable period of time after the disruption in the supply of inflatable restraint system components is corrected that the manufacturer estimates will ensure a sufficient quantity of components for both anticipated production and retrofit of those vehicles for which a temporary exemption is requested in the application, so that the vehicle manufacturer can recall those vehicles for which a temporary exemption is requested and install inflatable restraint systems in them, together with a demonstration of why the manufacturer believes this proposed period of time is reasonable for completing this recall, or an explanation of why it is not possible to provide such an estimate;

(h) A proposed date for termination of the exemption;

(i) A proposed date by which all exempted vehicles will have been recalled and had inflatable restraints installed (assuming owners returned their vehicles in a timely matter in response to a first notice by the manufacturer), or an explanation of why it is not possible to provide such an estimate.

S12.6 Processing an application for a temporary exemption. (a) NHTSA will process any application for temporary exemption that contains the information specified in S12.4 and S12.5. If an application fails to provide the information specified in S12.4 and S12.5, NHTSA will not process the application, but will advise the manufacturer of the information that must be provided if the agency is to process the application.

(b) Notice of each application for temporary exemption shall be published in the *Federal Register*.

(c) NHTSA will issue its decision to grant or deny the requested temporary exemption not later than 15 days after the agency receives a complete petition, as defined in paragraph (a). However, a failure to issue a decision within this time does not result in a grant of the petition.

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(d) Notice of each decision to grant or deny a temporary exemption, and the reasons for granting or denying it, will be published in the *Federal Register*.

(e) The Administrator may attach such conditions as he or she deems appropriate to a temporary exemption, including but not limited to requiring manufacturers to provide progress reports at specified times (including, as appropriate and to the extent possible, estimate of dates and times concerning when a supply disruption will be corrected and when recall will take place) and requiring manufacturers to take specific steps to ensure that as many exempted vehicles as possible will be returned for installation of missing inflatable restraint systems.

(f) Unless a later effective date is specified in a notice announcing an agency decision to grant a temporary exemption, a temporary exemption from the inflatable restraint requirement will become effective upon the date the decision is issued.

S12.7 Labels and written notice announcing temporary exemption.

S12.7.1 It shall be a condition of every temporary exemption from the inflatable restraint requirement that the manufacturer of exempted vehicles comply with the provisions of S12.7.2 and S12.7.3.

S12.7.2 (a) The manufacturer of any vehicle granted a temporary exemption from the inflatable restraint requirement shall affix a label within the passenger compartment of such vehicle. The label shall set forth the following information in block capital letters and numerals not less than three thirty-seconds of an inch high:

THIS VEHICLE DOES NOT CONTAIN AN AIR BAG IN CONFORMANCE WITH THE FEDERAL MOTOR VEHICLE SAFETY STANDARD FOR OCCUPANT CRASH PROTECTION. IT WAS EXEMPTED PURSUANT TO NHTSA EXEMPTION NO. (insert number assigned by NHTSA).

(b) This label shall not be removed until after the vehicle manufacturer has recalled the vehicle and installed an inflatable restraint system at those seating positions for which it was granted an exemption.

S12.7.3 The manufacturer of any vehicle that is delivered without an inflatable restraint system, pursuant to a temporary exemption granted under this section, shall, at the time of delivery of the vehicle, provide a written notice to the dealer to whom the vehicle is delivered. The manufacturer shall also provide a written notice by registered mail to the first purchaser of the vehicle for purposes other than resale, within two weeks after purchase. Unless otherwise provided for by the Administrator in the exemption, such notice shall provide the following information:

(a) This vehicle does not conform to Federal Motor Vehicle Safety Standard No. 208, because it is not equipped with an inflatable restraint at (insert the affected seating positions).

(b) The vehicle was allowed to be sold pursuant to NHTSA Exemption No. (insert appropriate exemption number).

(c) The reason this vehicle was exempted from the requirement for an inflatable restraint was because of factors beyond the manufacturer's control.

(d) The manufacturer will recall this vehicle not later than (insert the time set forth in the exemption) and install the missing inflatable restraint at no charge.

(e) If the reader has any questions or would like some further information, he or she may contact the manufacturer at (insert an address and telephone number).

S13 Alternative unbelted test available, under S3(b) of this standard, for certain vehicles manufactured before September 1, 2006.

S13.1 Instrumentation for Impact Test— Part 1—Electronic Instrumentation. Under the applicable conditions of S8, mount the vehicle on a dynamic test platform at the vehicle attitude set forth in S13.3, so that the longitudinal center line of the vehicle is parallel to the direction of the test platform travel and so that movement between the base of the vehicle and the test platform is prevented. The test platform is instrumented with an accelerometer and data processing system having a frequency response of 60 channel class as specified in SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5). The accelerometer sensitive axis is parallel to the direction of test platform travel. The test is conducted at a velocity change approximating 48 km/h (30 mph) with acceleration of the test platform such that all points on the crash pulse curve within the corridor identified in Figure 6 are covered. An inflatable restraint is to be activated at $20 \text{ ms} \pm 2 \text{ ms}$ from the time that 0.5 g is measured on the dynamic test platform. The test dummy specified in S8.1.8, placed in each front outboard designated seating position as specified in S10, excluding S10.7, S10.8, and S10.9, shall meet the injury criteria of S6.1, S6.2(a), S6.3, S6.4(a), S6.5, and S13.2 of this standard.

S13.2 Neck injury criteria. A vehicle certified to this alternative test requirement shall, in addition to meeting the criteria specified in S13.1, meet the following injury criteria for the neck, measured with the six axis load cell (ref. Denton drawing C-1709) that is mounted between the bottom of the skull and the top of the neck as shown in Drawing 78051-218, in the unbelted sled test:

(a) Flexion Bending Moment (calculated at the occipital condyle)-190 Nm. SAE Class 600.

(b) Extension Bending Moment (calculated at the occipital condyle)-57 Nm. SAE Class 600.

(c) Axial Tension—3300 peak N. SAE Class 1000.

(d) Axial Compression—4000 peak N. SAE Class 1000.

(e) Fore-and-Aft Shear—3100 peak N. SAE Class 1000.

S13.3 Vehicle test attitude. When the vehicle is in its "as delivered" condition, measure the angle between the driver's door sill and the horizontal. Mark where the angle is taken on the door sill. The "as delivered" condition is the vehicle as received at the test site, with 100 percent of all fluid capacities and all tires inflated to the manufacturer's specifications as listed on the vehicle's tire placard. When the vehicle is in its "fully loaded" condition, measure the angle between the driver's door sill and the horizontal, at the same place the "as delivered" angle was measured. The "fully loaded" condition is the test vehicle loaded in accordance with S8.1.1(a) or (b) of Standard No. 208, as applicable. The load placed in

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the cargo area shall be centered over the longitudinal centerline of the vehicle. The pretest door sill angle, when the vehicle is on the sled, (measured at the same location as the as delivered and fully loaded condition) shall be equal to or between the as delivered and fully loaded door sill angle measurements.

S13.4 Tires and wheels. Remove the tires and wheels.

S13.5. Vehicle Securing. The engine, transmissions, axles, exhaust, vehicle frame, and vehicle body may be rigidly secured to the vehicle and/or the sled, and fluids, batteries and unsecured components may be removed, in order to assure that all points on the crash pulse curve are within the corridor defined in Figure 6.

S14 Advanced air bag requirements for passenger cars and for trucks, buses, and multipurpose passenger vehicles with a GVWR of 3,855 kg (8500 pounds) or less and an unloaded vehicle weight of 2,495 kg (5500 pounds) or less, except for walk-in van-type trucks or vehicles designed to be sold exclusively to the U.S. Postal Service.

S14.1 Vehicles manufactured on or after September 1, 2003, and before September 1, 2006.(a) For vehicles manufactured for sale in the United States on or after September 1, 2003, and before September 1, 2006, a percentage of the manufacturer's production, as specified in S14.1.1, shall meet the requirements specified in S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

(b) Manufacturers that sell three or fewer carlines, as that term is defined at 49 CFR 585.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph instead of paragraph (a) of this section. At least 95 percent of the vehicles manufactured by the manufacturer on or after September 1, 2005 and before September 1, 2006 shall meet the requirements specified in S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter are not subject to the requirements of S14.1.

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.1.

S14.1.1 Phase-in schedule.

S14.1.1.1 Vehicles manufactured on or after September 1, 2003, and before September 1, 2004. Subject to S14.1.2(a), for vehicles manufactured by a manufacturer on or after September 1, 2003, and before September 1, 2004, the amount of vehicles complying with S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25, shall be not less than 20 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2003, the manufacturer's average annual production of vehicles manufactured on

or after September 1, 2001, and before September 1, 2004, or

(b) The manufacturer's production on or after September 1, 2003, and before September 1, 2004.

S14.1.1.2 Vehicles manufactured on or after September 1, 2004, and before September 1, 2005. Subject to S14.1.2(b), for vehicles manufactured by a manufacturer on or after September 1, 2004, and before September 1, 2005, the amount of vehicles complying with S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be not less than 65 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2004, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2002, and before September 1, 2005, or

(b) The manufacturer's production on or after September 1, 2004, and before September 1, 2005.

S14.1.1.3 Vehicles manufactured on or after September 1, 2005, and before September 1, 2006. Subject to S14.1.2(c), for vehicles manufactured by a manufacturer on or after September 1, 2005, and before September 1, 2006, the amount of vehicles complying with S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be 100 percent of the manufacturer's production during that period.

S14.1.2 Calculation of complying vehicles.

(a) For the purposes of complying with S14.1.1.1, a manufacturer may count a vehicle if it is manufactured on or after June 12, 2000, but before September 1, 2004.

(b) For purposes of complying with S14.1.1.2, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after June 12, 2000, but before September 1, 2005, and

(2) Is not counted toward compliance with S14.1.1.1.

(c) For purposes of complying with S14.1.1.3, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after June 12, 2000, but before September 1, 2006, and (2) Is not counted toward compliance with S14.1.1.1 or S14.1.1.2.

S14.1.3 Vehicles produced by more than one manufacturer.

S14.1.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.1.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S14.1.3.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S14.1.3.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR Part 585, between the

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manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.1.3.1.

S14.2 Vehicles manufactured on or after September 1, 2006. Each vehicle shall meet the requirements specified in S14.5.1(a), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

S14.3 Vehicles manufactured on or after September 1, 2007, and before September 1, 2010.

(a) For vehicles manufactured for sale in the United States on or after September 1, 2007, and before September 1, 2010, a percentage of the manufacturer's production, as specified in S14.3.1, shall meet the requirements specified in S14.5.1(b) (in addition to the other requirements of this standard).

(b) Manufacturers that sell two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2008, and before September 1, 2010, shall meet the requirements specified in S14.5.1(b) (in addition to the other requirements specified in this standard).

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with Part 567 of this chapter are not subject to the requirements of S14.3.

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.3.

S14.3.1 Phase-in schedule.

S14.3.1.1 Vehicles manufactured on or after September 1, 2007, and before September 1, 2008. Subject to S14.3.2(a), for vehicles manufactured by a manufacturer on or after September 1, 2007, and before September 1, 2008, the amount of vehicles complying with S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25, shall be not less than 35 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2007, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2005, and before September 1, 2008, or

(b) The manufacturer's production on or after September 1, 2007, and before September 1, 2008.

S14.3.1.2 Vehicles manufactured on or after September 1, 2008, and before September 1, 2009. Subject to S14.3.2(b), for vehicles manufactured by a manufacturer on or after September 1, 2008, and before September 1, 2009, the amount of vehicles complying with S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be not less than 65 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2008, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2006 and before September 1, 2009, or

(b) The manufacturer's production on or after September 1, 2008, and before September 1, 2009.

S14.3.1.3 Vehicles manufactured on or after September 1, 2009, and before September 1, 2010. Subject to S14.3.2(c), for vehicles manufactured by a manufacturer on or after September 1, 2009, and before September 1, 2010, the amount of vehicles complying with S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 shall be 100 percent of the manufacturer's production during that period.

S14.3.2 Calculation of complying vehicles.

(a) For the purposes of complying with S14.3.1.1, a manufacturer may count a vehicle if it is manufactured on or after September 1, 2006, but before September 1, 2008.

(b) For purposes of complying with S14.3.1.2, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2006, but before September 1, 2009, and

(2) Is not counted toward compliance with S14.3.1.1.

(c) For purposes of complying with S14.3.1.3, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2006, but before September 1, 2010, and

(2) Is not counted toward compliance with S14.3.1.1 or S14.3.1.2.

S14.3.3 Vehicles produced by more than one manufacturer.

S14.3.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.3.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S14.3.3.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S14.3.3.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR Part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.3.3.1.

S14.4 Vehicles manufactured on or after September 1, 2010. Each vehicle shall meet the requirements specified in S14.5.1(b), S14.5.2, S15.1, S15.2, S17, S19, S21, S23, and S25 (in addition to the other requirements specified in this standard).

S14.5 Barrier test requirements using 50th percentile adult male dummies.

S14.5.1 Rigid barrier belted test.(a) Each vehicle that is certified as complying with S14.1 or S14.2 shall, at each front outboard designated seating position, meet the injury criteria specified in S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 when tested under S5.1.1(b)(1).

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(b) Each vehicle that is certified as complying with S14.3 or S14.4 shall, at each front outboard designated seating position, meet the injury criteria specified in S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 when tested under S5.1.1(b)(2).

S14.5.2 Rigid barrier unbelted test. Each vehicle that is certified as complying with S14 shall, at each front outboard designated seating position, meet the injury criteria specified in S6.1, S6.2(b), S6.3, S6.4(b), S6.5, and S6.6 when tested under S5.1.2(b).

S14.6 Vehicles manufactured on or after September 1, 2009, and before September 1, 2012 (Phase-in of higher maximum speed (56 km/h (35 mph)) belted test requirement using 5th percentile adult female dummies).

(a) For vehicles manufactured for sale in the United States on or after September 1, 2009, and before September 1, 2012, a percentage of the manufacturer's production, as specified in S14.6.1, shall meet the requirements specified in S15.1(b) (in addition to the other requirements specified in this standard).

(b) Manufacturers that sell two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2010, and before September 1, 2012, shall meet the requirements specified in S15.1(b) (in addition to the other requirements specified in this standard).

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter are not subject to the requirements of S14.6.

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.6.

S14.6.1 Phase-in schedule.

S14.6.1.1 Vehicles manufactured on or after September 1, 2009, and before September 1, 2010. Subject to S14.6.2(a), for vehicles manufactured by a manufacturer on or after September 1, 2009, and before September 1, 2010, the amount of vehicles complying with S15.1(b) shall be not less than 35 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2009, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2007, and before September 1, 2010, or

(b) The manufacturer's production on or after September 1, 2009, and before September 1, 2010.

S14.6.1.2 Vehicles manufactured on or after September 1, 2010, and before September 1, 2011. Subject to S14.6.2(b), for vehicles manufactured by a manufacturer on or after September 1, 2010, and before September 1, 2011, the amount of vehicles complying with S15.1(b) shall be not less than 65 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two produc-

tion years prior to September 1, 2010, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2008 and before September 1, 2011, or

(b) The manufacturer's production on or after September 1, 2010, and before September 1, 2011.

S14.6.1.3 Vehicles manufactured on or after September 1, 2011, and before September 1, 2012. Subject to S14.6.2(c), for vehicles manufactured by a manufacturer on or after September 1, 2011, and before September 1, 2012, the amount of vehicles complying with S15.1(b) shall be 100 percent of the manufacturer's production during that period.

S14.6.2 Calculation of complying vehicles.

(a) For the purposes of complying with S14.6.1.1, a manufacturer may count a vehicle if it is manufactured on or after September 1, 2008, but before September 1, 2010.

(b) For purposes of complying with S14.6.1.2, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2008, but before September 1, 2011, and

(2) Is not counted toward compliance with S14.6.1.1.

(c) For purposes of complying with S14.6.1.3, a manufacturer may count a vehicle if it:

(1) Is manufactured on or after September 1, 2008, but before September 1, 2012, and

(2) Is not counted toward compliance with S14.6.1.1 or S14.6.1.2.

S14.6.3 Vehicles produced by more than one manufacturer.

S14.6.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.6.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S14.6.3.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

S14.6.3.2 A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR Part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.6.3.1.

S14.7 Vehicles manufactured on or after September 1, 2012. (Higher maximum speed (56 km/h (35 mph)) belted test requirement using 5th percentile adult female dummies). Each vehicle shall meet the requirements specified in S15.1(b) (in addition to the other requirements specified in this standard). However, vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with

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Part 567 of this chapter may comply with the requirements specified in S15.1(a) instead of S15.1(b), if they are manufactured before September 1, 2013.

S14.8 Vehicles manufactured on or after September 1, 2009 and before September 1, 2010. Vehicles manufactured on or after September 1, 2009 and before September 1, 2010, shall comply with S14.8.1 through S14.8.4. At any time during the production year ending August 31, 2010, each manufacturer shall, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles by make, model and vehicle identification number that have been certified as complying with S19, S21, and S23 (in addition to the other requirements specified in this standard) when using the child restraint systems specified in Appendix A-1 of this standard. The manufacturer's designation of a vehicle as meeting the requirements when using the child restraint systems in Appendix A-1 of this standard is irrevocable.

S14.8.1 Subject to S14.8.2, for vehicles manufactured on or after September 1, 2009, the number of vehicles certified as complying with S19, S21, and S23 when using the child restraint systems specified in Appendix A-1 of this standard shall be not less than 50 percent of:

(a) The manufacturer's average annual production of vehicles subject to S19, S21, and S23 of this standard manufactured on or after September 1, 2006 and before September 1, 2009; or

(b) The manufacturer's production of vehicles subject to S19, S21, and S23 manufactured on or after September 1, 2009 and before September 1, 2010.

S14.8.2 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S14.8.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as provided in S14.8.2(a) through (c), subject to S14.8.3.

(a) A vehicle which is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer which markets the vehicle.

(c) A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S14.8.2(a) or (b).

S14.8.3 For the purposes of calculating average annual production of vehicle for each manufacturer and the number of vehicles by each manufacturer under S14.8.1, each vehicle that is excluded from the requirement to test with child restraints listed in Appendix A or A-1 of this standard is not counted.

S14.8.4 Until September 1, 2011, vehicles manufactured by a final-stage manufacturer or alterer could be certified as complying with S19, S21, and S23 when using the child restraint systems specified in Appendix A. Vehicles manufactured on or after September 1, 2011 by

these manufacturers must be certified as complying with S19, S21, and S23 when using the child restraint systems specified in Appendix A-1.

S14.8.5 Until September 1, 2011, manufacturers selling fewer than 5,000 vehicles per year in the U.S. may certify their vehicles as complying with S19, S21, and S23 when using the child restraint systems specified in Appendix A. Vehicles manufactured on or after September 1, 2011 by these manufacturers must be certified as complying with S19, S21, and S23 when using the child restraint systems specified in Appendix A-1.

S15 Rigid barrier test requirements using 5th percentile adult female dummies.

S15.1 Belted Test. (a) Each vehicle that is certified as complying with S14.1 or S14.2 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 when tested under S16.1(a)(1).

(b) Each vehicle that is certified as complying with S14.6 or S14.7 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 when tested under S16.1(a)(2).

S15.2 Unbelted test. Each vehicle that is certified as complying with S14 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 of this standard when the vehicle is crash tested in accordance with the procedures specified in S16.1(b) of this standard with the anthropomorphic test devices unbelted.

S15.3 Injury criteria for the 49 CFR Part 572, Subpart O Hybrid III 5th percentile female test dummy.

S15.3.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S15.3.2 Head injury criteria. (a) For any two points in time, t_1 and t_2 , during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2 , the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r , expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$HIC = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 - t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 700.

S15.3.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 60 g 's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S15.3.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shown shall not exceed 52 mm (2.0 in).

S15.3.5 The force transmitted axially through each femur shall not exceed 6805 N (1530 lb).

S15.3.6 Neck injury. When measuring neck injury, each of the following injury criteria shall be met.

(a) **Nij.**

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(1) The shear force (F_x), axial force (F_z), and bending moment (M_y) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for N_{ij} purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

$$N_{ij} = (F_z/F_{zc}) + (M_{oc}/M_{yc})$$

(5) None of the four N_{ij} values shall exceed 1.0 at any time during the event.

(b) **Peak tension.** Tension force (F_z), measured at the upper neck load cell, shall not exceed 2620 N (589 lbf) at any time.

(c) **Peak compression.** Compression force (F_z), measured at the upper neck load cell, shall not exceed 2520 N (566 lbf) at any time.

S15.3.7 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR Part 572, Subpart O Hybrid III 5th percentile female test dummy.

S16. Test procedures for rigid barrier test requirements using 5th percentile adult female dummies.

S16.1 **General provisions.** Crash testing to determine compliance with the requirements of S15 of this standard is conducted as specified in the following paragraphs (a) and (b).

(a) **Belted test—(1) Vehicles certified to S14.1 or S14.2.** Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular within a tolerance of ± 5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

(2) **Vehicles certified to S14.6 or S14.7.** Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 56 km/h (35 mph), into a fixed rigid barrier that is perpendicular within a tolerance of ± 5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

(b) **Unbelted test.** Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard, except S16.3.5. Impact the vehicle traveling longitudinally forward at any speed, from 32 km/h (20 mph) to 40 km/h (25 mph), inclusive, into a fixed rigid barrier that is perpendicular within a tolerance of ± 5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

S16.2 Test conditions.

S16.2.1 The vehicle, including test devices and instrumentation, is loaded as in S8.1.1.

S16.2.2 Movable vehicle windows and vents are placed in the fully closed position, unless the vehicle manufacturer chooses to specify a different adjustment position prior to the time the vehicle is certified.

S16.2.3 Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S16.2.4 Doors are fully closed and latched but not locked.

S16.2.5 The dummy is clothed in form fitting cotton stretch garments with short sleeves and above the knee length pants. A size 7½ W shoe which meets the configuration and size specifications of MIL-S-21711E (incorporated by reference, see §571.5) or its equivalent is placed on each foot of the test dummy.

S16.2.6 Limb joints are set at one g, barely restraining the weight of the limb when extended horizontally. Leg joints are adjusted with the torso in the supine position.

S16.2.7 Instrumentation shall not affect the motion of dummies during impact.

S16.2.8 The stabilized temperature of the dummy is at any level between 20.6 °C and 22.2 °C (69 °F to 72 °F).

S16.2.9 Steering wheel adjustment.

S16.2.9.1 Adjust a tiltable steering wheel, if possible, so that the steering wheel hub is at the geometric center of its full range of driving positions.

S16.2.9.2 If there is no setting detent at the mid-position, lower the steering wheel to the detent just below the mid-position.

S16.2.9.3 If the steering column is telescoping, place the steering column in the mid-position. If there is no mid-position, move the steering wheel rearward one position from the mid-position.

S16.2.10 Driver and passenger seat set-up.

S16.2.10.1 **Lumbar support adjustment.** Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S16.2.10.2 **Other seat adjustments.** Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position any adjustable head restraint in the lowest and most forward position.

S16.2.10.3 **Seat position adjustment.** If the passenger seat does not adjust independently of the driver seat, the driver seat shall control the final position of the passenger seat.

S16.2.10.3.1 Using only the controls that primarily move the seat and seat cushion independent of the seat back in the fore and aft directions, move the seat cushion reference point (SCRCP) to the rearmost position. Using any part of any control, other than those just used, determine the full range of angles of the seat cushion reference line and set the seat cushion reference line to the middle of the range. Using any part of any control other than those that primarily move the seat or seat cushion fore and aft, while maintaining the seat cushion reference line angle, place the SCRCP to its lowest position.

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S16.2.10.3.2 Using only the control that primarily moves the seat fore and aft, move the SCRP to the full forward position.

S16.2.10.3.3 If the seat or seat cushion height is adjustable, other than by the controls that primarily move the seat or seat cushion fore and aft, determine the maximum and minimum heights of the SCRP, while maintaining, as closely as possible, the angle determined in S16.2.10.3.1. Set the SCRP at the midpoint height with the seat cushion reference line angle set as closely as possible to the angle determined in S16.2.10.3.1. Mark location of the seat for future reference.

S16.3 Dummy seating positioning procedures. The 49 CFR Part 572 Subpart O 5th percentile adult female test dummy is positioned as follows:

S16.3.1 General provisions and definitions.

S16.3.1.1 All angles are measured with respect to the horizontal plane unless otherwise stated.

S16.3.1.2 The dummy's neck bracket is adjusted to align the zero degree index marks.

S16.3.1.3 The term "midsagittal plane" refers to the vertical plane that separates the dummy into equal left and right halves.

S16.3.1.4 The term "vertical longitudinal plane" refers to a vertical plane parallel to the vehicle's longitudinal centerline.

S16.3.1.5 The term "vertical plane" refers to a vertical plane, not necessarily parallel to the vehicle's longitudinal centerline.

S16.3.1.6 The term "transverse instrumentation platform" refers to the transverse instrumentation surface inside the dummy's skull casting to which the neck load cell mounts. This surface is perpendicular to the skull cap's machined inferior-superior mounting surface.

S16.3.1.7 The term "thigh" refers to the femur between, but not including, the knee and the pelvis.

S16.3.1.8 The term "leg" refers to the lower part of the entire leg, including the knee.

S16.3.1.9 The term "foot" refers to the foot, including the ankle.

S16.3.1.10 The longitudinal centerline of a bucket seat cushion is defined by a vertical plane that passes through the SgRP and is parallel to the longitudinal centerline of the vehicle.

S16.3.1.11 For leg and thigh angles, use the following references:

S16.3.1.11.1 **Thigh**—a straight line on the thigh skin between the center of the ½-13 UNC-2B tapped hole in the upper leg femur clamp (see drawings 880105-504 (left thigh) and 880105-505 (right thigh), upper leg femur clamp) and the knee pivot shoulder bolt (part 880105-527 in drawing 880105-528R & 528L, sliding knee assembly without potentiometer).

S16.3.1.11.2 **Leg**—a straight line on the leg skin between the center of the ankle shell (parts 880105-609 & 633 in drawing 880105-660, ankle assembly) and the knee pivot shoulder bolt (part 880105-527 in drawing 880105-528R & 528L, sliding knee assembly without potentiometer).

S16.3.1.12 The term "seat cushion reference point" (SCRP) means a point placed on the outboard side of the seat cushion at a horizontal distance between 150 mm (5.9 in) and 250 mm (9.8 in) from the front edge of the seat used as a guide in positioning the seat.

S16.3.1.13 The term "seat cushion reference line" means a line on the side of the seat cushion, passing through the seat cushion reference point, whose projection in the vehicle vertical longitudinal plane is straight and has a known angle with respect to the horizontal.

S16.3.2 Driver dummy positioning.

S16.3.2.1 Driver torso/head/seat back angle positioning.

S16.3.2.1.1 With the seat in the position determined in S16.2.10.3.3, use only the control that primarily moves the seat fore and aft to place the seat in the rearmost position. If the seat cushion reference line angle automatically changes as the seat is moved from the full forward position, maintain, as closely as possible, the seat cushion reference line angle determined in S16.2.10.3.1, for the final forward position when measuring the pelvic angle as specified in S16.3.2.1.11. The seat cushion reference angle position may be achieved through the use of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft.

S16.3.2.1.2 Fully recline the seat back, if adjustable. Install the dummy into the driver's seat, such that when the legs are positioned 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

S16.3.2.1.3 **Bucket seats.** Place the dummy on the seat cushion so that its midsagittal plane is vertical and coincides with the vertical longitudinal plane through the center of the seat cushion, within ± 10 mm (± 0.4 in).

S16.3.2.1.4 **Bench seats.** Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and aligned within ± 10 mm (± 0.4 in) of the center of the steering wheel rim.

S16.3.2.1.5 Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

S16.3.2.1.6 Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to

6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

S16.3.2.1.7 Gently rock the upper torso laterally in a side to side motion three times through a ± 5 degree arc (approximately 51 mm (2 in) side to side).

S16.3.2.1.8 If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. Keeping the leg and the thigh in a vertical plane, place the foot in the vertical longitudinal plane that passes through the centerline of the accelerator pedal. Rotate the left thigh outboard about

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the hip until the center of the knee is the same distance from the midsagittal plane of the dummy as the right knee ± 5 mm (± 0.2 in). Using only the control that primarily moves the seat fore and aft, attempt to return the seat to the full forward position. If either of the dummy's legs first contacts the steering wheel, then adjust the steering wheel, if adjustable, upward until contact with the steering wheel is avoided. If the steering wheel is not adjustable, separate the knees enough to avoid steering wheel contact. Proceed with moving the seat forward until either the leg contacts the vehicle interior or the seat reaches the full forward position. (The right foot may contact and depress the accelerator and/or change the angle of the foot with respect to the leg during seat movement.) If necessary to avoid contact with the vehicles brake or clutch pedal, rotate the test dummy's left foot about the leg. If there is still interference, rotate the left thigh outboard about the hip the minimum distance necessary to avoid pedal interference. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seat is a power seat, move the seat fore and aft to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior. If the steering wheel was moved, return it to the position described in S16.2.9. If the steering wheel contacts the dummy's leg(s) prior to attaining this position, adjust it to the next higher detent, or if infinitely adjustable, until there is 5 mm (0.2 in) clearance between the wheel and the dummy's leg(s).

S16.3.2.1.9 For vehicles without adjustable seat backs, adjust the lower neck bracket to level the head as much as possible. For vehicles with adjustable seat backs, while holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform of the head is level to within ± 0.5 degree, making sure that the pelvis does not interfere with the seat bight. Inspect the abdomen to ensure that it is properly installed. If the torso contacts the steering wheel, adjust the steering wheel in the following order until there is no contact: telescoping adjustment, lowering adjustment, raising adjustment. If the vehicle has no adjustments, or contact with the steering wheel cannot be eliminated by adjustment, position the seat at the next detent where there is no contact with the steering wheel as adjusted in S16.2.9. If the seat is a power seat, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the steering wheel as adjusted in S16.2.9 and the point of contact on the dummy.

S16.3.2.1.10 If it is not possible to achieve the head level within ± 0.5 degrees, minimize the angle.

S16.3.2.1.11 Measure and set the dummy's pelvic angle using the pelvic angle gauge (drawing TE-2504, incorporated by reference in 49 CFR Part 572, Subpart O of this chapter). The angle shall be set to 20.0 degrees ± 2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible by adjustments specified in S16.3.2.1.9 and S16.3.2.1.10.

S16.3.2.1.12 If the dummy is contacting the vehicle interior after these adjustments, using only the control that primarily moves the seat fore and aft, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments, the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forwardmost position, move the seat forward until the contact point is a maximum of 5 mm (0.2 in) from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position that causes no contact, or until the seat reaches its forwardmost position, whichever occurs first.

S16.3.2.2 Driver foot positioning.

S16.3.2.2.1 If the vehicle has an adjustable accelerator pedal, adjust it to the full forward position. If the heel of the right foot can contact the floor pan, follow the positioning procedure in (a). If not, follow the positioning procedure in (b).

(a) Rest the right foot of the test dummy on the undepressed accelerator pedal with the rearmost point of the heel on the floor pan in the plane of the pedal. If the foot cannot be placed on the accelerator pedal, set it initially perpendicular to the leg and then place it as far forward as possible in the direction of the pedal centerline with the rearmost point of the heel resting on the floor pan. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot. If the accelerator pedal in the full rearward position still does not touch the foot, leave the pedal in that position. Extend the foot and lower leg by decreasing the knee flexion angle until any part of the foot contacts the undepressed accelerator pedal. If the foot does not contact the pedal, place the highest part of the foot at the same height as the highest part of the pedal.

(b) Extend the foot and lower leg by decreasing the knee flexion angle until any part of the foot contacts the undepressed accelerator pedal or the highest part of the foot is at the same height as the highest part of the pedal. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot.

S16.3.2.2.2 If the ball of the right foot does not contact the pedal, increase the ankle plantar flexion angle such that the toe of the foot contacts or is as close as possible to contact with the undepressed accelerator pedal.

S16.3.2.2.3 If, in its final position, the heel is off of the vehicle floor, a spacer block must be used under the heel to support the final foot position (see figure 13). The surface of the block in contact with the heel must have an inclination of 30 degrees, measured from the horizontal, with the highest surface towards the rear of the vehicle.

S16.3.2.2.4 Place the left foot on the toe-board with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toe-board and floor pan.

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S16.3.2.2.5 If the left foot cannot be positioned on the toe board, place the foot perpendicular to the lower leg centerline as far forward as possible with the heel resting on the floor pan.

S16.3.2.2.6 If the left foot does not contact the floor pan, place the foot parallel to the floor and place the lower leg as perpendicular to the thigh as possible.

S16.3.2.2.7 When positioning the test dummy under S16.3.2.2.4, S16.3.2.2.5, and S16.2.2.6, avoid contact between the left foot of the test dummy and the vehicle's brake pedal, clutch pedal, wheel well projection, and foot rest. To avoid this contact, use the three foot position adjustments listed in paragraphs (a) through (c). The adjustment options are listed in priority order, with each subsequent option incorporating the previous. In making each adjustment, move the foot the minimum distance necessary to avoid contact. If it is not possible to avoid all prohibited foot contact, give priority to avoiding brake or clutch pedal contact.

(a) Rotate (abduction/adduction) the test dummy's left foot about the lower leg,

(b) Plantar flex the foot,

(c) Rotate the left leg about the hip in either an outboard or inboard direction.

S16.3.2.3 Driver arm/hand positioning.

S16.3.2.3.1 Place the dummy's upper arms adjacent to the torso with the arm centerlines as close to a vertical longitudinal plane as possible.

S16.3.2.3.2 Place the palms of the dummy in contact with the outer part of the steering wheel rim at its horizontal centerline with the thumbs over the steering wheel rim.

S16.3.2.3.3 If it is not possible to position the thumbs inside the steering wheel rim at its horizontal centerline, then position them above and as close to the horizontal centerline of the steering wheel rim as possible.

S16.3.2.3.4 Lightly tape the hands to the steering wheel rim so that if the hand of the test dummy is pushed upward by a force of not less than 9 N (2 lb) and not more than 22 N (5 lb), the tape releases the hand from the steering wheel rim.

S16.3.3 Passenger dummy positioning.

S16.3.3.1 Passenger torso/head/seat back angle positioning.

S16.3.3.1.1 With the seat at the mid-height in the full forward position determined in S16.2.10.3.3, use only the control that primarily moves the seat fore and aft to place the seat in the rearmost position, without adjusting independent height controls. If the seat cushion reference line angle automatically changes as the seat is moved from the full forward position, maintain as closely as possible the seat cushion reference line angle in S16.2.10.3.1, for the final forward position when measuring the pelvic angle as specified in S16.3.3.1.11. The seat cushion reference line angle position may be achieved through the use of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft.

S16.3.3.1.2 Fully recline the seat back, if adjustable. Install the dummy into the passenger seat, such that

when the legs are 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

S16.3.3.1.3 **Bucket seats.** Place the dummy on the seat cushion so that its midsagittal plane is vertical and coincides with the vertical longitudinal plane through the center of the seat cushion, within ± 10 mm (± 0.4 mm).

S16.3.3.1.4 **Bench seats.** Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ± 10 mm (± 0.4 in), as the midsagittal plane of the driver dummy.

S16.3.3.1.5 Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

S16.3.3.1.6 Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

S16.3.3.1.7 Gently rock the upper torso laterally side to side three times through a ± 5 degree arc (approximately 51 mm (2 in) side to side).

S16.3.3.1.8 If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. With the feet perpendicular to the legs, place the heels on the floor pan. If a heel will not contact the floor pan, place it as close to the floor pan as possible. Using only the control that primarily moves the seat fore and aft, attempt to return the seat to the full forward position. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seats are power seats, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior.

S16.3.3.1.9 For vehicles without adjustable seat backs, adjust the lower neck bracket to level the head as much as possible. For vehicles with adjustable seat backs, while holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform of the head is level to within ± 0.5 degrees, making sure that the pelvis does not interfere with the seat bight. Inspect the abdomen to insure that it is properly installed.

S16.3.3.1.10 If it is not possible to orient the head level within ± 0.5 degrees, minimize the angle.

S16.3.3.1.11 Measure and set the dummy's pelvic angle using the pelvic angle gauge (drawing TE-2504, incorporated by reference in 49 CFR Part 572, Subpart O, of this chapter). The angle shall be set to 20.0 degrees ± 2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible, as specified in S16.3.3.1.9 and S16.3.3.1.10.

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S16.3.3.1.12 If the dummy is contacting the vehicle interior after these adjustments, using only the control that primarily moves the seat fore and aft, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments, the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forwardmost position, move the seat forward until the contact point is a maximum of 5 mm (0.2 in) from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position that causes no contact, or until the seat reaches its forwardmost position, whichever occurs first.

S16.3.3.2 Passenger foot positioning.

S16.3.3.2.1 Place the passenger's feet flat on the toe board.

S16.3.3.2.2 If the feet cannot be placed flat on the toe board, set them perpendicular to the leg centerlines and place them as far forward as possible with the heels resting on the floor pan. If either foot does not contact the floor pan, place the foot parallel to the floor pan and place the lower leg as perpendicular to the thigh as possible.

S16.3.3.3 Passenger arm/hand positioning.

S16.3.3.3.1 Place the dummy's upper arms in contact with the seat back and the torso.

S16.3.3.3.2 Place the palms of the dummy in contact with the outside of the thighs.

S16.3.3.3.3 Place the little fingers in contact with the seat cushion.

S16.3.4 Driver and passenger adjustable head restraints.

S16.3.4.1 If the head restraint has an automatic adjustment, leave it where the system positions the restraint after the dummy is placed in the seat.

S16.3.4.2 Adjust each head restraint to its lowest position.

S16.3.4.3 Measure the vertical distance from the top most point of the head restraint to the bottom most point. Locate a horizontal plane through the midpoint of this distance. Adjust each head restraint vertically so that this horizontal plane is aligned with the center of gravity (CG) of the dummy head.

S16.3.4.3 If the above position is not attainable, move the vertical center of the head restraint to the closest detent below the center of the head CG.

S16.3.4.4 If the head restraint has a fore and aft adjustment, place the restraint in the forwardmost position or until contact with the head is made, whichever occurs first.

S16.3.5 Driver and passenger manual belt adjustment (for tests conducted with a belted dummy)

S16.3.5.1 If an adjustable seat belt D-ring anchorage exists, place it in the manufacturer's design position for a 5th percentile adult female with the seat in the position specified in S16.2.10.3.

S16.3.5.2 Place the Type 2 manual belt around the test dummy and fasten the latch.

S16.3.5.3 Ensure that the dummy's head remains as level as possible, as specified in S16.3.2.1.9 and S16.3.2.1.10 and S16.3.3.1.9 and S16.3.3.1.10.

S16.3.5.4 Remove all slack from the lap belt. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this operation four times. Apply a 9 N (2 lbf) to 18 N (4 lbf) tension load to the lap belt. If the belt system is equipped with a tension-relieving device, introduce the maximum amount of slack into the upper torso belt that is recommended by the manufacturer. If the belt system is not equipped with a tension-relieving device, allow the excess webbing in the shoulder belt to be retracted by the retractive force of the retractor.

S17 Offset frontal deformable barrier requirements using 5th percentile adult female test dummies. Each vehicle that is certified as complying with S14 shall, at each front outboard designated seating position, meet the injury criteria specified in S15.3 of this standard when the vehicle is crash tested in accordance with the procedures specified in S18 of this standard with the anthropomorphic test devices restrained by a Type 2 seat belt assembly.

S18 Test procedure for offset frontal deformable barrier requirements using 5th percentile adult female dummies.

S18.1 General provisions. Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 40 km/h (25 mph), into a fixed offset deformable barrier under the conditions and procedures specified in S18.2 of this standard, impacting only the left side of the vehicle.

S18.2 Test conditions.

S18.2.1 Offset frontal deformable barrier. The offset frontal deformable barrier shall conform to the specifications set forth in Subpart C of Part 587 of this chapter.

S18.2.2 General test conditions. All of the test conditions specified in S16.2 of this standard apply.

S18.2.3 Dummy seating procedures. Position the anthropomorphic test dummies as specified in S16.3 of this standard.

S18.2.4 Impact configuration. The test vehicle shall impact the barrier with the longitudinal centerline of the vehicle parallel to the line of travel and perpendicular to the barrier face within a tolerance of ± 5 degrees. The test vehicle shall be aligned so that the vehicle strikes the barrier with 40 percent overlap on the left side of the vehicle, with the vehicle's front engaging the barrier face such that the vehicle's longitudinal centerline is offset outboard of the edge of the barrier face by 10 percent of the vehicle's width ± 50 mm (2.0 in) as illustrated in Figure 10. The vehicle width is defined as the maximum dimension measured across the widest part of the vehicle, including bumpers and molding but excluding such components as exterior mirrors, flexible mud flaps, marker lamps, and dual rear wheel configurations.

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S19 Requirements to provide protection for infants in rear facing and convertible child restraints and car beds.

S19.1 Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S19.2 or S19.3, under the test procedures specified in S20.

S19.2 Option 1—Automatic suppression feature. Each vehicle shall meet the requirements specified in S19.2.1 through S19.2.3.

S19.2.1 The vehicle shall be equipped with an automatic suppression feature for the passenger air bag which results in deactivation of the air bag during each of the static tests specified in S20.2 (using the 49 CFR Part 572 Subpart R 12-month-old CRABI child dummy in any of the child restraints identified in sections B and C of appendix A of this standard and the 49 CFR part 572 subpart K Newborn Infant dummy in any of the car beds identified in section A of appendix A, as appropriate), and activation of the air bag system during each of the static tests specified in S20.3 (using the 49 CFR Part 572 Subpart O 5th percentile adult female dummy).

S19.2.2 The vehicle shall be equipped with at least one telltale which emits light whenever the passenger air bag system is deactivated and does not emit light whenever the passenger air bag system is activated, except that the telltale(s) need not illuminate when the passenger seat is unoccupied. Each telltale:

- (a) Shall emit yellow light;
- (b) Shall have the identifying words “PASSENGER AIR BAG OFF” or “PASS AIR BAG OFF” on the telltale or within 25 mm (1.0 in) of the telltale; and
- (c) Shall not be combined with the readiness indicator required by S4.5.2 of this standard.
- (d) Shall be located within the interior of the vehicle and forward of and above the design H-point of both the driver’s and the right front passenger’s seat in their forwardmost seating positions and shall not be located on or adjacent to a surface that can be used for temporary or permanent storage of objects that could obscure the telltale from either the driver’s or right front passenger’s view, or located where the telltale would be obscured from the driver’s view if a rear-facing child restraint listed in Appendix A is installed in the right front passenger’s seat.
- (e) Shall be visible and recognizable to a driver and right front passenger during night and day when the occupants have adapted to the ambient light roadway conditions.
- (f) Telltales need not be visible or recognizable when not activated.
- (g) Means shall be provided for making telltales visible and recognizable to the driver and right front passenger under all driving conditions. The means for providing the required visibility may be adjustable manually or automatically, except that the telltales may not be adjustable under any driving conditions to a level that they become invisible or not recognizable to the driver and right front passenger.

(h) The telltale must not emit light except when the passenger air bag is turned off or during a bulb check upon vehicle starting.

S19.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag system is suppressed, regardless of whether the passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S19.2.2.

S19.3 Option 2—Low risk deployment. Each vehicle shall meet the injury criteria specified in S19.4 of this standard when the passenger air bag is deployed in accordance with the procedures specified in S20.4.

S19.4 Injury criteria for the 49 CFR Part 572, Subpart R 12-month-old CRABI test dummy.

S19.4.1 All portions of the test dummy and child restraint shall be contained within the outer surfaces of the vehicle passenger compartment.

S19.4.2 Head injury criteria.

(a) For any two points in time, t_1 and t_2 , during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2 , the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r , expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 390.

S19.4.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 50 g ’s, except for intervals whose cumulative duration is not more than 3 milliseconds.

S19.4.4 Neck injury. When measuring neck injury, each of the following injury criteria shall be met.

(a) **Nij.**

(1) The shear force (F_x), axial force (F_z), and bending moment (M_y) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for N_{ij} purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (F_z) can be either in tension or compression while the occipital condyle bending moment (M_{ocy}) can be in either flexion or extension. This results in four possible loading conditions for N_{ij} : tension-extension (N_{te}), tension-flexion (N_{tf}), compression-extension (N_{ce}), or compression-flexion (N_{cf}).

(3) When calculating N_{ij} using equation S19.4.4(a)(4), the critical values, F_{zc} and M_{yc} , are:

(i) $F_{zc} = 1460 \text{ N (328 lbf)}$ when F_z is in tension

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(ii) $F_{zc} = 1460 \text{ N}$ (328 lbf) when F_z is in compression
 (iii) $M_{yc} = 43 \text{ Nm}$ (32 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) $M_{yc} = 17 \text{ Nm}$ (13 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the N_{ij} value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each N_{ij} loading condition is given by:

$$N_{ij} = (F_z / F_{zc}) + (M_{oc} / M_{yc})$$

(5) None of the four N_{ij} values shall exceed 1.0 at any time during the event.

(b) **Peak tension.** Tension force (F_z), measured at the upper neck load cell, shall not exceed 780 N (175 lbf) at any time.

(c) **Peak compression.** Compression force (F_z), measured at the upper neck load cell, shall not exceed 960 N (216 lbf) at any time.

S19.4.5 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR Part 572 Subpart R 12-month-old CRABI test dummy.

S20 Test procedure for S19.

S20.1 General provisions.

S20.1.1 Tests specifying the use of a car bed, a rear facing child restraint, or a convertible child restraint may be conducted using any such restraint listed in sections A, B, and C of Appendix A of this standard respectively. The car bed, rear facing child restraint, or convertible child restraint may be unused or have been previously used only for automatic suppression tests. If it has been used, there shall not be any visible damage prior to the test.

S20.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with the front outboard passenger seating position, if adjustable fore and aft, at full rearward, middle, and full forward positions. If the child restraint or dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance, or if the seat is a power seat, using only the control that primarily moves the seat fore and aft, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance between the dummy or child restraint and the vehicle interior.

S20.1.3 If the car bed, rear facing child restraint, or convertible child restraint is equipped with a handle, the vehicle shall comply in tests conducted with the handle at both the child restraint manufacturer's recommended position for use in vehicles and in the upright position.

S20.1.4 If the car bed, rear facing child restraint, or convertible child restraint is equipped with a sunshield, the vehicle shall comply in tests conducted with the sunshield both fully open and fully closed.

S20.1.5 The vehicle shall comply in tests with the car bed, rear facing child restraint, or convertible child restraint uncovered and in tests with a towel or blanket

weighing up to 1.0 kg (2.2 lb) placed on or over the restraint in any of the following positions:

(a) with the blanket covering the top and sides of the restraint, and

(b) with the blanket placed from the top of the vehicle's seat back to the forwardmost edge of the restraint.

S20.1.6 Except as otherwise specified, if the car bed, rear facing child restraint, or convertible child restraint has an anchorage system as specified in S5.9 of FMVSS No. 213 and is tested in a vehicle with a front outboard passenger vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply in the belted tests with the restraint anchorage system attached to the vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply in the belted test requirements with the restraint anchorage system unattached to the vehicle seat anchorage system and the vehicle seat belt attached. The vehicle shall comply in the unbelted tests with the restraint anchorage system unattached to the vehicle seat anchorage system.

S20.1.7 If the car bed, rear facing child restraint, or convertible child restraint comes equipped with a detachable base, the vehicle shall comply in tests conducted with the detachable base attached to the child restraint and with the detachable base unattached to the child restraint.

S20.1.8 Do not attach any tethers.

S20.1.9 **Seat set-up.** Unless otherwise stated.

S20.1.9.1 **Lumbar support adjustment.** Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S20.1.9.2 **Other seat adjustments.** Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.

S20.1.9.3 Set the seat and seat cushion in the position determined in S16.2.10.3.1.

S20.1.9.4 Using only the control that primarily moves the seat in the fore and aft direction, determine the full rearward, middle, and full forward positions of the SCRP. Using any part of any seat or seat cushion adjustments, other than that which primarily moves the seat or seat cushion fore-aft, determine the SCRP mid-point height for each of the three fore-aft test positions, while maintaining, as closely as possible, the seat cushion reference line middle angle determined in S16.2.10.3.1.

S20.1.9.5 The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3.

S20.1.9.6 If adjustable, set the head restraint at the full down and full forward position.

S20.1.10 The longitudinal centerline of a bucket seat cushion is defined by a vertical plane that passes through the SgRP and is parallel to the longitudinal centerline of the vehicle.

S20.2 Static tests of automatic suppression feature which shall result in deactivation of the passenger air bag. Each vehicle that is certified as

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complying with S19.2 shall meet the following test requirements.

S20.2.1 Belted rear facing and convertible child restraints.

S20.2.1.1 The vehicle shall comply in tests using any child restraint specified in section B and section C of Appendix A of this standard, installed in the front outboard passenger vehicle seat in the following orientations:

- (a) With the section B and section C child restraints facing rearward as appropriate; and
- (b) With the section C child restraints facing forward.

S20.2.1.2 The vehicle shall comply with the child restraint attached to the vehicle in the following manner:

- (a) Using the vehicle safety belts as specified in S20.2.1.5; and

- (b) If the child restraint is certified to S5.9 of §571.213, and the vehicle seat has an anchorage system as specified in §571.225, using only the mechanism provided by the child restraint manufacturer for attachment to the lower anchorages as specified in S20.2.1.6.

S20.2.1.3 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as “Plane A.”

S20.2.1.4 For bucket seats, “Plane B” refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of the front outboard passenger vehicle seat cushion. For bench seats, “Plane B” refers to a vertical plane through the front outboard passenger vehicle seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

S20.2.1.5 Installation with vehicle safety belts.

(a) Place any adjustable seat belt anchorages at the vehicle manufacturer’s nominal design position for a 50th percentile adult male occupant.

(b) Without attaching the child restraint anchorage system components specified in S5.9 of §571.213 to a vehicle child restraint anchorage system specified in §571.225, align the child restraint system facing rearward or forward, depending on the orientation being tested, such that Plane A is aligned with Plane B.

(c) While maintaining the child restraint positions achieved in S20.2.1.5(b), secure the child restraint by following, to the extent possible, the child restraint manufacturer’s directions regarding proper installation of the restraint for the orientation being tested. Cinch the vehicle belts to any tension from zero up to 134 N to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

(d) Position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer’s instructions provided with the child restraint for seating infants.

(e) Start the vehicle engine or place the ignition in the “on” position, whichever will turn on the suppression

system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.1.6 Installation using the lower anchor bars and the child restraint manufacturer provided attachment mechanism.

S20.2.1.6.1 If the attachment mechanism provided by the manufacturer incorporates a strap(s), use the following procedure:

(a) Place the child restraint on the vehicle seat facing rearward or forward, depending on the orientation being tested, with Plane A of the child restraint aligned within ± 10 mm with a longitudinal vertical plane passing through a point midway between the centers of the two lower anchor bars.

(b) Position any adjustments on the child restraint, to the extent possible according to the child restraint manufacturer’s instructions.

(c) Connect the lower anchor straps of the restraint to the lower anchor bars of the seat and remove the slack, but do not apply any load using these straps.

(d) Move the child restraint rearward until it contacts the seat back.

(e) Use the loading device equipped with the loading foot shown in Figure A1 and position it as shown in Figure A2 of Appendix A of this section. The 15 ± 3 degree angle of the loading device illustrated in Figure A2 is determined with an initial preload of 75 ± 25 N.

(f) Over a period of 90 ± 30 seconds, increase the load to 875 ± 25 N.

(g) After achieving the 875 N load in step (f) of this section, hold the bar length at present position and allow the load to settle for 60 seconds.

(h) Following the one-minute settling period specified in step (g) of this section, increase the load to 875 ± 25 N such that the 875 ± 25 N load is achieved within 10 seconds of the settling period.

(i) Hold the bar length at present position and allow the load to settle for 120 seconds after achieving the load in step (f) of this section.

(j) Following the settling period specified in step (i) of this section, increase the load to 875 ± 25 N such that the 875 ± 25 N load is achieved within 10 seconds of the settling period.

(k) Observe the settling of the load and tighten the lower anchor straps when the load is 850 ± 5 N or 180 seconds has elapsed since achieving the 875 ± 25 N load in step (f) of this section, whichever comes first. Tighten the lower anchor straps at the same time such that the load is reduced 15 ± 10 N and the change occurs within 2 seconds.

(l) Remove the loading device and position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer’s instructions provided with the child restraint for seating infants.

(m) Start the vehicle engine or place the ignition in the “on” position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

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S20.2.1.6.2 If the mechanism provided by the manufacturer does not incorporate a strap(s), use the following procedure:

(a) Place the vehicle seat in the rear-most and mid-height position.

(b) Place the child restraint on the vehicle seat facing rearward or forward, depending on the orientation being tested, with Plane A of the child restraint aligned within ± 10 mm with a longitudinal vertical plane passing through a point midway between the centers of the two lower anchor bars.

(c) Position any adjustments on the child restraint, to the extent possible, according to the child restraint manufacturer's instructions.

(d) Connect the lower anchor attachments to the lower anchor bars following, to the extent possible, the child restraint manufacturer's instructions.

(e) Move the child restraint rearward until it contacts the seat back.

(f) If the child restraint does not use a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, follow, to the extent possible, the CRS manufacturer's instructions for installing the child restraint onto the seat. Do not load the seat as provided in S20.2.1.6.2(g).

(g) If the child restraint uses a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, within 25 ± 5 seconds, apply a 475 ± 25 N force, that has no lateral component, aligned angularly ± 10 degrees with a parallel plane located within ± 100 mm of the plane formed by the linear mechanism. Release the force.

(h) Position the 49 CFR part 572 subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(i) Move the vehicle seat to the seat position being tested (full rear, mid, full forward).

(j) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.2 Unbelted rear facing and convertible child restraints.

S20.2.2.1 The vehicle shall comply in tests using any child restraint specified in section B and section C of appendix A of this standard.

S20.2.2.2 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as "Plane A".

S20.2.2.3 For bucket seats, "Plane B" refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of the front outboard passenger vehicle seat cushion. For bench seats, "Plane B" refers to a vertical plane through the front outboard passenger seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

S20.2.2.4 Facing rear.

(a) Align the child restraint system facing rearward such that Plane A is aligned with Plane B and the child restraint is in contact with the seat back.

(b) Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(c) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.2.5 Facing forward.

(a) Align the child restraint system facing forward such that Plane A is aligned with Plane B and the child restraint is in contact with the seat back.

(b) Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(c) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.3 Tests with a belted car bed.

S20.2.3.1 The vehicle shall comply in tests using any car bed specified in section A of Appendix A of this standard.

S20.2.3.2 (a) Install the car bed by following, to the extent possible, the car bed manufacturer's directions regarding proper installation of the car bed.

(b) Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to secure the car bed.

(c) Position the 49 CFR Part 572 Subpart K Newborn Infant dummy in the car bed by following, to the extent possible, the car bed manufacturer's instructions provided with the car bed for positioning infants.

(d) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.3 Static tests of automatic suppression feature which shall result in activation of the passenger air bag system.

S20.3.1 Each vehicle certified to this option shall comply in tests conducted with the front outboard passenger seating position, if adjustable fore and aft, at the mid-height, in the full rearward and middle positions determined in S20.1.9.4, and the forward position determined in S16.3.3.1.8.

S20.3.2 Place a 49 CFR part 572 subpart O 5th percentile adult female test dummy at the front outboard passenger seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S20.3.1, subject to the fore-aft seat positions in S20.3.1. Do not fasten the seat belt.

S20.3.3 Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

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S20.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S20.4 Low risk deployment test. Each vehicle that is certified as complying with S19.3 shall meet the following test requirements.

S20.4.1 Position the front outboard passenger vehicle seat at the mid-height in the full forward position determined in S20.1.9.4, and adjust the seat back (if adjustable independent of the seat) to the nominal design position for a 50th percentile adult male as specified in S8.1.3. Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint at the full down and most forward position. If the child restraint or dummy contacts the vehicle interior, do the following: using only the control that primarily moves the seat in the fore and aft direction, move the seat rearward to the next detent that provides clearance; or if the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance.

S20.4.2 The vehicle shall comply in tests using any child restraint specified in section B and section C of appendix A to this standard.

S20.4.3 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as "Plane A".

S20.4.4 For bucket seats, "Plane B" refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of the front outboard passenger seat cushion. For bench seats, "Plane B" refers to a vertical plane through the front outboard passenger seat parallel to the vehicle longitudinal centerline that is the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

S20.4.5 Align the child restraint system facing rearward such that Plane A is aligned with Plane B.

S20.4.6 If the child restraint is certified to S5.9 of §571.213, and the vehicle seat has an anchorage system as specified in §571.225, attach the child restraint to the vehicle seat anchorage as specified in S20.2.1.6. Do not attach the top tether of the child restraint system. Do not attach the vehicle safety belt.

S20.4.7 While maintaining the child restraint position achieved in S20.4.5, secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint in the rear facing mode. Place any adjustable seat belt anchorages at the manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to any tension from zero up to 134 N (30 lb) to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

S20.4.8 Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by

following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

S20.4.9 Deploy the front outboard passenger frontal air bag system. If the air bag system contains a multi-stage inflator, the vehicle shall be able to comply at any stage or combination of stages or time delay between successive stages that could occur in the presence of an infant in a rear facing child restraint and a 49 CFR Part 572, Subpart R 12-month-old CRABI dummy positioned according to S20.4, and also with the seat at the mid-height, in the middle and full rearward positions determined in S20.1.9.4, in a rigid barrier crash test at speeds up to 64 km/h (40 mph).

S21 Requirements using 3-year-old child dummies.

S21.1 Each vehicle that is certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S21.2, S21.3, S21.4 or S21.5, under the test procedures specified in S22 or S28, as applicable.

S21.2 Option 1—Automatic suppression feature. Each vehicle shall meet the requirements specified in S21.2.1 through S21.2.3.

S21.2.1 The vehicle shall be equipped with an automatic suppression feature for the passenger air bag which results in deactivation of the air bag during each of the static tests specified in S22.2 (using a 49 CFR Part 572 Subpart P 3-year-old child dummy and, as applicable, any child restraint specified in section C and section D of appendix A to this standard), and activation of the air bag system during each of the static tests specified in S22.3 (using a 49 CFR Part 572 Subpart O 5th percentile adult female dummy).

S21.2.2 The vehicle shall be equipped with a telltale light meeting the requirements specified in S19.2.2.

S21.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag is suppressed, regardless of whether the passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S21.2.2.

S21.3 Option 2—Dynamic automatic suppression system that suppresses the air bag when an occupant is out of position. (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for the passenger air bag system which meets the requirements specified in S27.

S21.4 Option 3—Low risk deployment. Each vehicle shall meet the injury criteria specified in S21.5 of this standard when the passenger air bag is deployed in accordance with both of the low risk deployment test procedures specified in S22.4.

S21.5 Injury criteria for the 49 CFR Part 572, Subpart P 3-year-old child test dummy.

S21.5.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S21.5.2 Head injury criteria.

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(a) For any two points in time, t_1 and t_2 , during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2 , the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r , expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 570.

S21.5.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 55 g 's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S21.5.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shall not exceed 34 millimeters (1.3 in).

S21.5.5 **Neck injury.** When measuring neck injury, each of the following injury criteria shall be met.

(a) **Nij.**

(1) The shear force (F_x), axial force (F_z), and bending moment (M_y) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (F_z) can be either in tension or compression while the occipital condyle bending moment (M_{ocy}) can be in either flexion or extension. This results in four possible loading conditions for Nij: Tension-extension (N_{te}), tension-flexion (N_{tf}), compression-extension (N_{ce}), or compression-flexion (N_{cf}).

(3) When calculating Nij using equation S21.5.5(a)(4), the critical values, F_{zc} and M_{yc} , are:

- (i) $F_{zc} = 2120$ N (477 lbf) when F_z is in tension
- (ii) $F_{zc} = 2120$ N (477 lbf) when F_z is in compression
- (iii) $M_{yc} = 68$ Nm (50 lbf-ft) when a flexion moment exists at the occipital condyle
- (iv) $M_{yc} = 27$ Nm (20 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

$$Nij = (F_z / F_{zc}) + (M_{ocy} / M_{yc})$$

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) **Peak tension.** Tension force (F_z), measured at the upper neck load cell, shall not exceed 1130 N (254 lbf) at any time.

(c) **Peak compression.** Compression force (F_z), measured at the upper neck load cell, shall not exceed 1380 N (310 lbf) at any time.

S21.5.6 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given in 49 CFR Part 572 Subpart P 3-year-old child test dummy.

S22 Test procedure for S21.

S22.1 General provisions and definitions.

S22.1.1 Tests specifying the use of a forward facing child restraint, including a booster seat where applicable, may be conducted using any such restraint listed in section C and section D of Appendix A of this standard, respectively. The child restraint may be unused or have been previously used only for automatic suppression tests. If it has been used, there shall not be any visible damage prior to the test. Booster seats are to be used in the manner appropriate for a 3-year-old child of the same height and weight as the 3-year-old child dummy.

S22.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with the front outboard passenger seating position at the mid-height, in the full rearward, middle, and the full forward positions determined in S22.1.7.4. If the dummy contacts the vehicle interior, using only the control that primarily moves the seat fore and aft, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance.

S22.1.3 Except as otherwise specified, if the child restraint has an anchorage system as specified in S5.9 of FMVSS No. 213 and is tested in a vehicle with a front outboard passenger vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply with the belted test conditions with the restraint anchorage system attached to the vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply with the belted test conditions with the restraint anchorage system unattached to the vehicle seat anchorage system and the vehicle seat belt attached.

S22.1.4 Do not attach any tethers.

S22.1.5 The definitions provided in S16.3.1 through S16.3.10 apply to the tests specified in S22.

S22.1.6 For leg and thigh angles use the following references:

(a) **Thigh**—a straight line on the thigh skin between the center of the $\frac{9}{16} \times \frac{1}{2}$ in. screw (part 9001024, item 10 in drawing 210-0000 sheet 2 of 7, complete assembly (HYB III 3 YR OLD)) and the knee bolt (part 210-5301 in drawing 210-5000-1 & -1, leg assembly).

(b) **Leg**—a straight line on the leg skin between the center of the ankle bolt (part 210-5701 in drawing 210-5000-1 & -2, leg assembly) and the knee bolt (part 210-5301 in drawing 210-5000-1 & -2, leg assembly).

S22.1.7 **Seat set-up.** Unless otherwise stated,

S22.1.7.1 **Lumbar support adjustment.** Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

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S22.1.7.2 Other seat adjustments. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.

S22.1.7.3 Set the seat and seat cushion in the position determined in S16.2.10.3.1.

S22.1.7.4 Using only the control that primarily moves the seat in the fore and aft direction, determine the full rearward, middle, and full forward positions of the SCRP. Using any part of any seat or seat cushion adjustments other than that which primarily moves the seat or seat cushion fore-aft, determine the SCRP mid-point height for each of the three fore-aft test positions, while maintaining, as closely as possible, the seat cushion reference line angle determined in S16.2.10.3.1.

S22.1.7.5 The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3.

S22.1.7.6 If adjustable, set the head restraint at the full down and full forward position.

S22.2 Static tests of automatic suppression feature which shall result in deactivation of the passenger air bag. Each vehicle that is certified as complying with S21.2 shall meet the following test requirements:

22.2.1 Belted test with forward facing or booster seat child restraint

S22.2.1.1 Install the restraint in the front outboard passenger vehicle seat in accordance, to the extent possible, with the child restraint manufacturer's instructions provided with the seat for use by children with the same height and weight as the 3-year-old child dummy.

S22.2.1.2 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as "Plane A".

S22.2.1.3 For bucket seats, "Plane B" refers to a vertical longitudinal plane through the longitudinal centerline of the seat cushion of the front outboard passenger vehicle seat. For bench seats, "Plane B" refers to a vertical plane through the front outboard passenger vehicle seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal center-line of the vehicle as the center of the steering wheel.

S22.2.1.4 The vehicle shall comply with the child restraint belted to the vehicle in the following manner:

(a) Using the vehicle safety belts as specified in S22.2.1.5 with section C and section D child restraints of Appendix A of this section designed to be secured to the vehicle seat even when empty; and

(b) If the child restraint is certified to S5.9 of §571.213, and the vehicle seat has an anchorage system as specified in §571.225, using only the mechanism provided by the child restraint manufacturer for attachment to the lower anchorage as specified in S22.2.1.6.

S22.2.1.5 Installation with vehicle safety belts.

(a) Place any adjustable safety belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant.

(b) Without attaching the child restraint anchorage system components specified in S5.9 of §571.213 to a

vehicle child restraint anchorage system specified in §571.225, align the child restraint system facing forward, such that Plane A is aligned with Plane B.

(c) While maintaining the child restraint positions achieved in S22.2.1.5(b), secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint. Cinch the vehicle belts to any tension from zero up to 134 N to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

S22.2.1.6 Installation using the lower anchor bars and the attachment mechanism provided by the child restraint manufacturer.

S22.2.1.6.1 If the mechanism provided by the manufacturer incorporates a strap(s), use the following procedure.

(a) Place the child restraint on the vehicle seat facing forward, with Plane A of the child restraint aligned within ± 10 mm with a longitudinal vertical plane passing through a point midway between the centers of the two lower anchor bars.

(b) Position any adjustments on the child restraint, to the extent possible, according to the child restraint manufacturer's instructions.

(c) Connect the lower anchor straps to the lower anchor bars and remove most of the slack, but do not apply any load using these straps.

(d) Move the child restraint rearward until it contacts the seat back.

(e) Do not attach any top tethers.

(f) Use the loading device equipped with the loading foot shown in Figure A1 and position it as shown in Figure A2 of Appendix A of this standard. The 15 ± 3 degree angle of the loading device is determined with an initial preload of 75 ± 25 N.

(g) Over a period of 90 ± 30 seconds, increase the load to 875 ± 25 N.

(h) If the child restraint uses a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, within 25 ± 5 seconds, apply a 475 ± 25 N force, that has no lateral component, aligned angularly ± 10 degrees with a parallel plane located within ± 100 mm of the plane formed by the linear mechanism. Release the force.

(i) Following the one-minute settling period specified in step (h) of this section, increase the load to 875 ± 25 N such that the 875 ± 25 N load is achieved within 10 seconds of the settling period.

(j) Hold the bar length at present position and allow the load to settle for 120 seconds after achieving the load in step (g) of this section.

(k) Following the settling period specified in step (j) of this section, increase the load to 875 ± 25 N such that the 875 ± 25 N load is achieved within 10 seconds of the settling period.

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(l) Observe the settling of the load and tighten the lower anchor straps when the load is 850 ± 5 N or 180 seconds has elapsed since achieving the 875 ± 25 N load in step (g) of this section, whichever comes first. Tighten the lower anchor straps at the same time such that the load is reduced 15 ± 10 N and the change occurs within 2 seconds.

(m) Remove the loading device.

S22.2.1.6.2 If the mechanism provided by the manufacturer does not incorporate a strap(s), use the following procedure.

(a) Place the vehicle seat in the rear-most and mid-height position.

(b) Place the child restraint on the vehicle seat facing forward with Plane A of the child restraint aligned within ± 10 mm with a longitudinal vertical plane passing through a point midway between the centers of the two lower anchor bars.

(c) Position any adjustments on the child restraint, to the extent possible, according to the child restraint manufacturer's instructions.

(d) Connect the lower anchor attachments to the lower anchor bars following, to the extent possible, the child restraint manufacturer's instructions.

(e) Move the child restraint rearward until it contacts the seat back.

(f) Do not attach any top tethers.

(g) If the child restraint does not use a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, follow, to the extent possible, the manufacturer's instructions for installing the child restraint onto the seat. Do not load the seat as provided in S22.2.1.6.2(h).

(h) If the child restraint uses a linear sliding or ratcheting mechanism that requires the application of force to securely install the child restraint, within 25 ± 5 seconds apply a 475 ± 25 N force, that has no lateral component, aligned angularly ± 10 degrees with a parallel plane located within ± 100 mm of the plane formed by the linear mechanism. Release the force.

(i) Move the vehicle seat to the seat position being tested (full rear, mid, full forward).

S22.2.1.7 Forward facing child restraint.

S22.2.1.7.1 After installation of a forward facing child restraint, position the 49 CFR part 572 subpart P 3-year-old child dummy in the child restraint such that the dummy's lower torso is centered on the child restraint and the dummy's spine is against the seat back of the child restraint. Place the arms at the dummy's sides.

S22.2.1.7.2 Attach all belts that come with the child restraint that are appropriate for a child of the same height and weight as the 3-year-old child dummy, if any, by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating children.

S22.2.1.7.3 Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.1.8 Booster seat child restraint.

S22.2.1.8.1 After installation of a booster seat child restraint, position the 49 CFR part 572 subpart P 3-year-old child dummy in the booster seat such that the dummy's lower torso is centered on the booster seat cushion and the dummy's back is parallel to and in contact with the booster seat back or, if there is no booster seat back, the vehicle seat back. Place the arms at the dummy's sides.

S22.2.1.8.2 If applicable, attach all belts that come with the child restraint that are appropriate for a child of the same height and weight as the 3-year-old child dummy, if any, by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating children.

S22.2.1.8.3 If applicable, place the Type 2 manual belt around the test dummy and fasten the latch. Remove all slack from the lap belt portion. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this four times. Apply a 9 to 18 N (2 to 4 lb) tension load to the lap belt. Allow the excess webbing in the upper torso belt to be retracted by the retractive force of the retractor.

S22.2.1.8.4 Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2 **Unbelted tests with dummies.** Place the 49 CFR part 572 subpart P 3-year-old child dummy on the front outboard passenger vehicle seat in any of the following positions (without using a child restraint or booster seat or the vehicle's seat belts):

S22.2.2.1 Sitting on seat with back against seat back.

(a) Place the dummy on the front outboard passenger seat.

(b) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ± 10 mm (± 0.4 in), as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ± 10 mm (± 0.4 in). Position the torso of the dummy against the seat back. Position the dummy's thighs against the seat cushion.

(c) Allow the legs of the dummy to extend off the surface of the seat.

(d) Rotate the dummy's upper arms down until they contact the seat back.

(e) Rotate the dummy's lower arms until the dummy's hands contact the seat cushion.

(f) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

(g) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.2 **Sitting on seat with back against reclined seat back.** Repeat the test sequence in

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S22.2.2.1 with the seat back angle 25 degrees rearward of the manufacturer's nominal design position for the 50th percentile adult male. If the seat will not recline 25 degrees rearward of the nominal design position, use the closest position that does not exceed 25 degrees.

S22.2.2.3 Sitting on seat with back not against seat back.

(a) Place the dummy on the front outboard passenger seat.

(b) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ± 10 mm (± 0.4 in), as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ± 10 mm (± 0.4 in). Position the dummy with the spine vertical so that the horizontal distance from the dummy's back to the seat back is no less than 25 mm (1.0 in) and no more than 150 mm (6.0 in), as measured along the dummy's midsagittal plane at the mid-sternum level. To keep the dummy in position, a material with a maximum breaking strength of 311 N (70 lb) may be used to hold the dummy.

(c) Position the dummy's thighs against the seat cushion.

(d) Allow the legs of the dummy to extend off the surface of the seat.

(e) Position the upper arms parallel to the spine and rotate the dummy's lower arms until the dummy's hands contact the seat cushion.

(f) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

(g) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.4 Sitting on seat edge, spine vertical, hands by the dummy's sides.

(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ± 10 mm (± 0.4 in), as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ± 10 mm (± 0.4 in).

(b) Position the dummy in the seated position forward in the seat such that the legs are vertical and the back of the legs rest against the front of the seat with the spine vertical. If the dummy's feet contact the floor pan, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan and the dummy spine vertical. To keep the dummy in position, a material with a maximum breaking strength of 311 N (70 lb) may be used to hold the dummy.

(c) Place the upper arms parallel to the spine.

(d) Lower the dummy's lower arms such that they contact the seat cushion.

(e) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

(f) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.5 Standing on seat, facing forward.

(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ± 10 mm (± 0.4 in), as the center of the steering wheel rim. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ± 10 mm (± 0.4 in). Position the dummy in a standing position on the front outboard passenger seat cushion facing the front of the vehicle while placing the heels of the dummy's feet in contact with the seat back.

(b) Rest the dummy against the seat back, with the arms parallel to the spine.

(c) If the head contacts the vehicle roof, recline the seat so that the head is no longer in contact with the vehicle roof, but allow no more than 5 mm (0.2 in) distance between the head and the roof. If the seat does not sufficiently recline to allow clearance, omit the test.

(d) If necessary use a material with a maximum breaking strength of 311 N (70 lb) or spacer blocks to keep the dummy in position.

(e) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

(f) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.6 Kneeling on seat, facing forward.

(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ± 10 mm (± 0.4 in), as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ± 10 mm (± 0.4 in).

(b) Position the dummy in a kneeling position in the front outboard passenger vehicle seat with the dummy facing the front of the vehicle with its toes at the intersection of the seat back and seat cushion. Position the dummy so that the spine is vertical. Push down on the legs so that they contact the seat as much as possible and then release. Place the arms parallel to the spine.

(c) If necessary use a material with a maximum breaking strength of 311 N (70 lb) or spacer blocks to keep the dummy in position.

(d) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

(e) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.7 Kneeling on seat, facing rearward.

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(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline, within ± 10 mm (± 0.4 in), as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ± 10 mm (± 0.4 in).

(b) Position the dummy in a kneeling position in the front outboard passenger vehicle seat with the dummy facing the rear of the vehicle. Position the dummy such that the dummy's head and torso are in contact with the seat back. Push down on the legs so that they contact the seat as much as possible and then release. Place the arms parallel to the spine.

(c) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

(d) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.8 Lying on seat. This test is performed only in vehicles with 3 designated front seating positions.

(a) Lay the dummy on the front outboard passenger vehicle seat such that the following criteria are met:

(1) The midsagittal plane of the dummy is horizontal,
(2) The dummy's spine is perpendicular to the vehicle's longitudinal axis,

(3) The dummy's arms are parallel to its spine,
(4) A plane passing through the two shoulder joints of the dummy is vertical,

(5) The anterior of the dummy is facing the vehicle front,

(6) The head of the dummy is positioned towards the passenger door, and

(7) The horizontal distance from the topmost point of the dummy's head to the vehicle door is 50 to 100 mm (2-4 in).

(8) The dummy is as far back in the seat as possible.

(b) Rotate the thighs as much as possible toward the chest of the dummy and rotate the legs as much as possible against the thighs.

(c) Move the dummy's upper left arm parallel to the vehicle's transverse plane and the lower left arm 90 degrees to the upper arm. Rotate the lower left arm about the elbow joint and toward the dummy's head until movement is obstructed.

(d) Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

(e) Wait 10 seconds, then check whether the air bag is deactivated.

S22.3 Static tests of automatic suppression feature which shall result in activation of the passenger air bag system.

S22.3.1 Each vehicle certified to this option shall comply in tests conducted with the front outboard passenger seating position at the mid-height, in the full rearward,

and middle positions determined in S22.1.7.4, and the forward position determined in S16.3.3.1.8.

S22.3.2 Place a 49 CFR part 572 subpart O 5th percentile adult female test dummy at the front outboard passenger seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S22.3.1. Do not fasten the seat belt.

S22.3.3 Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

S22.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S22.4 Low risk deployment tests.

S22.4.1 Each vehicle that is certified as complying with S21.4 shall meet the following test requirements with the 49 CFR Part 572, Subpart P 3-year-old child dummy in both of the following positions: Position 1 (S22.4.2) and Position 2 (S22.4.3).

S22.4.1.1 Locate and mark a point on the front of the dummy's chest jacket on the midsagittal plane that is 114 mm (4.5 in) ± 3 mm (± 0.1 in) along the surface of the skin from the top of the skin at the neck line. This is referred to as "Point 1."

S22.4.1.2 Mark a point on the instrument panel that is longitudinally and transversely, as measured along the surface of the instrument panel, within ± 6 mm (± 0.2 in) of the point that is defined by the intersection of the instrument panel and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric center of the static fully inflated air bag.

S22.4.1.3 Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located in S22.4.1.2. This is referred to as "Plane D."

S22.4.1.4 Locate the horizontal plane through the point located in S22.4.1.2. This is referred to as "Plane C."

S22.4.2 Position 1 (chest on instrument panel).

S22.4.2.1 Set the seat and seat cushion in the positions determined in S16.2.10.3.1. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest and most forward position.

S22.4.2.2 Place the dummy in the front outboard passenger seat such that:

S22.4.2.2.1 The midsagittal plane is coincident with Plane D within ± 10 mm (± 0.4 in).

S22.4.2.2.2 The legs are initially vertical to the floor pan. The legs and thighs shall be adjusted to the extent necessary for the head/torso to contact the instrument panel as specified in S22.4.2.3.

S22.4.2.2.3 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S22.4.2.3 Without changing the seat position and with the dummy's thorax instrument cavity rear face vertical, move the dummy forward until the dummy head/torso

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contacts the instrument panel. If the dummy loses contact with the seat cushion because of the forward movement, maintain the height of the dummy and the angle of the thigh with respect to the torso. Once contact is made, raise the dummy vertically until Point 1 lies in Plane C within ± 10 mm (± 0.4 in). If the dummy's head contacts the windshield and keeps Point 1 from reaching Plane C, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the head and the windshield. (The dummy shall remain in contact with the instrument panel while being raised or lowered, which may change the dummy's fore-aft position.)

S22.4.2.4 If possible, position the legs of the dummy so that the legs are vertical and the feet rest flat on the floor pan of the vehicle. If the positioning against the instrument panel does not allow the feet to be on the floor pan, the feet shall be parallel to the floor pan.

S22.4.2.5 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S22.4.3 Position 2 (head on instrument panel).

S22.4.3.1 Place the front outboard passenger seat at the mid-height, in full rearward seating position determined in S22.1.7.4. Place the seat back, if adjustable independent of the seat, at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest and most forward position.

S22.4.3.2 Place the dummy in the front outboard passenger seat such that:

S22.4.3.2.1 The midsagittal plane is coincident with Plane D within ± 10 mm (± 0.4 in).

S22.4.3.2.2 The legs are vertical to the floor pan, the back of the legs are in contact with the seat cushion, and the dummy's thorax instrument cavity rear face is vertical. If it is not possible to position the dummy with the legs in the prescribed position, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan, and the back of the legs are in contact with the front of the seat cushion. Set the transverse distance between the longitudinal centerlines at the front of the dummy's knees at 86 to 91 mm (3.4 to 3.6 in), with the thighs and the legs of the dummy in vertical planes.

S22.4.3.2.3 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S22.4.3.3 Using only the control that primarily moves the seat in the fore and aft direction, move the seat forward, while maintaining the thorax instrument cavity rear face orientation until any part of the dummy contacts the vehicle's instrument panel.

S22.4.3.4 If dummy contact has not been made with the vehicle's instrument panel at the full forward seat-

ing position of the seat, slide the dummy forward until contact is made. Maintain the thorax instrument cavity rear face vertical orientation. If the dummy loses contact with the seat, from that point forward, maintain the height of the dummy. Except as provided in S22.4.3.5, maintain the angle of the thigh with respect to the horizontal.

S22.4.3.5 If head/torso contact with the instrument panel has not been made, maintain the angle of the thighs with respect to the horizontal while applying a force towards the front of the vehicle on the spine of the dummy between the shoulder joints, perpendicular to the thorax instrument cavity rear face, until the head or torso comes into contact with the vehicle's instrument panel or until a maximum force of 222 N (50 lb) is achieved. If the head/torso is still not in contact with the instrument panel, hold the femurs and release the 222 N (50 lb) force. While maintaining the relative angle between the torso and the femurs, roll the dummy forward on the seat cushion, without sliding, until head/torso contact with the instrument panel is achieved. If seat contact is lost prior to or during femur rotation out of the horizontal plane, constrain the dummy to rotate about the dummy H-point. If the dummy cannot be rolled forward on the seat due to contact of the dummy feet with the floor pan, extend the lower legs forward, at the knees, until floor pan contact is avoided.

S22.4.3.6 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S22.4.4 Deploy the front outboard passenger frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash test at or below 26 km/h (16 mph), under the test procedure specified in S22.5.

S22.5 Test procedure for determining stages of air bag systems subject to low risk deployment (low speed crashes) test requirement.

S22.5.1 The test described in S22.5.2 shall be conducted with an unbelted 50th percentile adult male test dummy in the driver seating position according to S8 as it applies to that seating position and an unbelted 5th percentile adult female test dummy either in the front outboard passenger vehicle seating position according to S16 as it applies to that seating position or at any fore-aft seat position on the passenger side.

S22.5.2 Impact the vehicle traveling longitudinally forward at any speed, up to and including 26 km/h (16 mph) into a fixed rigid barrier that is perpendicular ± 5 degrees to the line of travel of the vehicle under the applicable conditions of S8, S10, and S16 excluding S10.7, S10.8, S10.9, and S16.3.5.

S22.5.3 Determine which inflation stage or combination of stages are fired and determine the time delay between successive stages. That stage or combination of

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stages, with time delay between successive stages, shall be used in deploying the air bag when conducting the low risk deployment tests described in S22.4, S24.4, and S26.

S22.5.4 If the air bag does not deploy in the impact described in S22.5.2, the low risk deployment tests described in S22.4, S24.4, and S26 shall be conducted with all stages using the maximum time delay between stages.

S23 Requirements using 6-year-old child dummies.

S23.1 Each vehicle that is certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S23.2, S23.3, or S23.4, under the test procedures specified in S24 or S28, as applicable.

S23.2 Option 1—Automatic suppression feature. Each vehicle shall meet the requirements specified in S23.2.1 through S23.2.3.

S23.2.1 The vehicle shall be equipped with an automatic suppression feature for the passenger frontal air bag system which results in deactivation of the air bag during each of the static tests specified in S24.2 (using a 49 CFR Part 572 Subpart N 6-year-old child dummy in any of the child restraints specified in section D of Appendix A of this standard), and activation of the air bag system during each of the static tests specified in S24.3 (using a 49 CFR Part 572 Subpart O 5th percentile adult female dummy).

S23.2.2 The vehicle shall be equipped with a telltale light meeting the requirements specified in S19.2.2.

S23.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag is suppressed, regardless of whether the passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S23.2.2.

S23.3 Option 2—Dynamic automatic suppression system that suppresses the air bag when an occupant is out of position. (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for the passenger frontal air bag system which meets the requirements specified in S27.

S23.4 Option 3—Low risk deployment. Each vehicle shall meet the injury criteria specified in S23.5 of this standard when the passenger air bag is statically deployed in accordance with both of the low risk deployment test procedures specified in S24.4.

S23.5 Injury criteria for the 49 CFR Part 572 Subpart N 6-year-old child dummy.

S23.5.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S23.5.2 Head injury criteria.

(a) For any two points in time, t_1 and t_2 , during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2 , the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r , expressed as a multiple of g (the

acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 700.

S23.5.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 60 g 's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S23.5.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shall not exceed 40 mm (1.6 in).

S23.5.5 Neck injury. When measuring neck injury, each of the following injury criteria shall be met.

(a) N_{ij} .

(1) The shear force (F_x), axial force (F_z), and bending moment (M_y) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for N_{ij} purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (F_z) can be either in tension or compression while the occipital condyle bending moment (M_{ocy}) can be in either flexion or extension. This results in four possible loading conditions for N_{ij} : tension-extension (N_{te}), tension-flexion (N_{tf}), compression-extension (N_{ce}), or compression-flexion (N_{cf}).

(3) When calculating N_{ij} using equation S23.5.5(a)(4), the critical values, F_{zc} and M_{yc} , are:

(i) $F_{zc} = 2800$ N (629 lbf) when F_z is in tension

(ii) $F_{zc} = 2800$ N (629 lbf) when F_z is in compression

(iii) $M_{yc} = 93$ Nm (69 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) $M_{yc} = 37$ Nm (27 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the N_{ij} value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each N_{ij} loading condition is given by:

$$N_{ij} = (F_z / F_{zc}) + (M_{ocy} / M_{yc})$$

(5) None of the four N_{ij} values shall exceed 1.0 at any time during the event.

(b) Peak tension. Tension force (F_z), measured at the upper neck load cell, shall not exceed 1490 N (335 lbf) at any time.

(c) Peak compression. Compression force (F_z), measured at the upper neck load cell, shall not exceed 1820 N (409 lbf) at any time.

S23.5.6 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and

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moment calculations are the same as given for the 49 CFR Part 572 Subpart N 6-year-old child test dummy.

S24 Test procedure for S23.

S24.1 General provisions and definitions.

S24.1.1 Tests specifying the use of a booster seat may be conducted using any such restraint listed in section D of Appendix A of this standard. The booster seat may be unused or have been previously used only for automatic suppression. If it has been used, there shall not be any visible damage prior to the test. Booster seats are to be used in the manner appropriate for a 6-year-old child of the same height and weight as the 6-year-old child dummy.

S24.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with the front outboard passenger seating position at the mid-height, in the full rearward seat track position, the middle seat track position, and the full forward seat track position as determined in this section. Using only the control that primarily moves the seat in the fore and aft direction, determine the full rearward, middle, and full forward positions of the SCRP. Using any seat or seat cushion adjustments other than that which primarily moves the seat fore-aft, determine the SCRP mid-point height for each of the three fore-aft test positions, while maintaining as closely as possible, the seat cushion angle determined in S16.2.10.3.1. Set the seat back angle, if adjustable independent of the seat, at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. If the dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior.

S24.1.3 Except as otherwise specified, if the booster seat has an anchorage system as specified in S5.9 of FMVSS No. 213 and is used under this standard in testing a vehicle with a front outboard passenger vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply with the belted test conditions with the restraint anchorage system attached to the FMVSS No. 225 vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply with the belted test conditions with the restraint anchorage system unattached to the FMVSS No. 225 vehicle seat anchorage system and the vehicle seat belt attached. The vehicle shall comply with the unbelted test conditions with the restraint anchorage system unattached to the FMVSS No. 225 vehicle seat anchorage system.

S24.1.4 Do not attach any tethers.

S24.1.5 The definitions provided in S16.3.1 through S16.3.10 apply to the tests specified in S24.

S24.1.6 For leg and thigh angles, use the following references:

S24.1.6.1 **Thigh**—a straight line on the thigh skin between the center of the 5/16-18 UNC-2B threaded access hole in the upper leg clamp (drawing 127-4004, 6 YR H3-upper leg clamp) and the knee screw (part 9000248 in drawing 127-4000-1 & -2, leg assembly).

S24.1.6.2 **Leg**—a straight line on the leg skin between the center of the lower leg screw (part 9001170 in drawing 127-4000-1 & -2, leg assembly) and the knee screw (part 9000248 in drawing 127-4000-1 & -2, leg assembly).

S24.2 **Static tests of automatic suppression feature which shall result in deactivation of the passenger air bag.** Each vehicle that is certified as complying with S23.2 of FMVSS No. 208 shall meet the following test requirements with the child restraint in the front outboard passenger vehicle seat under the following conditions:

(a) Using the vehicle safety belts as specified in S22.2.1.5 with section D child restraints designed to be secured to the vehicle seat even when empty;

(b) If the child restraint is certified to S5.9 of §571.213, and the vehicle seat has an anchorage system as specified in §571.225, using only the mechanism provided by the child restraint manufacturer for attachment to the lower anchorage as specified in S22.2.1.6; and

(c) Without securing the child restraint with either the vehicle safety belts or any mechanism provided with a child restraint certified to S5.9 of §571.213.

S24.2.1 Except as provided in S24.2.2, conduct all tests as specified in S22.2, except that the 49 CFR Part 572 Subpart N 6-year-old child dummy shall be used.

S24.2.2 **Exceptions.** The tests specified in the following paragraphs of S22.2 need not be conducted: S22.2.1.7, S22.2.2.3, S22.2.2.5, S22.2.2.6, S22.2.2.7, and S22.2.2.8.

S24.2.3 Sitting back in the seat and leaning on the front outboard passenger door.

(a) Place the dummy in the seated position in the front outboard passenger vehicle seat. For bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion, within ± 10 mm (± 0.4 in). For bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the longitudinal centerline of the vehicle, within ± 10 mm (± 0.4 in), as the center of the steering wheel.

(b) Place the dummy's back against the seat back and rest the dummy's thighs on the seat cushion.

(c) Allow the legs and feet of the dummy to extend off the surface of the seat. If this positioning of the dummy's legs is prevented by contact with the instrument panel, using only the control that primarily moves the seat fore and aft, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward, while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the part of the dummy that was in contact with the vehicle interior.

(d) Rotate the dummy's upper arms toward the seat back until they make contact.

(e) Rotate the dummy's lower arms down until they contact the seat.

(f) Close the vehicle's passenger-side door and then start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system.

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(g) Push against the dummy's left shoulder to lean the dummy against the door; close all remaining doors.

(h) Wait ten seconds, then check whether the air bag is deactivated.

S24.3 Static tests of automatic suppression feature which shall result in activation of the passenger air bag system.

S24.3.1 Each vehicle certified to this option shall comply in tests conducted with the front outboard passenger seating position at the mid-height, in the full rearward and middle positions determined in S24.1.2, and the forward position determined in S16.3.3.1.8.

S24.3.2 Place a 49 CFR part 572 subpart O 5th percentile adult female test dummy at the front outboard passenger seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S24.3.1. Do not fasten the seat belt.

S24.3.3 Start the vehicle engine or place the ignition in the "on" position, whichever will turn on the suppression system, and then close all vehicle doors.

S24.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S24.4 Low risk deployment tests.

S24.4.1 Each vehicle that is certified as complying with S23.4 shall meet the following test requirements with the 49 CFR Part 572, Subpart N 6-year-old child dummy in both of the following positions: Position 1 (S24.4.2) or Position 2 (S24.4.3).

S24.4.1.1 Locate and mark a point on the front of the dummy's chest jacket on the midsagittal plane that is 139 mm (5.5 in) $\pm$ 3 mm ($\pm$ 0.1 in) along the surface of the skin from the top of the skin at the neckline. This is referred to as "Point 1."

S24.4.1.2 Mark a point on the instrument panel that is longitudinally and transversely, as measured along the surface of the instrument panel, within $\pm$ 6 mm ($\pm$ 0.2 in) of the point that is defined by the intersection of the instrument panel and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric center of the static fully inflated air bag.

S24.4.1.3 Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located in S24.4.1.2. This is referred to as "Plane D."

S24.4.1.4 Locate the horizontal plane through the point located in S24.4.1.2. This is referred to as "Plane C."

S24.4.2 Position 1 (chest on instrument panel).

S24.4.2.1 Set the seat and seat cushion in the positions determined in S16.2.10.3.1. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest and most forward position.

S24.4.2.2 Remove the legs of the dummy at the pelvic interface.

S24.4.2.3 Place the dummy in the front outboard passenger seat such that:

(a) The midsagittal plane is coincident with Plane D within $\pm$ 10 mm ($\pm$ 0.4 in).

(b) The upper arms are parallel to the torso and the hands are next to where the thighs would be.

(c) Without changing the seat position and with the dummy's thorax instrument cavity rear face 6 degrees forward of the vertical, move the dummy forward until the dummy head/torso contacts the instrument panel. If the dummy loses contact with the seat cushion because of the forward movement, maintain the height of the dummy while moving the dummy forward. If the head contacts the windshield before head/torso contact with the instrument panel, maintain the thorax instrument cavity angle and move the dummy forward such that the head is following the angle of the windshield until there is head/torso contact with the instrument panel. Once contact is made, raise or lower the dummy vertically until Point 1 lies in Plane C within $\pm$ 10 mm ($\pm$ 0.4 in). If the dummy's head contacts the windshield and keeps Point 1 from reaching Plane C, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the head and the windshield. (The dummy shall remain in contact with the instrument panel while being raised or lowered which may change the dummy's fore-aft position.)

S24.4.2.4 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S24.4.3 Position 2 (head on instrument panel).

S24.4.3.1 Place the front outboard passenger seat at the mid-height full rearward seating position determined in S24.1.2. Place the seat back, if adjustable independent of the seat, at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest and most forward position.

S24.4.3.2 Place the dummy in the front outboard passenger seat such that:

(a) The midsagittal plane is coincident with Plane D within $\pm$ 10 mm ($\pm$ 0.4 in).

(b) The legs are perpendicular to the floor pan, the back of the legs are in contact with the seat cushion, and the dummy's thorax instrument cavity rear face is 6 degrees forward of vertical. If it is not possible to position the dummy with the legs in the prescribed position, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan and the back of the legs are in contact with the front of the seat cushion. Set the transverse distance between the longitudinal centerlines at the front of the dummy's knees at 112 to 117 mm (4.4 to 4.6 in), with the thighs and the legs of the dummy in vertical planes.

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(c) The upper arms are parallel to the torso and the hands are in contact with the thighs.

S24.4.3.3 Using only the control that primarily moves the seat in the fore and aft direction, move the seat forward, while maintaining the thorax instrument cavity rear face orientation until any part of the dummy contacts the vehicle's instrument panel.

S24.4.3.4 If dummy contact has not been made with the vehicle's instrument panel at the full forward seating position of the seat, slide the dummy forward on the seat until contact is made. Maintain the thorax instrument cavity rear face orientation. If the dummy loses contact with the seat, from that point forward maintain the height of the dummy. Except as provided in S24.4.3.5, maintain the angle of the thigh with respect to the horizontal.

S24.4.3.5 If head/torso contact with the instrument panel has not been made, maintain the angle of the thighs with respect to the horizontal while applying a force towards the front of the vehicle on the spine of the dummy between the shoulder joints, perpendicular to the thorax instrument cavity rear face, until the head or torso comes into contact with the vehicle's instrument panel or until a maximum force of 222 N (50 lb) is achieved. If the head/torso is still not in contact with the instrument panel, hold the femurs and release the 222 N (50 lb) force. While maintaining the relative angle between the torso and the femurs, roll the dummy forward on the seat cushion, without sliding, until head/torso contact with the instrument panel is achieved. If seat contact is lost prior to or during femur rotation out of the horizontal plane, constrain the dummy to rotate about the dummy H-point. If the dummy cannot be rolled forward on the seat due to contact of the dummy feet with the floor pan, extend the lower legs forward, at the knees, until floor pan contact is avoided.

S24.4.3.6 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S24.4.4 Deploy the front outboard passenger frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash test at or below 26 km/h (16 mph), under the test procedure specified in S22.5.

S25 Requirements using an out-of-position 5th percentile adult female dummy at the driver position.

S25.1 Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S25.2 or S25.3 under the test procedures specified in S26 or S28, as appropriate.

S25.2 Option 1—Dynamic automatic suppression system that suppresses the air bag when the driver is out of position. (This option is available under the

conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for the driver air bag which meets the requirements specified in S27.

S25.3 Option 2—Low risk deployment. Each vehicle shall meet the injury criteria specified by S15.3 of this standard, except as modified in S25.4, when the driver air bag is statically deployed in accordance with both of the low risk deployment test procedures specified in S26.

S25.4 Neck injury criteria driver low risk deployment tests. When measuring neck injury in low risk deployment tests for the driver position, each of the following neck injury criteria shall be met.

(a) Nij.

(1) The shear force (F_x), axial force (F_z), and bending moment (M_y) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE Recommended Practice J211/1 MAR95 (incorporated by reference, see §571.5) Channel Frequency Class 600.

(2) During the event, the axial force (F_z) can be either in tension or compression while the occipital condyle bending moment (M_{ocy}) can be in either flexion or extension. This results in four possible loading conditions for

Nij: tension-extension (N_{te}), tension-flexion (N_{tf}), compression-extension (N_{ce}), or compression-flexion (N_{cf}).

(3) When calculating Nij using equation S25.4(a)(4), the critical values, F_{zc} and M_{yc} , are:

(i) $F_{zc} = 3880 \text{ N (872 lbf)}$ when F_z is in tension

(ii) $F_{zc} = 3880 \text{ N (872 lbf)}$ when F_z is in compression

(iii) $M_{yc} = 155 \text{ Nm (114 lbf-ft)}$ when a flexion moment exists at the occipital condyle

(iv) $M_{yc} = 61 \text{ Nm (45 lbf-ft)}$ when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

$$Nij = (F_z / F_{zc}) + (M_{ocy} / M_{yc})$$

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) **Peak tension.** Tension force (F_z), measured at the upper neck load cell, shall not exceed 2070 N (465 lbf) at any time.

(c) **Peak compression.** Compression force (F_z), measured at the upper neck load cell, shall not exceed 2520 N (566 lbf) at any time.

(d) Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given in 49 CFR Part 572 Subpart O 5th percentile female test dummy.

S26 Procedure for low risk deployment tests of driver air bag.

S26.1 Each vehicle that is certified as complying with S25.3 shall meet the requirements of S25.3 and S25.4

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with the 49 CFR Part 572 Subpart O 5th percentile adult female dummy in both of the following positions: Driver position 1 (S26.2) and Driver position 2 (S26.3).

S26.2 Driver position 1 (chin on module).

S26.2.1 Adjust the steering controls so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If there is no setting at the geometric center, position it one setting lower than the geometric center. Set the rotation of the steering wheel so that the vehicle wheels are pointed straight ahead.

S26.2.2 Mark a point on the steering wheel cover that is longitudinally and transversely, as measured along the surface of the steering wheel cover, within ± 6 mm (± 0.2 in) of the point that is defined by the intersection of the steering wheel cover and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric center of the static fully inflated air bag. Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located on the steering wheel cover. This is referred to as "Plane E."

S26.2.3 Place the seat and seat cushion in the position achieved in S16.2.10.3.1. If the seat or seat cushion is adjustable in the vertical direction by adjustments other than that which primarily moves the seat or seat cushion fore-aft, determine the maximum and minimum heights of the SCRP at this position, while maintaining the seat cushion reference line angle as closely as possible. Place the SCRP in the mid-height position. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest and most forward position.

S26.2.4 Place the dummy in the driver's seat such that:

S26.2.4.1 The midsagittal plane is coincident with Plane E within ± 10 mm (± 0.4 in).

S26.2.4.2 The legs are perpendicular to the floor pan and the back of the legs are in contact with the seat cushion. The legs may be adjusted if necessary to achieve the final head position.

S26.2.4.3 The dummy's thorax instrument cavity rear face is 6 degrees forward (toward the front of the vehicle) of the steering wheel angle (i.e., if the steering wheel angle is 25 degrees from vertical, the thorax instrument cavity rear face angle is 31 degrees).

S26.2.4.4 The initial transverse distance between the longitudinal centerlines at the front of the dummy's knees is 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes.

S26.2.4.5 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S26.2.5 Maintaining the spine angle, slide the dummy forward until the head/torso contacts the steering wheel.

S26.2.6 While maintaining the spine angle, adjust the height of the dummy so that the bottom of the chin is in the same horizontal plane as the highest point of the air

bag module cover (dummy height can be adjusted using the seat height adjustments and/or spacer blocks). If the seat prevents the bottom of the chin from being in the same horizontal plane as the module cover, adjust the dummy height to as close to the prescribed position as possible.

S26.2.7 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S26.3 Driver position 2 (chin on rim).

S26.3.1 Place the seat and seat cushion in the position achieved in S16.2.10.3.1. If the seat or seat cushion is adjustable in the vertical direction by adjustments other than that which primarily moves the seat or seat cushion fore-aft, determine the maximum and minimum heights of the SCRP at this position, while maintaining the seat cushion reference line angle as closely as possible. Place the SCRP in the mid-height position. If the seat back is adjustable independent of the seat, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest position.

S26.3.2 Adjust the steering controls so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If there is no setting at the geometric center, position it one setting lower than the geometric center. Set the rotation of the steering wheel so that the vehicle wheels are pointed straight ahead.

S26.3.3 Mark a point on the steering wheel cover that is longitudinally and transversely, as measured along the surface of the steering wheel cover, within ± 6 mm (± 0.2 in) of the point that is defined by the intersection of the steering wheel cover and a line between the volumetric center of the smallest volume that can encompass the folded undeployed air bag and the volumetric center of the static fully inflated air bag. Locate the vertical plane parallel to the vehicle longitudinal centerline through the point located on the steering wheel cover. This is referred to as "Plane E."

S26.3.4 Place the dummy in the driver's seat position such that:

S26.3.4.1 The midsagittal plane is coincident with Plane E within ± 10 mm (± 0.4 in).

S26.3.4.2 The legs are perpendicular to the floor pan and the back of the legs are in contact with the seat cushion. The legs may be adjusted if necessary to achieve the final head position.

S26.3.4.3 The dummy's thorax instrument cavity rear face is 6 degrees forward (toward the front of the vehicle) of the steering wheel angle (i.e., if the steering wheel angle is 25 degrees from vertical, the thorax instrument cavity rear face angle is 31 degrees).

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S26.3.4.4 The initial transverse distance between the longitudinal centerlines at the front of the dummy's knees is 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes.

S26.3.4.5 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S26.3.5 Maintaining the spine angle, slide the dummy forward until the head/torso contacts the steering wheel.

S26.3.6 While maintaining the spine angle, position the dummy so that a point on the chin 40 mm (1.6 in) $\pm$ 3 mm ($\pm$ 0.1 in) below the center of the mouth (chin point) is, within $\pm$ 10 mm ($\pm$ 0.4 in), in contact with a point on the steering wheel rim surface closest to the dummy that is 10 mm (0.4 in) vertically below the highest point on the rim in Plane E. If the dummy's head contacts the vehicle windshield or upper interior before the prescribed position can be obtained, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the vehicle's windshield or upper interior, as applicable.

S26.3.7 If the steering wheel can be adjusted so that the chin point can be in contact with the rim of the uppermost portion of the steering wheel, adjust the steering wheel to that position. If the steering wheel contacts the dummy's leg(s) prior to attaining this position, adjust it to the next highest detent, or if infinitely adjustable, until there is a maximum of 5 mm (0.2 in) clearance between the wheel and the dummy's leg(s). Readjust the dummy's torso such that the thorax instrument cavity rear face is 6 degrees forward of the steering wheel angle. Position the dummy so that the chin point is in contact, or if contact is not achieved, as close as possible to contact with the rim of the uppermost portion of the steering wheel.

S26.3.8 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S26.4 Deploy the driver frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash test at or below 26 km/h (16 mph), under the test procedure specified in S22.5.

S27 Option for dynamic automatic suppression system that suppresses the air bag when an occupant is out-of-position.

S27.1 **Availability of option.** This option is available for either air bag, singly or in conjunction, subject to the requirements of S27, if:

(a) A petition for rulemaking to establish dynamic automatic suppression system test procedures is submitted pursuant to Subpart B of Part 552 and a test procedure applicable to the vehicle is added to S28 pursuant to the procedures specified by that subpart, or

(b) A test procedure applicable to the vehicle is otherwise added to S28.

S27.2 **Definitions.** For purposes of S27 and S28, the following definitions apply:

Automatic suppression zone or ASZ means a three-dimensional zone adjacent to the air bag cover, specified by the vehicle manufacturer, where the deployment of the air bag will be suppressed by the DASS if a vehicle occupant enters the zone under specified conditions.

Dynamic automatic suppression system or DASS means a portion of an air bag system that automatically controls whether or not the air bag deploys during a crash by:

(1) Sensing the location of an occupant, moving or still, in relation to the air bag;

(2) Interpreting the occupant characteristics and location information to determine whether or not the air bag should deploy; and

(3) Activating or suppressing the air bag system based on the interpretation of occupant characteristics and location information.

S27.3 **Requirements.** Each vehicle shall, at each applicable front outboard designated seating position, when tested under the conditions of S28 of this standard, comply with the requirements specified in S27.4 through S27.6.

S27.4 Each vehicle shall be equipped with a DASS.

S27.5 **Static test requirement (low risk deployment for occupants outside the ASZ).**

S27.5.1 **Driver (49 CFR Part 572 Subpart O 5th percentile female dummy).** Each vehicle shall meet the injury criteria specified in S15.3 of this standard when the driver air bag is deployed in accordance with the procedures specified in S28.1.

S27.5.2 **Passenger (49 CFR Part 572 Subpart P 3-year-old child dummy and 49 CFR Part 572 Subpart N 6-year-old child dummy).** Each vehicle shall meet the injury criteria specified in S21.5 and S23.5, as appropriate, when the passenger air bag is deployed in accordance with the procedures specified in S28.2.

S27.6 **Dynamic test requirement (suppression of air bag for occupants inside the ASZ).**

S27.6.1 **Driver.** The DASS shall suppress the driver air bag before the head, neck, or torso of the specified test device enters the ASZ when the vehicle is tested under the procedures specified in S28.3.

S27.6.2 **Passenger.** The DASS shall suppress the passenger air bag before head, neck, or torso of the specified test device enters the ASZ when the vehicle is tested under the procedures specified in S28.4.

S28 **Test procedure for S27 of this standard.** [Reserved]

S28.1 **Driver suppression zone verification test (49 CFR Part 572 Subpart O 5th percentile female dummy).** [Reserved]

S28.2 **Passenger suppression zone verification test (49 CFR Part 572 Subpart P 3-year-old child dummy and 49 CFR Part 572 Subpart N 6-year-old child dummies).** [Reserved]

S28.3 **Driver dynamic test procedure for DASS requirements.** [Reserved]

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S28.4 Passenger dynamic test procedure for DASS requirements. [Reserved]

S29 Manufacturer option to certify vehicles to certain static suppression test requirements using human beings rather than test dummies.

S29.1 At the option of the manufacturer, instead of using test dummies in conducting the tests for the following automatic suppression and occupant recognition parts of the low risk deployment test requirements, human beings may be used as specified. If human beings are used, they shall assume, to the extent possible, the final physical position specified for the corresponding dummies for each test.

(a) If a manufacturer decides to certify a vehicle using a human being for a test of the passenger automatic suppression, it shall use humans for the entire series of tests, e.g., 3-year-old children for each test of the system involving 3-year-old test dummies. If a manufacturer decides to certify a vehicle using a test dummy for a test of the system, it shall use test dummies for the entire series of tests, e.g., a Hybrid III 3-year-old child dummy for each test of the system involving 3-year-old child test dummies.

(b) For S19.2, instead of using the 49 CFR Part 572 Subpart R 12-month-old child dummy, a human child who weighs between 8.2 and 9.1 kg (18 and 20 lb), and who is between 61 and 66 cm (24 and 26 in) tall may be used.

(c) For S19.2, instead of using the 49 CFR Part 572 Subpart K newborn infant dummy, a human child who

weighs between 8.2 and 9.1 kg (18 and 20 lb), and who is between 61 and 66 cm (24 and 26 in) tall may be used.

(d) For S21.2 and S21.5.1, instead of using the 49 CFR Part 572 Subpart P 3-year-old child dummy, a human child who weighs between 13.4 and 18 kg (29.5 and 39.5 lb), and who is between 89 and 99 cm (35 and 39 in) tall may be used.

(e) For S23.2 and S23.5.1, instead of using the 49 CFR Part 572 Subpart N 6-year-old child dummy, a human child who weighs between 21 and 25.6 kg (46.5 and 56.5 lb), and who is between 114 and

124.5 cm (45 and 49 in) tall may be used.

(f) For S19.2, S21.2, and S23.2, instead of using the 49 CFR Part 572 Subpart O 5th percentile adult female test dummy, a female who weighs between 46.7 and 51.25 kg (103 and 113 lb), and who is between 139.7 and 150 cm (55 and 59 in) tall may be used.

S29.2 Human beings shall be dressed in a cotton T-shirt, full length cotton trousers, and sneakers. Specified weights and heights include clothing.

S29.3 A manufacturer exercising this option shall upon request:

(a) Provide NHTSA with a method to deactivate the air bag during compliance testing under S20.2, S20.3, S22.2, S22.3, S24.2, and S24.3, and identify any parts or equipment necessary for deactivation; such assurance may be made by removing the air bag; and

(b) Provide NHTSA with a method to assure that the same test results would be obtained if the air bag were not deactivated.

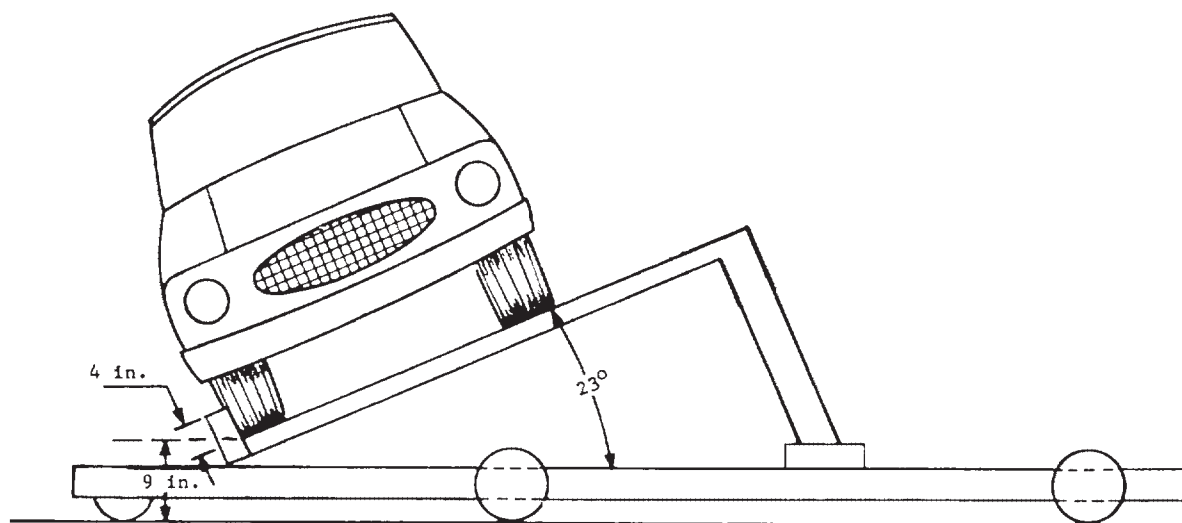


FIGURE 2-TYPICAL DEVICE FOR ROLLOVER TEST

Regulations

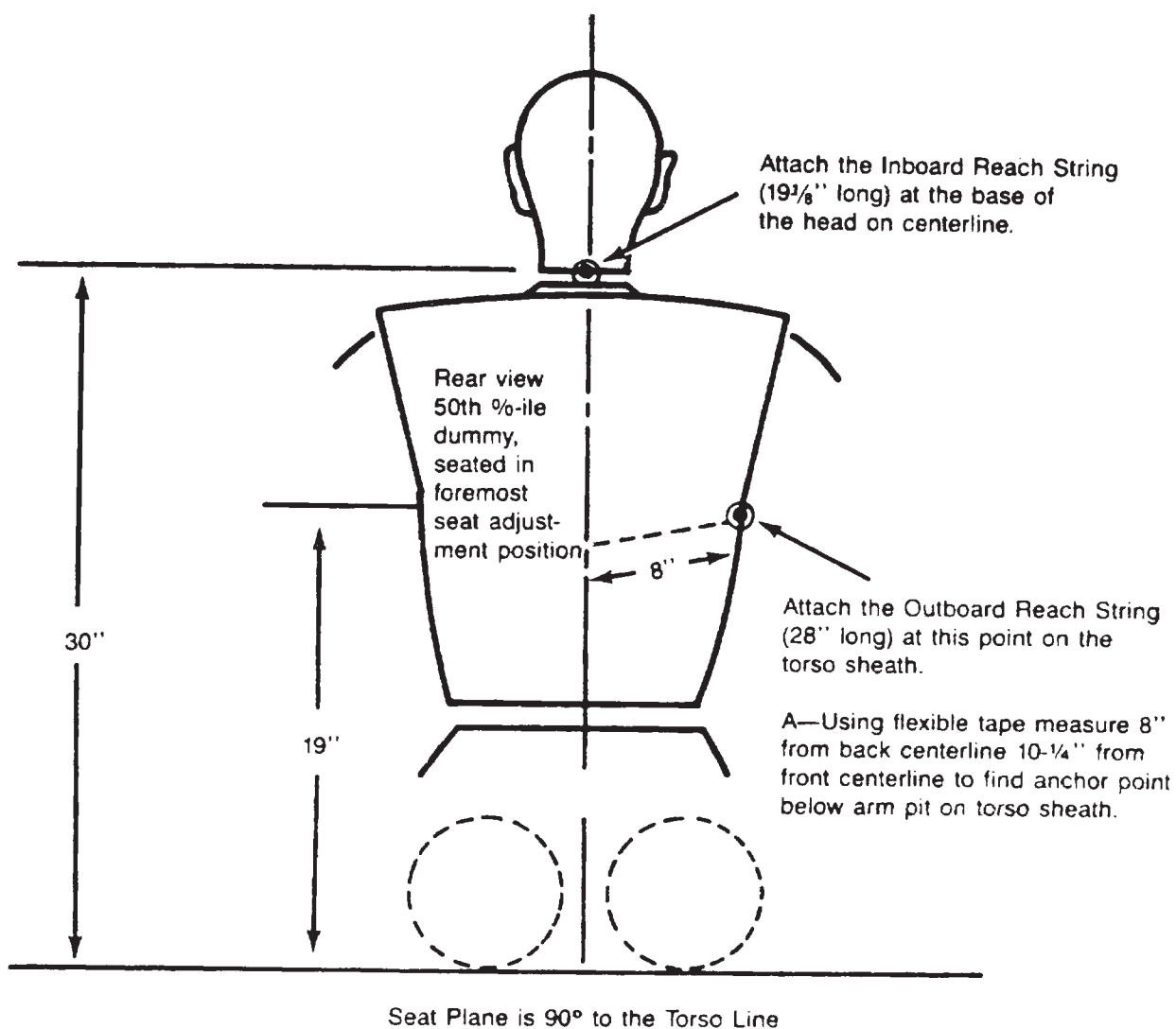


Figure 3 — Location of Anchoring Points for Latchplate Reach Limiting Chains or Strings to Test for Latchplate Accessibility Using Subpart E Test Device

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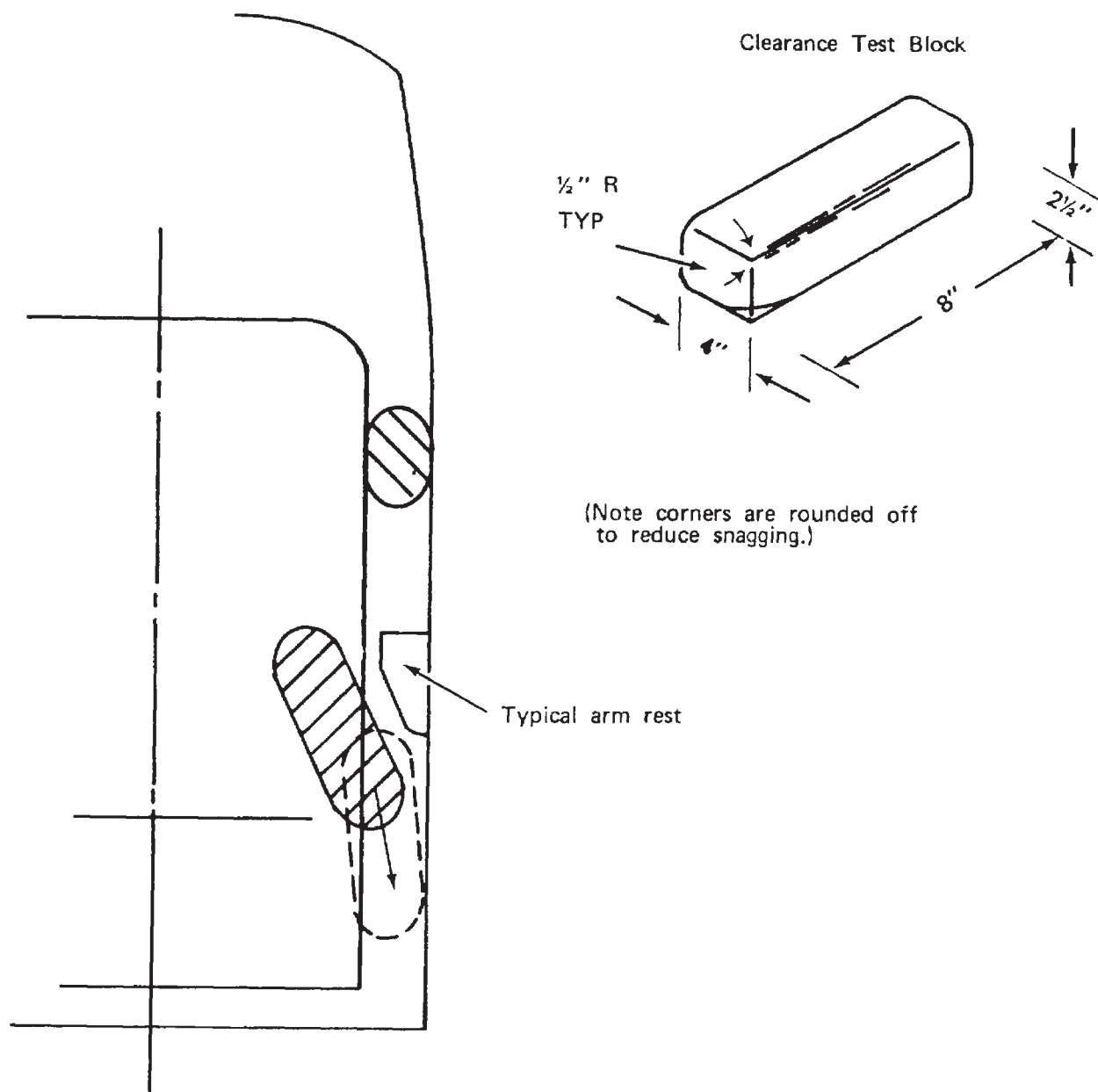


Figure 4 — USE OF CLEARANCE TEST BLOCK TO DETERMINE HAND/ARM ACCESS

Regulations

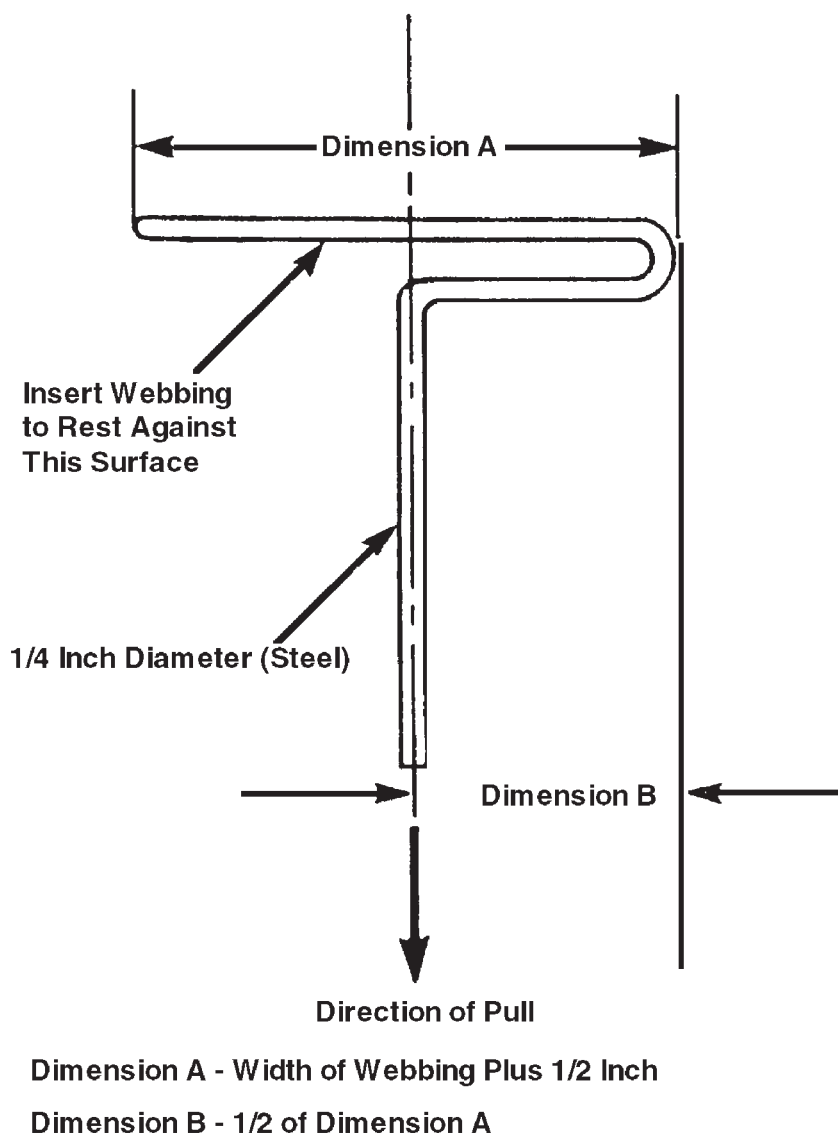
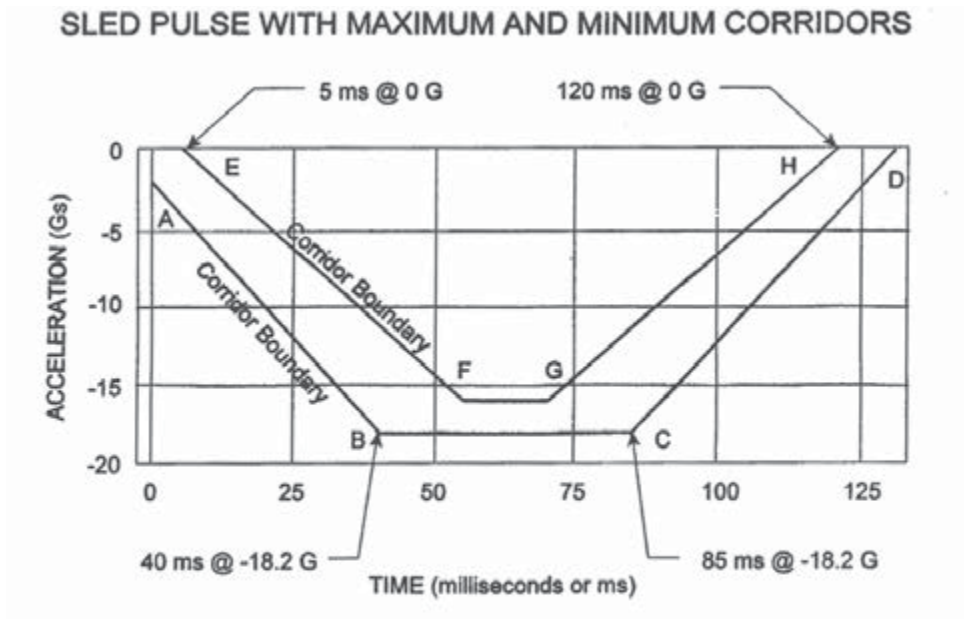


Figure 5. - Wedding Tension Pull Device

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Sled pulse for $\Delta V = 30(+0,-2)$ mph. The Time Zero for the test is defined by the point when the sled acceleration achieves -0.5 G's.

SLED PULSE AND COORDINATES		
REFERENCE POINT	t (ms)	ACCELERATION (G)
A	0	-2
B	40	-18.2
C	85	-18.2
D	130	0
E	5	0
F	55	-16
G	70	-16
H	120	0.00

Figure 6 - Sled Pulse and Coordinates

Regulations

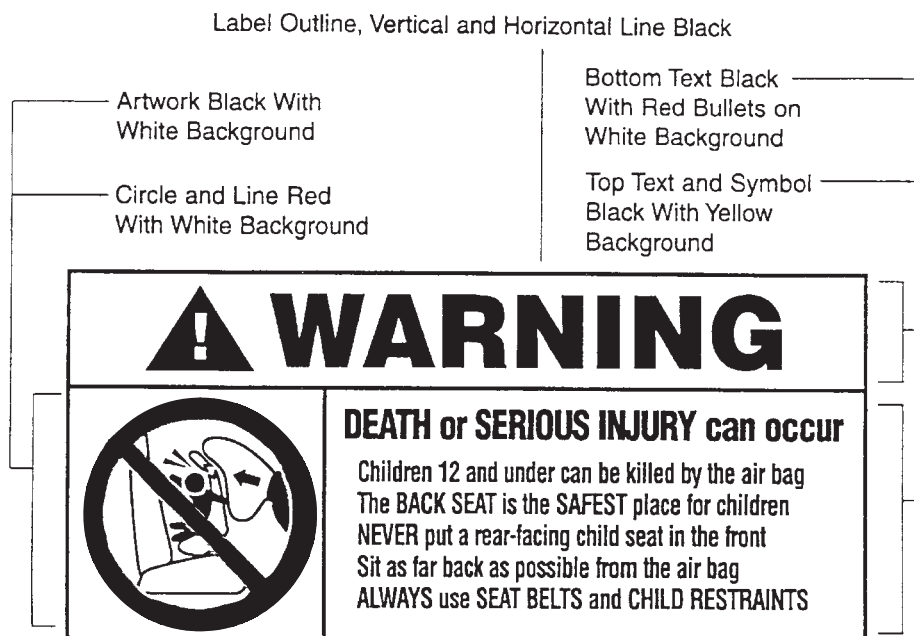


Figure 6a. Sun Visor label Visible When Visor is in Down Position.

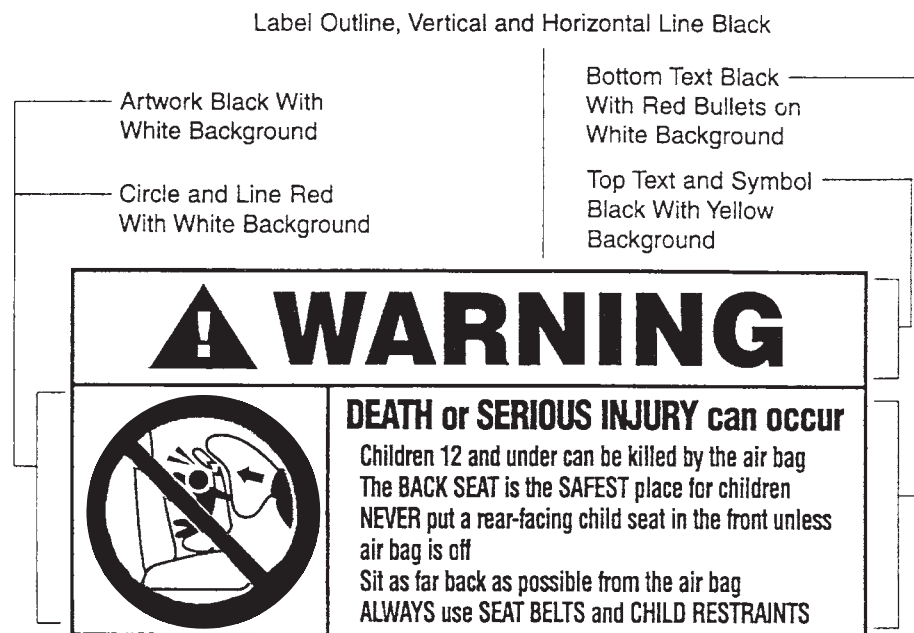


Figure 6b. Sun Visor Label Visible When Visor is in Down Position.

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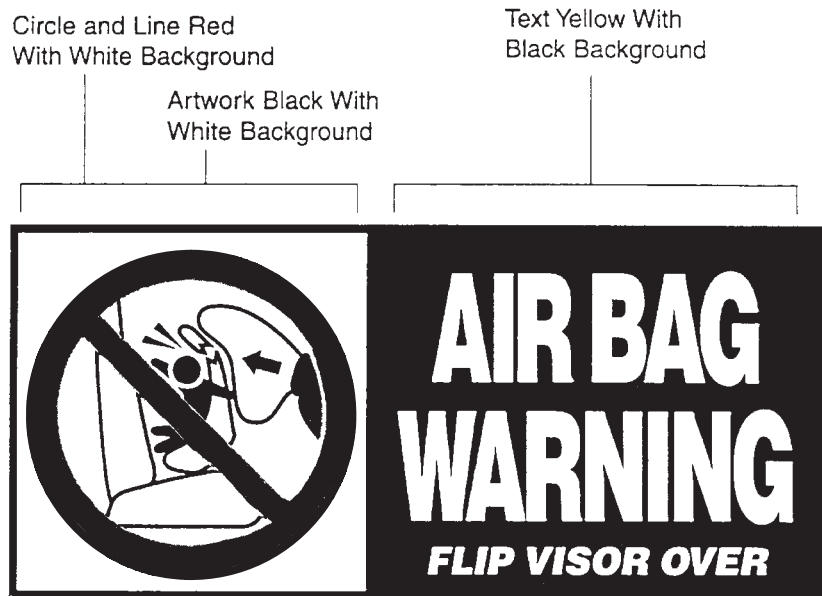


Figure 6c. Sun Visor Label Visible When Visor is in Up Position.

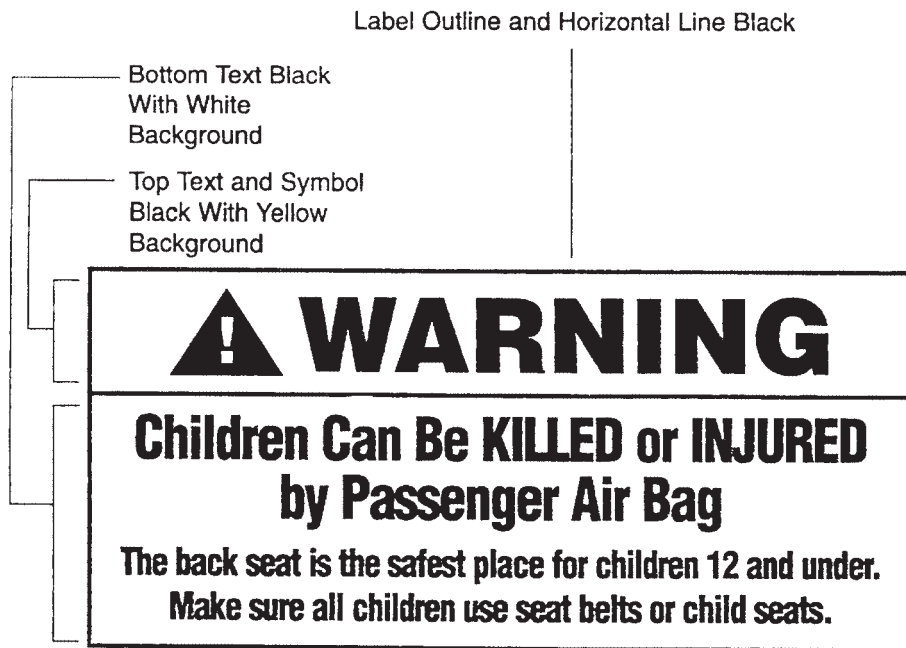


Figure 7. Removable Label on Dash.

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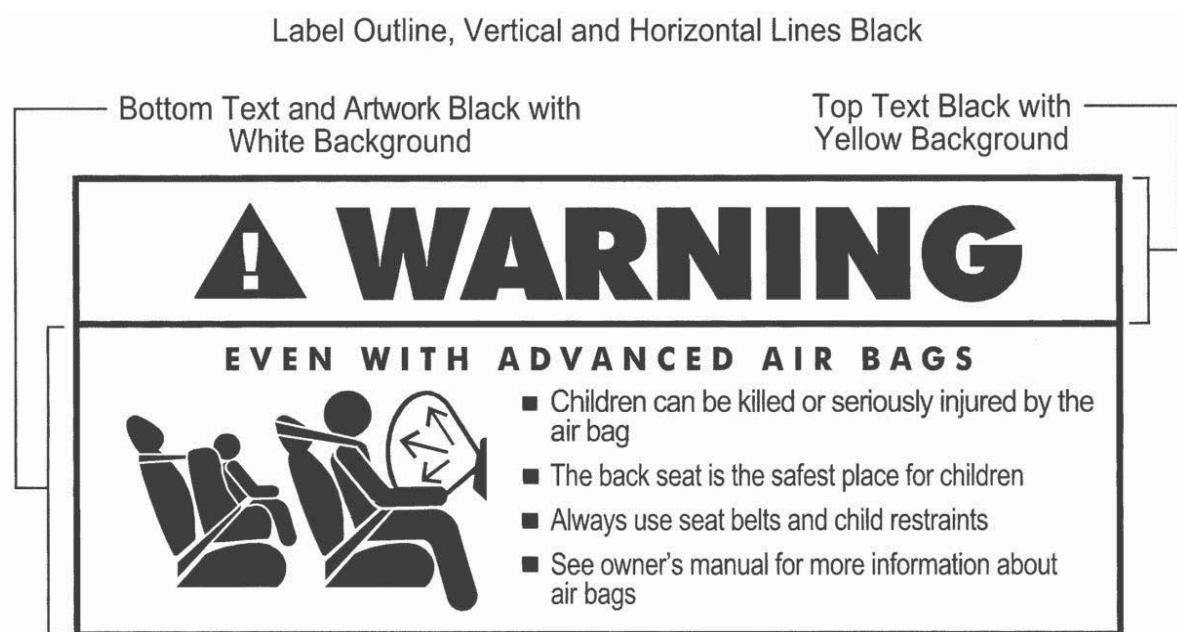


Figure 8. Sun Visor Label Visible When Visor is in Down Position.



Figure 9. Removable Label on Dash.

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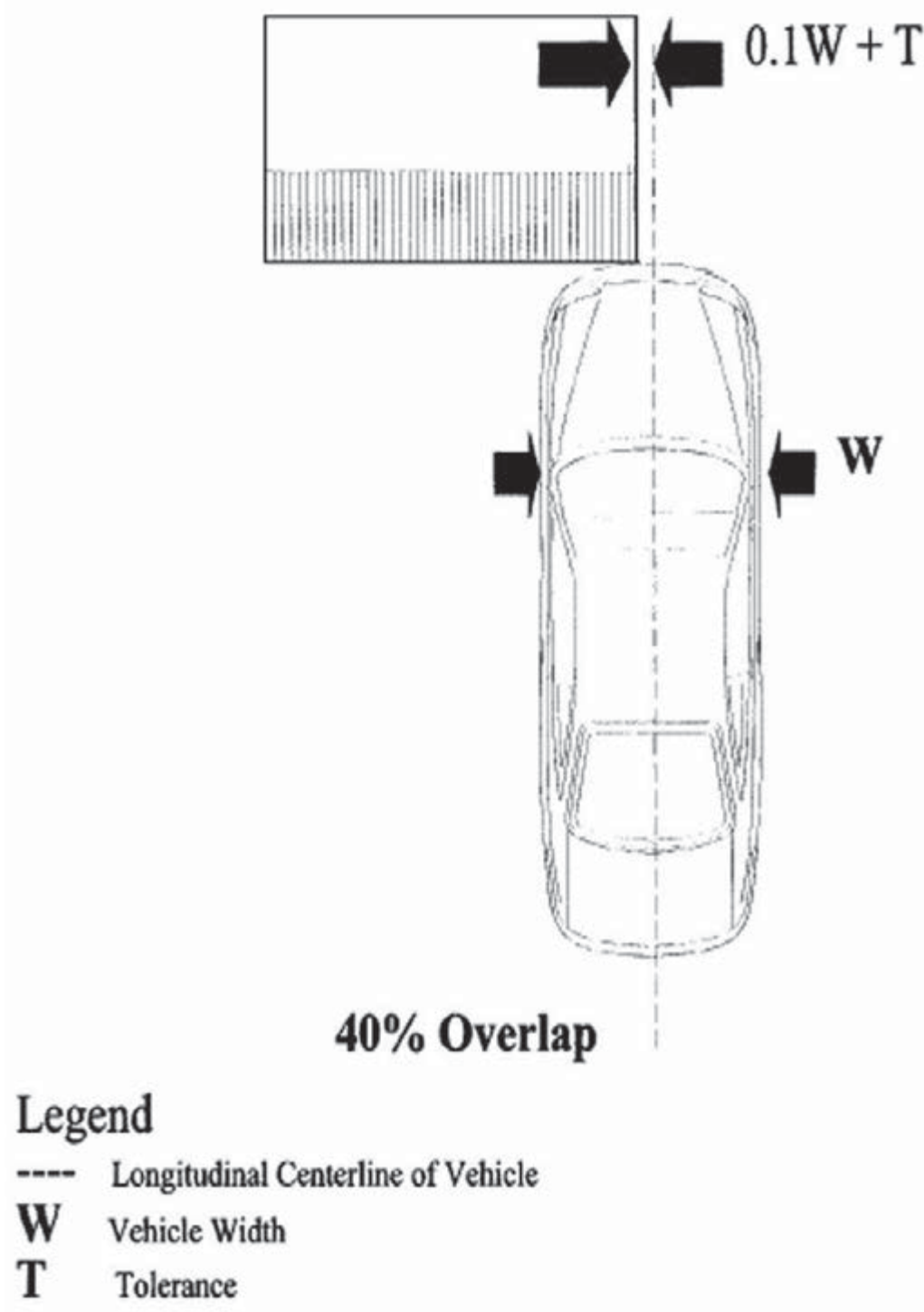


Figure 10 Configuration for Frontal Offset Deformable Barrier Test

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Figure 11. Sun visor Label Visible When Visor in Down Position.

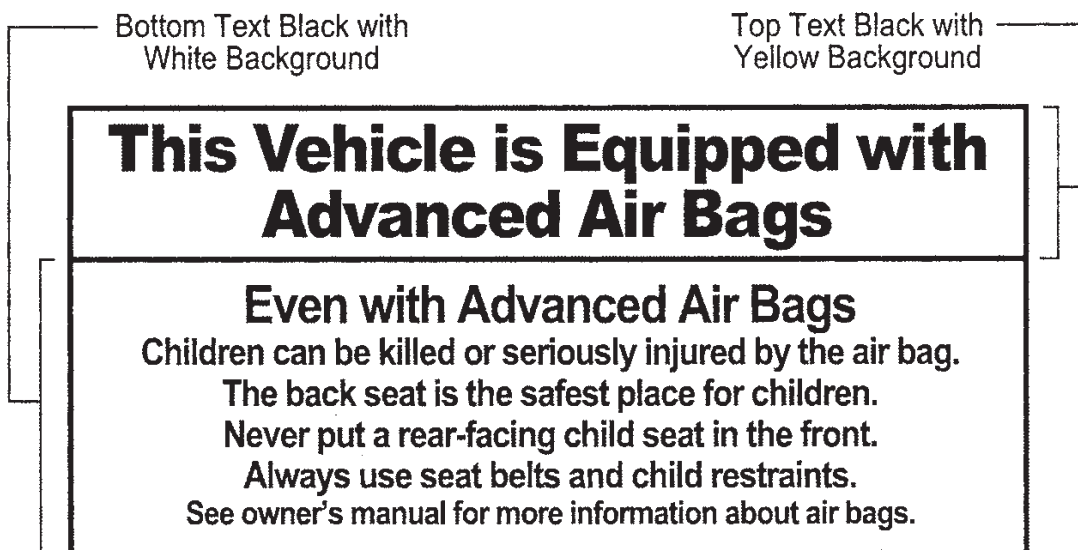


Figure 12. Removable Label on Dash.

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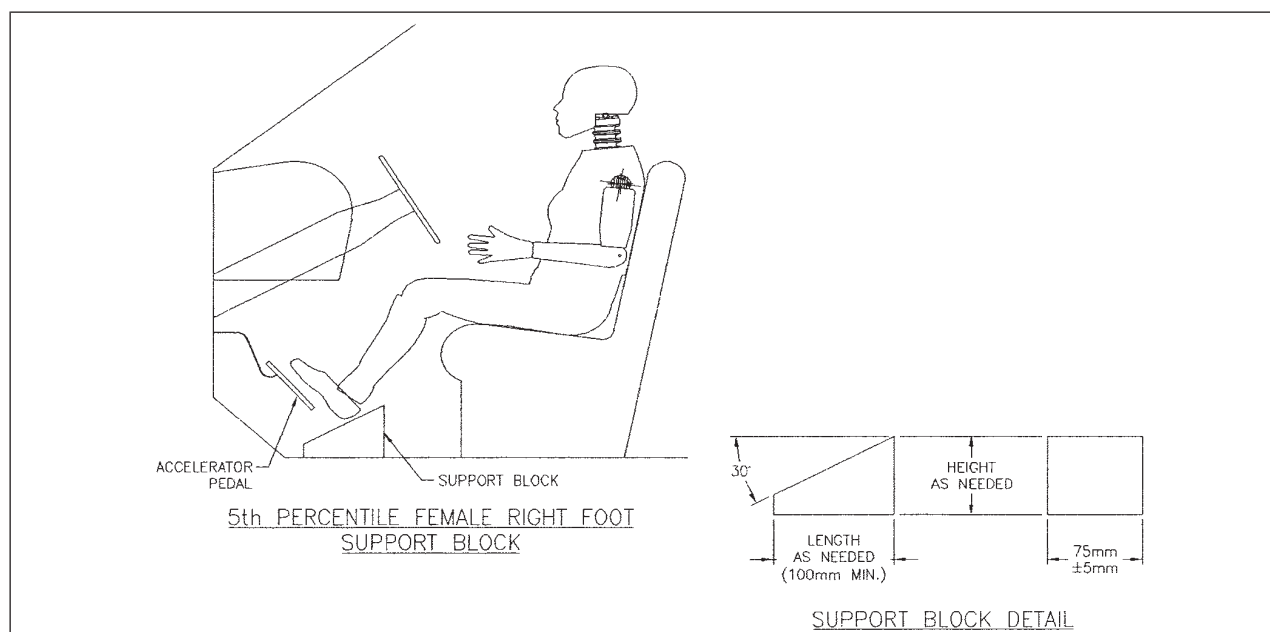


Figure 13.

§571.209 Standard No. 209; Seat belt assemblies.

S1. Purpose and scope. This standard specifies requirements for seat belt assemblies.

S2. Application. This standard applies to seat belt assemblies for use in passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. Definitions.

Adjustment hardware means any or all hardware designed for adjusting the size of a seat belt assembly to fit the user, including such hardware that may be integral with a buckle, attachment hardware, or retractor.

Attachment hardware means any or all hardware designed for securing the webbing of a seat belt assembly to a motor vehicle.

Automatic-locking retractor means a retractor incorporating adjustment hardware by means of a positive self-locking mechanism which is capable when locked of withstanding restraint forces.

Buckle means a quick release connector which fastens a person in a seat belt assembly.

Emergency-locking retractor means a retractor incorporating adjustment hardware by means of a locking mechanism that is activated by vehicle acceleration, webbing movement relative to the vehicle, or other automatic action during an emergency and is capable when locked of withstanding restraint forces.

Hardware means any metal or rigid plastic part of a seat belt assembly.

Load-limiter means a seat belt assembly component or feature that controls tension on the seat belt to modulate the forces that are imparted to occupants restrained by the belt assembly during a crash.

Nonlocking retractor means a retractor from which the webbing is extended to essentially its full length by

a small external force, which provides no adjustment for assembly length, and which may or may not be capable of sustaining restraint forces at maximum webbing extension.

Pelvic restraint means a seat belt assembly or portion thereof intended to restrain movement of the pelvis.

Retractor means a device for storing part or all of the webbing in a seat belt assembly.

Seat back retainer means the portion of some seat belt assemblies designed to restrict forward movement of a seat back.

Seat belt assembly means any strap, webbing, or similar device designed to secure a person in a motor vehicle in order to mitigate the results of any accident, including all necessary buckles and other fasteners, and all hardware designed for installing such seat belt assembly in a motor vehicle.

Strap means a narrow nonwoven material used in a seat belt assembly in place of webbing.

Type 1 seat belt assembly is a lap belt for pelvic restraint.

Type 2 seat belt assembly is a combination of pelvic and upper torso restraints.

Type 2a shoulder belt is an upper torso restraint for use only in conjunction with a lap belt as a Type 2 seat belt assembly.

Upper torso restraint means a portion of a seat belt assembly intended to restrain movement of the chest and shoulder regions.

Webbing means a narrow fabric woven with continuous filling yarns and finished selvages.

S4. Requirements.

S4.1(a) [Reserved]

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(b) **Single occupancy.** A seat belt assembly shall be designed for use by one, and only one, person at any one time.

(c) **Upper torso restraint.** A Type 2 seat belt assembly shall provide upper torso restraint without shifting the pelvic restraint into the abdominal region. An upper torso restraint shall be designed to minimize vertical forces on the shoulders and spine. Hardware for upper torso restraint shall be so designed and located in the seat belt assembly that the possibility of injury to the occupant is minimized.

A Type 2a shoulder belt shall comply with applicable requirements for a Type 2 seat belt assembly in S4.1 to S4.4, inclusive.

(d) **Hardware.** All hardware parts which contact under normal usage a person, clothing, or webbing shall be free from burrs and sharp edges.

(e) **Release.** A Type 1 or Type 2 seat belt assembly shall be provided with a buckle or buckles readily accessible to the occupant to permit his easy and rapid removal from the assembly. Buckle release mechanism shall be designed to minimize the possibility of accidental release. A buckle with release mechanism in the latched position shall have only one opening in which the tongue can be inserted on the end of the buckle designed to receive and latch the tongue.

(f) **Attachment hardware.** A seat belt assembly shall include all hardware necessary for installation in a motor vehicle in accordance with SAE Recommended Practice J800c (1973) (incorporated by reference, see §571.5). However, seat belt assemblies designed for installation in motor vehicles equipped with seat belt assembly anchorages that do not require anchorage nuts, plates, or washers, need not have such hardware, but shall have $\frac{7}{16}$ -20 UNF-2A or $\frac{1}{2}$ -13 UNC-2A attachment bolts or equivalent metric hardware. The hardware shall be designed to prevent attachment bolts and other parts from becoming disengaged from the vehicle while in service. Reinforcing plates or washers furnished for universal floor, installations shall be of steel, free from burrs and sharp edges on the peripheral edges adjacent to the vehicle, at least 1.5 mm in thickness and at least 2580 mm² in projected area. The distance between any edge of the plate and the edge of the bolt hole shall be at least 15 mm. Any corner shall be rounded to a radius of not less than 6 mm or cut so that no corner angle is less than 135° and no side is less than 6 mm in length.

(g) **Adjustment.**(1) A Type 1 or Type 2 seat belt assembly shall be capable of adjustment to fit occupants whose dimensions and weight range from those of a 5th-percentile adult female to those of a 95th-percentile adult male. The seat belt assembly shall have either an automatic-locking retractor, an emergency-locking retractor, or an adjusting device that is within the reach of the occupant.

(2) A Type 1 or Type 2 seat belt assembly for use in a vehicle having seats that are adjustable shall conform to the requirements of S4.1(g)(1) regardless of seat position. However, if a seat has a back that is separately adjustable, the requirements of S4.1(g)(1) need be met only with the seat back in the manufacturer's nominal design riding position.

(3) The adult occupants referred to in S4.1(g)(1) shall have the following measurements:

	5th-percentile adult female	95th-percentile adult male
Weight	46.3 kg	97.5 kg.
Erect sitting height	785 mm	965 mm.
Hip breadth (sitting)	325 mm	419 mm.
Hip circumference (sitting)	925 mm	1199 mm.
Waist circumference (sitting)	599 mm	1080 mm.
Chest depth	190 mm	267 mm.
Chest circumference:		
Nipple	775 mm	1130 mm.
Upper	757 mm	1130 mm.
Lower	676 mm	1130 mm.

(h) **Webbing.** The ends of webbing in a seat belt assembly shall be protected or treated to prevent raveling. The end of webbing in a seat belt assembly having a metal-to-metal buckle that is used by the occupant to adjust the size of the assembly shall not pull out of the adjustment hardware at maximum size adjustment. Provision shall be made for essentially unimpeded movement of webbing routed between a seat back and seat cushion and attached to a retractor located behind the seat.

(i) **Strap.** A strap used in a seat belt assembly to sustain restraint forces shall comply with the requirements for webbing in S4.2, and if the strap is made from a rigid material, it shall comply with applicable requirements in S4.2, S4.3, and S4.4.

(j) **Marking.** Each seat belt assembly shall be permanently and legibly marked or labeled with year of manufacture, model, and name or trademark of manufacturer or distributor, or of importer if manufactured outside the United States. A model shall consist of a single combination of webbing having a specific type of fiber weave and construction, and hardware having a specific design. Webbing of various colors may be included under the same model, but webbing of each color shall comply with the requirements for webbing in S4.2.

(k) **Installation instructions.** A seat belt assembly, other than a seat belt assembly installed in a motor vehicle by an automobile manufacturer, shall be accompanied by an instruction sheet providing sufficient information for installing the assembly in a motor vehicle. The installation instructions shall state whether the assembly is for universal installation or for installation only in specifically stated motor vehicles, and shall include at least those items specified in SAE Recommended Practice J800c (1973) (incorporated by reference, see §571.5). If the assembly is for use only in specifically stated motor vehicles, the assembly shall either be permanently and legibly marked or labeled with the following statement, or the instruction sheet shall include the following statement:

This seat belt assembly is for use only in [insert specific seating position(s), e.g., "front right"] in [insert specific vehicle make(s) and model(s)].

(l) **Usage and maintenance instructions.** A seat belt assembly or retractor shall be accompanied by written instructions for the proper use of the assembly, stressing

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particularly the importance of wearing the assembly snugly and properly located on the body, and on the maintenance of the assembly and periodic inspection of all components. The instructions shall show the proper manner of threading webbing in the hardware of seat belt assemblies in which the webbing is not permanently fastened. Instructions for a nonlocking retractor shall include a caution that the webbing must be fully extended from the retractor during use of the seat belt assembly unless the retractor is attached to the free end of webbing which is not subjected to any tension during restraint of an occupant by the assembly. Instructions for Type 2a shoulder belt shall include a warning that the shoulder belt is not to be used without a lap belt.

(m) **Workmanship.** Seat belt assemblies shall have good workmanship in accordance with good commercial practice.

S4.2 Requirements for webbing.

(a) **Width.** The width of the webbing in a seat belt assembly shall be not less than 46 mm, except for portions that do not touch a 95th percentile adult male with the seat in any adjustment position and the seat back in the manufacturer's nominal design riding position when measured under the conditions prescribed in S5.1(a).

(b) **Breaking strength.** The webbing in a seat belt assembly shall have not less than the following breaking strength when tested by the procedures specified in S5.1(b): Type 1 seat belt assembly—26,689 N; Type 2 seat belt assembly—22,241 N for webbing in pelvic restraint and 17,793 N for webbing in upper torso restraint.

(c) **Elongation.** Except as provided in S4.5, the webbing in a seat belt assembly shall not extend to more than the following elongation when subjected to the specified forces in accordance with the procedure specified in S5.1(c): Type 1 seat belt assembly—20 percent at 11,120 N; Type 2 seat belt assembly 30 percent at 11,120 N for webbing in pelvic restraint and 40 percent at 11,120 N for webbing in upper torso restraint.

(d) **Resistance to abrasion.** The webbing of a seat belt assembly, after being subjected to abrasion as specified in S5.1(d) or S5.3(c), shall have a breaking strength of not less than 75 percent of the breaking strength listed in S4.2(b) for that type of belt assembly.

(e) **Resistance to light.** The webbing in a seat belt assembly after exposure to the light of a carbon arc and tested by the procedure specified in S5.1(e) shall have a breaking strength not less than 60 percent of the strength before exposure to the carbon arc and shall have a color retention not less than No. 2 on the AATCC Gray Scale for Evaluating Change in Color (incorporated by reference, see §571.5).

(f) **Resistance to micro-organisms.** The webbing in a seat belt assembly after being subjected to micro-organisms and tested by the procedures specified in S5.1(f) shall have a breaking strength not less than 85 percent of the strength before subjection to micro-organisms.

S4.3 Requirements for hardware.

(a) **Corrosion resistance.** (1) Attachment hardware of a seat belt assembly after being subjected to the con-

ditions specified in S5.2(a) shall be free of ferrous corrosion on significant surfaces except for permissible ferrous corrosion at peripheral edges or edges of holes on underfloor reinforcing plates and washers. Alternatively, such hardware at or near the floor shall be protected against corrosion by at least an electrodeposited coating of nickel, or copper and nickel with at least a service condition number of SC2, and other attachment hardware shall be protected by an electrodeposited coating of nickel, or copper and nickel with a service condition number of SC1, in accordance with ASTM B456-79 (incorporated by reference, see §571.5), but such hardware shall not be racked for electroplating in locations subjected to maximum stress.

(2) Surfaces of buckles, retractors and metallic parts, other than attachment hardware, of a seat belt assembly after subjection to the conditions specified in S5.2(a) shall be free of ferrous or nonferrous corrosion which may be transferred, either directly or by means of the webbing, to the occupant or his clothing when the assembly is worn. After test, buckles shall conform to applicable requirements in paragraphs (d) to (g) of this section.

(b) **Temperature resistance.** Plastic or other non-metallic hardware parts of a seat belt assembly when subjected to the conditions specified in S5.2(b) shall not warp or otherwise deteriorate to cause the assembly to operate improperly or fail to comply with applicable requirements in this section and S4.4.

(c) **Attachment hardware.** (1) Eye bolts, shoulder bolts, or other bolt used to secure the pelvic restraint of seat belt assembly to a motor vehicle shall withstand a force of 40,034 N when tested by the procedure specified in S5.2(c)(1), except that attachment bolts of a seat belt assembly designed for installation in specific models of motor vehicles in which the ends of two or more seat belt assemblies cannot be attached to the vehicle by a single bolt shall have breaking strength of not less than 22,241 N.

(2) Other attachment hardware designed to receive the ends of two seat belt assemblies shall withstand a tensile force of at least 26,689 N without fracture of a section when tested by the procedure specified in S5.2(c)(2).

(3) A seat belt assembly having single attachment hooks of the quick-disconnect type for connecting webbing to an eye bolt shall be provided with a retaining latch or keeper which shall not move more than 2 mm in either the vertical or horizontal direction when tested by the procedure specified in S5.2(c)(3).

(d) **Buckle release.** (1) The buckle of a Type 1 or Type 2 seat belt assembly shall release when a force of not more than 133 N is applied.

(2) A buckle designed for pushbutton application of buckle release force shall have a minimum area of 452 mm² with a minimum linear dimension of 10 mm for applying the release force, or a buckle designed for lever application of buckle release force shall permit the insertion of a cylinder 10 mm in diameter and 38 mm in length to at least the midpoint of the cylinder along the cylinder's entire length in the actuation portion of the buckle release. A buckle having other design for release

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shall have adequate access for two or more fingers to actuate release.

(3) The buckle of a Type 1 or Type 2 seat belt assembly shall not release under a compressive force of 1779 N applied as prescribed in paragraph S5.2(d)(3). The buckle shall be operable and shall meet the applicable requirement of paragraph S4.4 after the compressive force has been removed.

(e) **Adjustment force.** The force required to decrease the size of a seat belt assembly shall not exceed 49 N when measured by the procedure specified in S5.2(e).

(f) **Tilt-lock adjustment.** The buckle of a seat belt assembly having tilt-lock adjustment shall lock the webbing when tested by the procedure specified in S5.2(f) at an angle of not less than 30 degrees between the base of the buckle and the anchor webbing.

(g) **Buckle latch.** The buckle latch of a seat belt assembly when tested by the procedure specified in S5.2(g) shall not fail, nor gall or wear to an extent that normal latching and unlatching is impaired, and a metal-to-metal buckle shall separate when in any position of partial engagement by a force of not more than 22 N.

(h) **Nonlocking retractor.** The webbing of a seat belt assembly shall extend from a nonlocking retractor within 6 mm of maximum length when a tension is applied as prescribed in S5.2(h). A nonlocking retractor on upper torso restraint shall be attached to the nonadjustable end of the assembly, the reel of the retractor shall be easily visible to an occupant while wearing the assembly, and the maximum retraction force shall not exceed 5 N in any strap or webbing that contacts the shoulder when measured by the procedure specified in S5.2(h), unless the retractor is attached to the free end of webbing which is not subjected to any tension during restraint of an occupant by the assembly.

(i) **Automatic-locking retractor.** The webbing of a seat belt assembly equipped with an automatic locking retractor, when tested by the procedure specified in S5.2(i), shall not move more than 25 mm between locking positions of the retractor, and shall be retracted with a force under zero acceleration of not less than 3 N when attached to pelvic restraint, and not less than 2 N nor more than 5 N in any strap or webbing that contacts the shoulders of an occupant when the retractor is attached to upper torso restraint. An automatic locking retractor attached to upper torso restraint shall not increase the restraint on the occupant of the seat belt assembly during use in a vehicle traveling over rough roads as prescribed in S5.2(i).

(j) **Emergency-locking retractor.**

(1) **For seat belt assemblies manufactured before February 22, 2007.** Except for manufacturers that, at the manufacturer's option, voluntarily choose to comply with S4.3(j)(2) during this period (with said option irrevocably selected prior to, or at the time of, certification of the seat belt assembly), an emergency-locking retractor of a Type 1 or Type 2 seat belt assembly, when tested in accordance with the procedures specified in paragraph S5.2(j)(1)—

(i) Shall lock before the webbing extends 25 mm when the retractor is subjected to an acceleration of 7 m/s^2 (0.7 g);

(ii) Shall not lock, if the retractor is sensitive to webbing withdrawal, before the webbing extends 51 mm when the retractor is subjected to an acceleration of 3 m/s^2 (0.3 g) or less;

(iii) Shall not lock, if the retractor is sensitive to vehicle acceleration, when the retractor is rotated in any direction to any angle of 15° or less from its orientation in the vehicle;

(iv) Shall exert a retractive force of at least 3 N under zero acceleration when attached only to the pelvic restraint;

(v) Shall exert a retractive force of not less than 1 N and not more than 5 N under zero acceleration when attached only to an upper torso restraint;

(vi) Shall exert a retractive force not less than 1 N and not more than 7 N under zero acceleration when attached to a strap or webbing that restrains both the upper torso and the pelvis.

(2) **For seat belt assemblies manufactured on or after February 22, 2007 and for manufacturers opting for early compliance.** An emergency-locking retractor of a Type 1 or Type 2 seat belt assembly, when tested in accordance with the procedures specified in paragraph S5.2(j)(2)—

(i) Shall under zero acceleration loading—

(A) Exert a retractive force of not less than 1 N and not more than 7 N when attached to a strap or webbing that restrains both the upper torso and the pelvis;

(B) Exert a retractive force not less than 3 N when attached only to the pelvic restraint; and

(C) Exert a retractive force of not less than 1 N and not more than 5 N when attached only to an upper torso restraint.

(D) For a retractor sensitive to vehicle acceleration, lock when tilted at any angle greater than 45 degrees from the angle at which it is installed in the vehicle or meet the requirements of S4.3(j)(2)(ii).

(E) For a retractor sensitive to vehicle acceleration, not lock when the retractor is rotated in any direction to any angle of 15 degrees or less from its orientation in the vehicle.

(ii) Shall lock before the webbing payout exceeds the maximum limit of 25 mm when the retractor is subjected to an acceleration of 0.7 g under the applicable test conditions of S5.2(j)(2)(iii)(A) or (B). The retractor is determined to be locked when the webbing belt load tension is at least 35 N.

(iii) For a retractor sensitive to webbing withdrawal, shall not lock before the webbing payout extends to the minimum limit of 51 mm when the retractor is subjected to an acceleration no greater than 0.3 g under the test condition of S5.2(j)(2)(iii)(C).

(k) **Performance of retractor.** A retractor used on a seat belt assembly after subjection to the tests specified in S5.2(k) shall comply with applicable requirements in paragraphs (h) to (j) of this section and S4.4, except that

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the retraction force shall be not less than 50 percent of its original retraction force.

S4.4 Requirements for assembly performance.

(a) **Type I seat belt assembly.** Except as provided in S4.5, the complete seat belt assembly including webbing, straps, buckles, adjustment and attachment hardware, and retractors shall comply with the following requirements when tested by the procedures specified in S5.3(a):

(1) The assembly loop shall withstand a force of not less than 22,241 N; that is, each structural component of the assembly shall withstand a force of not less than 11,120 N.

(2) The assembly loop shall extend not more than 7 inches or 178 mm when subjected to a force of 22,241 N; that is, the length of the assembly between anchorages shall not increase more than 356 mm.

(3) Any webbing cut by the hardware during test shall have a breaking strength at the cut of not less than 18,683 N.

(4) Complete fracture through any solid section of metal attachment hardware shall not occur during test.

(b) **Type 2 seat belt assembly.** Except as provided in S4.5, the components of a Type 2 seat belt assembly including webbing, straps, buckles, adjustment and attachment hardware, and retractors shall comply with the following requirements when tested by the procedure specified in S5.3(b):

(1) The structural components in the pelvic restraint shall withstand a force of not less than 11,120 N.

(2) The structural components in the upper torso restraint shall withstand a force of not less than 6,672 N.

(3) The structural components in the assembly that are common to pelvic and upper torso restraints shall withstand a force of not less than 13,345 N.

(4) The length of the pelvic restraint between anchorages shall not increase more than 508 mm when subjected to a force of 11,120 N.

(5) The length of the upper torso restraint between anchorages shall not increase more than 508 mm when subjected to a force of 6,672 N.

(6) Any webbing cut by the hardware during test shall have a breaking strength of not less than 15,569 N at a cut in webbing of the pelvic restraint, or not less than 12,455 N at a cut in webbing of the upper torso restraint.

(7) Complete fracture through any solid section of metal attachment hardware shall not occur during test.

S4.5 Load-limiter.(a) A Type 1 or Type 2 seat belt assembly that includes a load-limiter is not required to comply with the elongation requirements of S4.2(c), S4.4(a)(2), S4.4(b)(4) or S4.4(b)(5).

(b) A seat belt assembly that includes a load limiter and that does not comply with the elongation requirements of this standard may be installed in motor vehicles at any designated seating position that is subject to the requirements of S5.1 of Standard No. 208 (§571.208).

S4.6 Manual belts subject to crash protection requirements of Standard No. 208.

(a)(1) A manual seat belt assembly, which is subject to the requirements of S5.1 of Standard No. 208 (49 CFR

571.208) by virtue of any provision of Standard No. 208 other than S4.1.2.1(c)(2) of that standard, does not have to meet the requirements of S4.2(a)-(f) and S4.4 of this standard.

(2) A manual seat belt assembly subject to the requirements of S5.1 of Standard No. 208 (49 CFR 571.208) by virtue of S4.1.2.1(c)(2) of Standard No. 208 does not have to meet the elongation requirements of S4.2(c), S4.4(a)(2), S4.4(b)(4), and S4.4(b)(5) of this standard.

S5. Demonstration procedures.

S5.1 Webbing—(a) **Width.** The width of webbing from three seat belt assemblies shall be measured after conditioning for at least 24 hours in an atmosphere having relative humidity between 48 and 67 percent and a temperature of $23^{\circ} \pm 2^{\circ} \text{C}$. The tension during measurement of width shall be not more than 22 N on webbing from a Type 1 seat belt assembly, and 9786 N ± 450 N on webbing from a Type 2 seat belt assembly. The width of webbing from a Type 2 seat belt assembly may be measured during the breaking strength test described in paragraph (b) of this section.

(b) **Breaking strength.** Webbing from three seat belt assemblies shall be conditioned in accordance with paragraph (a) of this section and tested for breaking strength in a testing machine of capacity verified to have an error of not more than one percent in the range of the breaking strength of the webbing in accordance with ASTM E4-79 (incorporated by reference, see §571.5). The machine shall be equipped with split drum grips illustrated in Figure 1, having a diameter between 51 and 102 mm. The rate of grip separation shall be between 51 and 102 mm per minute. The distance between the centers of the grips at the start of the test shall be between 102 and 254 mm. After placing the specimen in the grips, the webbing shall be stretched continuously at a uniform rate to failure. Each value shall be not less than the applicable breaking strength requirement in S4.2(b), but the median value shall be used for determining the retention of breaking strength in paragraphs (d), (e) and (f) of this section.

(c) **Elongation.** Elongation shall be measured during the breaking strength test described in paragraph (b) of this section by the following procedure: A preload between 196 N and 245 N shall be placed on the webbing mounted in the grips of the testing machine and the needle points of an extensometer, in which the points remain parallel during test, are inserted in the center of the specimen. Initially the points shall be set at a known distance apart between 102 and 203 mm. When the force on the webbing reaches the value specified in S4.2(c), the increase in separation of the points of the extensometer shall be measured and the percent elongation shall be calculated to the nearest 0.5 percent. Each value shall be not more than the appropriate elongation requirement in S4.2(c).

(d) **Resistance to abrasion.** The webbing from three seat belt assemblies shall be tested for resistance to abrasion by rubbing over the hexagon bar prescribed in Figure 2 in the following manner: The webbing shall be mounted in the apparatus shown schematically in Figure 2. One end of the webbing (A) shall be attached to a mass (B) of 2.35 kg ± 0.05 kg, except that a mass of 1.5 kg ± 0.05 kg shall be used for webbing in pelvic and upper torso restraints of a belt assembly used in a child restraint system. The

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webbing shall be passed over the two new abrading edges of the hexagon bar (C) and the other end attached to an oscillating drum (D) which has a stroke of 330 mm. Suitable guides shall be used to prevent movement of the webbing along the axis of hexagonal bar C. Drum D shall be oscillated for 5,000 strokes or 2,500 cycles at a rate of 60 ± 2 strokes per minute or 30 ± 1 cycles per minute. The abraded webbing shall be conditioned as prescribed in paragraph (a) of this section and tested for breaking strength by the procedure described in paragraph (b) of this section. The median values for the breaking strengths determined on abraded and unabraded specimens shall be used to calculate the percentage of breaking strength retained.

(e) **Resistance to light.** Webbing at least 508 mm in length from three seat belt assemblies shall be suspended vertically on the inside of the specimen track in a Type E carbon-arc light exposure apparatus described in ASTM G23-81 (incorporated by reference, see §571.5), except that the filter used for 100 percent polyester yarns shall be chemically strengthened soda-lime glass with a transmittance of less than 5 percent for wave lengths equal to or less than 305 nanometers and 90 percent or greater transmittance for wave lengths of 375 to 800 nanometers. The apparatus shall be operated without water spray at an air temperature of $60^\circ \pm 2^\circ\text{Celsius}$ ($^\circ\text{C}$) measured at a point 25 ± 5 mm outside the specimen rack and midway in height. The temperature sensing element shall be shielded from radiation. The specimens shall be exposed to light from the carbon-arc for 100 hours and then conditioned as prescribed in paragraph (a) of this section. The colorfastness of the exposed and conditioned specimens shall be determined on the AATCC Gray Scale for Evaluating Change in Color (incorporated by reference, see §571.5). The breaking strength of the specimens shall be determined by the procedure prescribed in paragraph (b) of this section. The median values for the breaking strengths determined on exposed and unexposed specimens shall be used to calculate the percentage of breaking strength retained.

(f) **Resistance to micro-organisms.** Webbing at least 508 millimeters (mm) in length from three seat belt assemblies shall first be preconditioned in accordance with appendix A(1) and (2) of AATCC Test Method 30-1981 (incorporated by reference, see §571.5), and then subjected to Test I, "Soil Burial Test" of that test method. After soil-burial for a period of 2 weeks, the specimen shall be washed in water, dried and conditioned as prescribed in paragraph (a) of this section. The breaking strengths of the specimens shall be determined by the procedure prescribed in paragraph (b) of this section. The median values for the breaking strengths determined on exposed and unexposed specimens shall be used to calculate the percentage of breaking strength retained.

NOTE: This test shall not be required on webbing made from material which is inherently resistant to micro-organisms.

S5.2 Hardware.

(a) **Corrosion resistance.** Three seat belt assemblies shall be tested in accordance with ASTM B117-73 (Reapproved 1979) (incorporated by reference, see §571.5). Any surface coating or material not intended for permanent retention on the metal parts during service life shall be

removed prior to preparation of the test specimens for testing. The period of test shall be 50 hours for all attachment hardware at or near the floor, consisting of two periods of 24 hours exposure to salt spray followed by 1 hour drying and 25 hours for all other hardware, consisting of one period of 24 hours exposure to salt spray followed by 1 hour drying. In the salt spray test chamber, the parts from the three assemblies shall be oriented differently, selecting those orientations most likely to develop corrosion on the larger areas. At the end of test, the seat belt assembly shall be washed thoroughly with water to remove the salt. After drying for at least 24 hours under standard laboratory conditions specified in S5.1(a) attachment hardware shall be examined for ferrous corrosion on significant surfaces, that is, all surfaces that can be contacted by a sphere 19 mm in diameter, and other hardware shall be examined for ferrous and nonferrous corrosion which may be transferred, either directly or by means of the webbing, to a person or his clothing during use of a seat belt assembly incorporating the hardware.

NOTE: When attachment and other hardware are permanently fastened, by sewing or other means, to the same piece of webbing, separate assemblies shall be used to test the two types of hardware. The test for corrosion resistance shall not be required for attachment hardware made from corrosion-resistant steel containing at least 11.5 percent chromium or for attachment hardware protected with an electrodeposited coating of nickel, or copper and nickel, as prescribed in S4.3(a). The assembly that has been used to test the corrosion resistance of the buckle shall be used to measure adjustment force, tilt-lock adjustment, and buckle latch in paragraphs (e), (f), and (g), respectively, of this section, assembly performance in S5.3 and buckle release force in paragraph (d) of this section.

(b) **Temperature resistance.** Three seat belt assemblies having plastic or nonmetallic hardware or having retractors shall be subjected to the conditions prescribed in Procedure D of ASTM D756-78 (incorporated by reference, see §571.5). The dimension and weight measurement shall be omitted. Buckles shall be unlatched and retractors shall be fully retracted during conditioning. The hardware parts after conditioning shall be used for all applicable tests in S4.3 and S4.4.

(c) **Attachment hardware.** (1) Attachment bolts used to secure the pelvic restraint of a seat belt assembly to a motor vehicle shall be tested in a manner similar to that shown in Figure 3. The load shall be applied at an angle of 45° to the axis of the bolt through attachment hardware from the seat belt assembly, or through a special fixture which simulates the loading applied by the attachment hardware. The attachment hardware or simulated fixture shall be fastened by the bolt to the anchorage shown in Figure 3, which has a standard $\frac{7}{16}$ -20UNF-2B or $\frac{1}{2}$ -UNF-2B or metric equivalent threaded hole in a hardened steel plate at least 10 mm in thickness. The bolt shall be installed with two full threads exposed from the fully seated position. The appropriate force required by S4.3(c) shall be applied. A bolt from each of three seat belt assemblies shall be tested.

(2) Attachment hardware, other than bolts, designed to receive the ends of two seat belt assemblies shall be subjected to a tensile force of 26,689 N in a manner simulating use. The hardware shall be examined for fracture after the force is released. Attachment hardware from three seat belt assemblies shall be tested.

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(3) Single attachment hook for connecting webbing to any eye bolt shall be tested in the following manner: The hook shall be held rigidly so that the retainer latch or keeper, with cotter pin or other locking device in place, is in a horizontal position as shown in Figure 4. A force of $667 \text{ N} \pm 9 \text{ N}$ shall be applied vertically as near as possible to the free end of the retainer latch, and the movement of the latch by this force at the point of application shall be measured. The vertical force shall be released, and a force of $667 \text{ N} \pm 9 \text{ N}$ shall be applied horizontally as near as possible to the free end of the retainer latch. The movement of the latch by this force at the point of load application shall be measured. Alternatively, the hook may be held in other positions, provided the forces are applied and the movements of the latch are measured at the points indicated in Figure 4. A single attachment hook from each of three seat belt assemblies shall be tested.

(d) **Buckle release.** (1) Three seat belt assemblies shall be tested to determine compliance with the maximum buckle release force requirements, following the assembly test in S5.3. After subjection to the force applicable for the assembly being tested, the force shall be reduced and maintained at 667 N on the assembly loop of a Type 1 seat belt assembly, 334 N on the components of a Type 2 seat belt assembly. The buckle release force shall be measured by applying a force on the buckle in a manner and direction typical of those which would be employed by a seat belt occupant. For push button-release buckles, the force shall be applied at least 3 mm from the edge of the push button access opening of the buckle in a direction that produces maximum releasing effect. For lever-release buckles, the force shall be applied on the centerline of the buckle lever or finger tab in a direction that produces maximum releasing effect.

(2) The area for application of release force on push-button actuated buckle shall be measured to the nearest 30 mm^2 . The cylinder specified in S4.3(d) shall be inserted in the actuation portion of a lever released buckle for determination of compliance with the requirement. A buckle with other release actuation shall be examined for access of release by fingers.

(3) The buckle of a Type 1 or Type 2 seat belt assembly shall be subjected to a compressive force of 1779 N applied anywhere on a test line that is coincident with the center line of the belt extended through the buckle or on any line that extends over the center of the release mechanism and intersects the extended centerline of the belt at an angle of 60° . The load shall be applied by using a curved cylindrical bar having a cross section diameter of 19 mm and a radius of curvature of 152 mm , placed with its longitudinal center line along the test line and its center directly above the point or the buckle to which the load will be applied. The buckle shall be latched, and a tensile force of 334 N shall be applied to the connected webbing during the application of the compressive force. Buckles from three seat belt assemblies shall be tested to determine compliance with paragraph S4.3(d)(3).

(e) **Adjustment Force.** Three seat belt assemblies shall be tested for adjustment force on the webbing at the buckle, or other manual adjusting device normally

used to adjust the size of the assembly. With no load on the anchor end, the webbing shall be drawn through the adjusting device at a rate of $508 \text{ mm} \pm 50 \text{ mm}$ per minute and the maximum force shall be measured to the nearest 1 N after the first 25 mm of webbing movement. The webbing shall be precycled 10 times prior to measurement.

(f) **Tilt-lock adjustment.** This test shall be made on buckles or other manual adjusting devices having tilt-lock adjustment normally used to adjust the size of the assembly. Three buckles or devices shall be tested. The base of the adjustment mechanism and the anchor end of the webbing shall be oriented in planes normal to each other. The webbing shall be drawn through the adjustment mechanism in a direction to increase belt length at a rate of $508 \text{ mm} \pm 50 \text{ mm}$ per minute while the plane of the base is slowly rotated in a direction to lock the webbing. Rotation shall be stopped when the webbing locks, but the pull on the webbing shall be continued until there is a resistance of at least 89 N . The locking angle between the anchor end of the webbing and the base of the adjustment mechanism shall be measured to the nearest degree. The webbing shall be precycled 10 times prior to measurement.

(g) **Buckle latch.** The buckles from three seat belt assemblies shall be opened fully and closed at least 10 times. Then the buckles shall be clamped or firmly held against a flat surface so as to permit normal movement of buckle part, but with the metal mating plate (metal-to-metal buckles) or of webbing end (metal-to-webbing buckles) withdrawn from the buckle. The release mechanism shall be moved 200 times through the maximum possible travel against its stop with a force of $133 \text{ N} \pm 13 \text{ N}$ at a rate not to exceed 30 cycles per minute. The buckle shall be examined to determine compliance with the performance requirements of S4.3(g). A metal-to-metal buckle shall be examined to determine whether partial engagement is possible by means of any technique representative of actual use. If partial engagement is possible, the maximum force of separation when in such partial engagement shall be determined.

(h) **Nonlocking retractor.** After the retractor is cycled 10 times by full extension and retraction of the webbing, the retractor and webbing shall be suspended vertically and a force of 18 N shall be applied to extend the webbing from the retractor. The force shall be reduced to 13 N when attached to a pelvic restraint, or to 5 N per strap or webbing that contacts the shoulder of an occupant when retractor is attached to an upper torso restraint. The residual extension of the webbing shall be measured by manual rotation of the retractor drum or by disengaging the retraction mechanism. Measurements shall be made on three retractors. The location of the retractor attached to upper torso restraint shall be examined for visibility of reel during use of seat belt assembly in a vehicle.

NOTE : This test shall not be required on a nonlocking retractor attached to the free end of webbing which is not subjected to any tension during restraint of an occupant by the assembly.

(i) **Automatic-locking retractor.** Three retractors shall be tested in a manner to permit the retraction force to be determined exclusive of the gravitational forces on

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hardware or webbing being retracted. The webbing shall be fully extended from the retractor. While the webbing is being retracted, the average force or retraction within plus or minus 51 mm of 75 percent extension (25 percent retraction) shall be determined and the webbing movement between adjacent locking segments shall be measured in the same region of extension. A seat belt assembly with automatic locking retractor in upper torso restraint shall be tested in a vehicle in a manner prescribed by the installation and usage instructions. The retraction force on the occupant of the seat belt assembly shall be determined before and after traveling for 10 minutes at a speed of 24 kilometers per hour (km/h) or more over a rough road (e.g., Belgian block road) where the occupant is subjected to displacement with respect to the vehicle in both horizontal and vertical directions. Measurements shall be made with the vehicle stopped and the occupant in the normal seated position.

(j) **Emergency-locking retractor.**

(1) **For seat belt assemblies manufactured before February 22, 2007.** Except for manufacturers that elect to comply with S4.3(j)(2) and the corresponding test procedures of S5.2(j)(2), a retractor shall be tested in a manner that permits the retraction force to be determined exclusive of the gravitational forces on hardware or webbing being retracted. The webbing shall be fully extended from the retractor, passing over or through any hardware or other material specified in the installation instructions. While the webbing is being retracted, the lowest force of retraction within ± 51 mm of 75 percent extension shall be determined. A retractor that is sensitive to webbing withdrawal shall be subjected to an acceleration of 3 m/s^2 (0.3 g) within a period of 50 milliseconds (ms) while the webbing is at 75 percent extension, to determine compliance with S4.3(j)(1)(ii). The retractor shall be subjected to an acceleration of 7 m/s^2 (0.7 g) within a period of 50 ms, while the webbing is at 75 percent extension, and the webbing movement before locking shall be measured under the following conditions: For a retractor sensitive to webbing withdrawal, the retractor shall be accelerated in the direction of webbing retraction while the retractor drum's central axis is oriented horizontally and at angles of 45°, 90°, 135°, and 180° to the horizontal plane. For a retractor sensitive to vehicle acceleration, the retractor shall be:

(i) Accelerated in the horizontal plane in two directions normal to each other, while the retractor drum's central axis is oriented at the angle at which it is installed in the vehicle; and

(ii) Accelerated in three directions normal to each other while the retractor drum's central axis is oriented at angles of 45°, 90°, 135°, and 180° from the angle at which it is installed in the vehicle, unless the retractor locks by gravitational force when tilted in any direction to any angle greater than 45° from the angle at which it is installed in the vehicle.

(2) **For seat belt assemblies manufactured on or after February 22, 2007 and for manufacturers opting for early compliance.** A retractor shall be tested in a manner that permits the retraction force to be determined exclusive of the gravitational forces on the hardware or webbing being retracted.

(i) **Retraction force:** The webbing shall be extended fully from the retractor, passing over and through any hardware or other material specified in the installation instructions. While the webbing is being retracted, measure the lowest force of retraction within ± 51 mm of 75 percent extension.

(ii) **Gravitational locking:** For a retractor sensitive to vehicle acceleration, rotate the retractor in any direction to an angle greater than 45 degrees from the angle at which it is installed in the vehicle. Apply a force to the webbing greater than the minimum force measured in S5.2(j)(2)(i) to determine compliance with S4.3(j)(2)(i)(D).

(iii) **Dynamic tests:** Each acceleration pulse shall be recorded using an accelerometer having a full scale range of ± 10 g and processed according to the practices set forth in SAE Recommended Practice J211-1 DEC2003 (incorporated by reference, see §571.5) Channel Frequency Class 60. The webbing shall be positioned at 75 percent extension, and the displacement shall be measured using a displacement transducer. For tests specified in S5.2(j)(2)(iii)(A) and (B), the 0.7 g acceleration pulse shall be within the acceleration-time corridor shown in Figure 8 of this standard.

(A) For a retractor sensitive to vehicle acceleration—

(1) The retractor drum's central axis shall be oriented at the angle at which it is installed in the vehicle ± 0.5 degrees. Accelerate the retractor in the horizontal plane in two directions normal to each other and measure the webbing payout; and

(2) If the retractor does not meet the 45-degree tilt-lock requirement of S4.3(j)(2)(i)(D), accelerate the retractor in three directions normal to each other while the retractor drum's central axis is oriented at angles of 45, 90, 135, and 180 degrees from the angle at which it is installed in the vehicle and measure webbing payout.

(B) For a retractor sensitive to webbing withdrawal—

(1) The retractor drum's central axis shall be oriented horizontally ± 0.5 degrees. Accelerate the retractor in the direction of webbing retraction and measure webbing payout; and

(2) The retractor drum's central axis is oriented at angles of 45, 90, 135, and 180 degrees to the horizontal plane. Accelerate the retractor in the direction of the webbing retraction and measure the webbing payout.

(C) A retractor that is sensitive to webbing withdrawal shall be subjected to an acceleration no greater than 0.3 g occurring within a period of the first 50 ms and sustaining an acceleration no greater than 0.3 g throughout the test, while the webbing is at 75 percent extension. Measure the webbing payout.

(k) **Performance of retractor.** After completion of the corrosion-resistance test described in paragraph (a) of this section, the webbing shall be fully extended and allowed to dry for at least 24 hours under standard laboratory conditions specified in S5.1(a). The retractor shall be examined for ferrous and nonferrous corrosion which may be transferred, either directly or by means of the webbing, to a person or his clothing during use of a seat belt assembly incorporating the retractor, and for ferrous corrosion on significant surfaces if the retractor is

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part of the attachment hardware. The webbing shall be withdrawn manually and allowed to retract for 25 cycles. The retractor shall be mounted in an apparatus capable of extending the webbing fully, applying a force of 89 N at full extension, and allowing the webbing to retract freely and completely. The webbing shall be withdrawn from the retractor and allowed to retract repeatedly in this apparatus until 2,500 cycles are completed. The retractor and webbing shall then be subjected to the temperature resistance test prescribed in paragraph (b) of this section. The retractor shall be subjected to 2,500 additional cycles of webbing withdrawal and retraction. Then, the retractor and webbing shall be subjected to dust in a chamber similar to one illustrated in Figure 8 containing about 0.9 kg of coarse grade dust conforming to the specification given in SAE Recommended Practice J726 SEP79 (incorporated by reference, see §571.5). The dust shall be agitated every 20 minutes for 5 seconds by compressed air, free of oil and moisture, at a gage pressure of 550 ± 55 kPa entering through an orifice 1.5 ± 0.1 mm in diameter. The webbing shall be extended to the top of the chamber and kept extended at all times except that the webbing shall be subjected to 10 cycles of complete retraction and extension within 1 to 2 minutes after each agitation of the dust. At the end of 5 hours, the assembly shall be removed from the chamber. The webbing shall be fully withdrawn from the retractor manually and allowed to retract completely for 25 cycles. An automatic-locking retractor or a nonlocking retractor attached to pelvic restraint shall be subjected to 5,000 additional cycles of webbing withdrawal and retraction. An emergency locking retractor or a nonlocking retractor attached to upper torso restraint shall be subjected to 45,000 additional cycles of webbing withdrawal and retraction between 50 and 100 percent extension. The locking mechanism of an emergency locking retractor shall be actuated at least 10,000 times within 50 to 100 percent extension of webbing during the 50,000 cycles. At the end of test, compliance of the retractors with applicable requirements in S4.3 (h), (i), and (j) shall be determined. Three retractors shall be tested for performance.

S5.3 Assembly performance—(a) Type 1 seat belt assembly. Three complete seat belt assemblies, including webbing, straps, buckles, adjustment and attachment hardware, and retractors, arranged in the form of a loop as shown in Figure 5, shall be tested in the following manner:

(1) The testing machine shall conform to the requirements specified in S5.1(b). A double-roller block shall be attached to one head of the testing machine. This block shall consist of two rollers 102 mm in diameter and sufficiently long so that no part of the seat belt assembly touches parts of the block other than the rollers during test. The rollers shall be mounted on antifriction bearings and spaced 305 mm between centers, and shall have sufficient capacity so that there is no brinelling, bending or other distortion of parts which may affect the results. An anchorage bar shall be fastened to the other head of the testing machine.

(2) The attachment hardware furnished with the seat belt assembly shall be attached to the anchorage bar.

The anchor points shall be spaced so that the webbing is parallel in the two sides of the loop. The attaching bolts shall be parallel to, or at an angle of 45° or 90° to the webbing, whichever results in an angle nearest to 90° between webbing and attachment hardware except that eye bolts shall be vertical, and attaching bolts or non-threaded anchorages of a seat belt assembly designed for use in specific models of motor vehicles shall be installed to produce the maximum angle in use indicated by the installation instructions, utilizing special fixtures if necessary to simulate installation in the motor vehicle. Rigid adapters between anchorage bar and attachment hardware shall be used if necessary to locate and orient the adjustment hardware. The adapters shall have a flat support face perpendicular to the threaded hole for the attaching bolt and adequate in area to provide full support for the base of the attachment hardware connected to the webbing. If necessary, a washer shall be used under a swivel plate or other attachment hardware to prevent the webbing from being damaged as the attaching bolt is tightened.

(3) The length of the assembly loop from attaching bolt to attaching bolt shall be adjusted to about 1295 mm, or as near thereto as possible. A force of 245 N shall be applied to the loop to remove any slack in webbing at hardware. The force shall be removed and the heads of the testing machine shall be adjusted for an assembly loop between 1220 and 1270 mm in length. The length of the assembly loop shall then be adjusted by applying a force between 89 and 98 N to the free end of the webbing at the buckle, or by the retraction force of an automatic-locking or emergency-locking retractor. A seat belt assembly that cannot be adjusted to this length shall be adjusted as closely as possible. An automatic-locking or emergency locking retractor when included in a seat belt assembly shall be locked at the start of the test with a tension on the webbing slightly in excess of the retractive force in order to keep the retractor locked. The buckle shall be in a location so that it does not touch the rollers during test, but to facilitate making the buckle release test in S5.2(d) the buckle should be between the rollers or near a roller in one leg.

(4) The heads of the testing machine shall be separated at a rate between 51 and 102 mm per minute until a force of $22,241 \pm 222$ N is applied to the assembly loop. The extension of the loop shall be determined from measurements of head separation before and after the force is applied. The force shall be decreased to 667 ± 45 N and the buckle release force measured as prescribed in S5.2(d).

(5) After the buckle is released, the webbing shall be examined for cutting by the hardware. If the yarns are partially or completely severed in a line for a distance of 10 percent or more of the webbing width, the cut webbing shall be tested for breaking strength as specified in S5.1(b) locating the cut in the free length between grips. If there is insufficient webbing on either side of the cut to make such a test for breaking strength, another seat belt assembly shall be used with the webbing repositioned in the hardware. A tensile force of $11,120 \pm 111$ N shall be applied to the components or a force of 22,241

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± 222 N shall be applied to the assembly loop. After the force is removed, the breaking strength of the cut webbing shall be determined as prescribed above.

(6) If a Type 1 seat belt assembly includes an automatic-locking retractor or an emergency-locking retractor, the webbing and retractor shall be subjected to a tensile force of $11,120 \pm 111$ N with the webbing fully extended from the retractor.

(7) If a seat belt assembly has a buckle in which the tongue is capable of inverted insertion, one of the three assemblies shall be tested with the tongue inverted.

(b) **Type 2 seat belt assembly.** Components of three seat belt assemblies shall be tested in the following manner:

(1) The pelvic restraint between anchorages shall be adjusted to a length between 1220 and 1270 mm, or as near this length as possible if the design of the pelvic restraint does not permit its adjustment to this length. An automatic-locking or emergency-locking retractor when included in a seat belt assembly shall be locked at the start of the test with a tension on the webbing slightly in excess of the retractive force in order to keep the retractor locked. The attachment hardware shall be oriented to the webbing as specified in paragraph (a)(2) of this section and illustrated in Figure 5. A tensile force $11,120 \pm 111$ N shall be applied on the components in any convenient manner and the extension between anchorages under this force shall be measured. The force shall be reduced to 334 ± 22 N and the buckle release force measured as prescribed in S5.2(d).

(2) The components of the upper torso restraint shall be subjected to a tensile force of $6,672 \pm 67$ N following the procedure prescribed above for testing pelvic restraint and the extension between anchorages under this force shall be measured. If the testing apparatus permits, the pelvic and upper torso restraints may be tested simultaneously. The force shall be reduced to 334 ± 22 N and the buckle release force measured as prescribed in S5.2(d).

(3) Any component of the seat belt assembly common to both pelvic and upper torso restraint shall be subjected to a tensile force of $13,344 \pm 134$ N.

(4) After the buckle is released in tests of pelvic and upper torso restraints, the webbing shall be examined for cutting by the hardware. If the yarns are partially or completely severed in a line for a distance of 10 percent or more of the webbing width, the cut webbing shall be tested for breaking strength as specified in S5.1(b) locating the cut in the free length between grips. If there is insufficient webbing on either side of the cut to make such a test for breaking strength, another seat belt assembly shall be used with the webbing repositioned in the hardware. The force applied shall be $11,120 \pm 111$ N for components of pelvic restraint, and $6,672 \pm 67$ N for components of upper torso restraint. After the force is removed, the breaking strength of the cut webbing shall be determined as prescribed above.

(5) If a Type 2 seat belt assembly includes an automatic-locking retractor or an emergency-locking retractor the webbing and retractor shall be subjected to a tensile force of $11,120 \pm 111$ N with the webbing fully

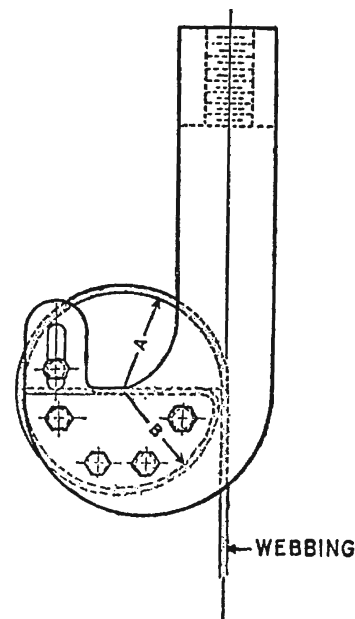
extended from the retractor, or to a tensile force of $6,672 \pm 67$ N with the webbing fully extended from the retractor if the design of the assembly permits only upper torso restraint forces on the retractor.

(6) If a seat belt assembly has a buckle in which the tongue is capable of inverted insertion, one of the three assemblies shall be tested with the tongue inverted.

(c) **Resistance to buckle abrasion.** Seat belt assemblies shall be tested for resistance to abrasion by each buckle or manual adjusting device normally used to adjust the size of the assembly. The webbing of the assembly to be used in this test shall be exposed for 4 hours to an atmosphere having relative humidity of 65 per cent and temperature of 18°C . The webbing shall be pulled back and forth through the buckle or manual adjusting device as shown schematically in Figure 7. The anchor end of the webbing (A) shall be attached to a mass (B) of 1.4 kg. The webbing shall pass through the buckle (C), and the other end (D) shall be attached to a reciprocating device so that the webbing forms an angle of 8° with the hinge stop (E). The reciprocating device shall be operated for 2,500 cycles at a rate of 18 cycles per minute with a stroke length of 203 mm. The abraded webbing shall be tested for breaking strength by the procedure described in paragraph S5.1(b).

S5.4 Tolerances on angles. Unless a range of angles is specified or a tolerance is otherwise explicitly provided, all angles and orientations of seat belt assemblies and components specified in this standard shall have a tolerance of ± 3 degrees.

FIGURE 1

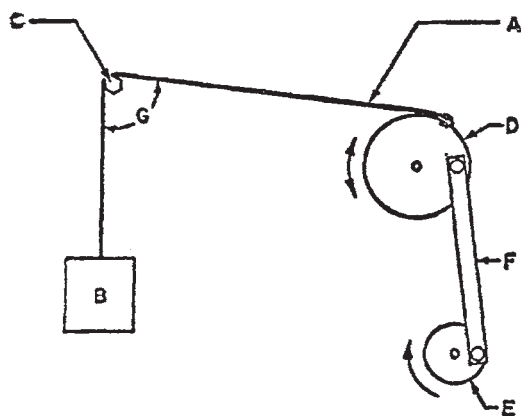


A 1 TO 2 INCHES OR 2.5 TO 5 CENTIMETERS

B A MINUS 0.06 INCH OR 0.15 CENTIMETER

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FIGURE 2



- 1 - WEBBING
- 2 - WEIGHT
- 3 - HEXAGONAL ROD
STEEL - SAE 51416
ROCKWELL HARDNESS - B-97 TO B-101
SURFACE - COLD DRAWN FINISH
SIZE - 0.250 ± 0.001 INCH OR
 6.35 ± 0.03 MILLIMETER
RADIUS ON EDGES - 0.020 ± 0.004 INCH OR
 0.5 ± 0.1 MILLIMETER
- 4 - CRANK
- 5 - CRANK ARM
- 6 - CRANK
- 7 - CRANK ARM
- 8 - ANGLE BETWEEN WEBBING - 85 ± 2 DEGS.

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FIGURE 3

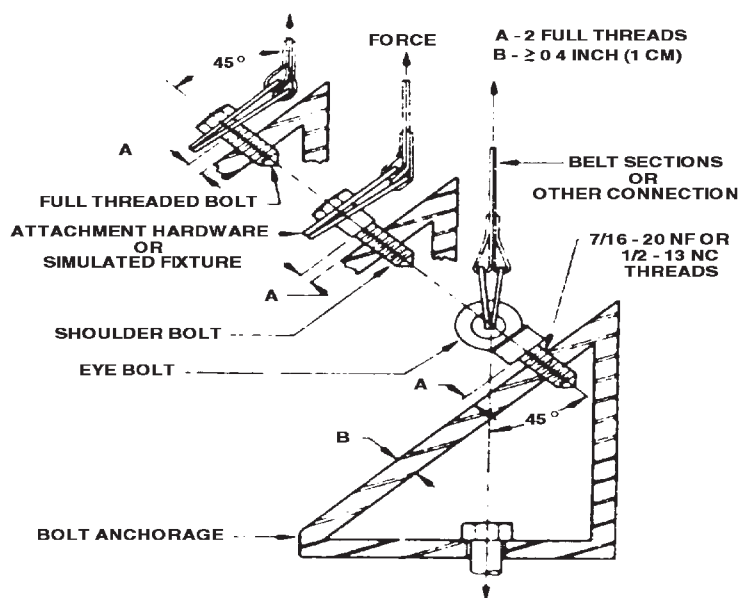
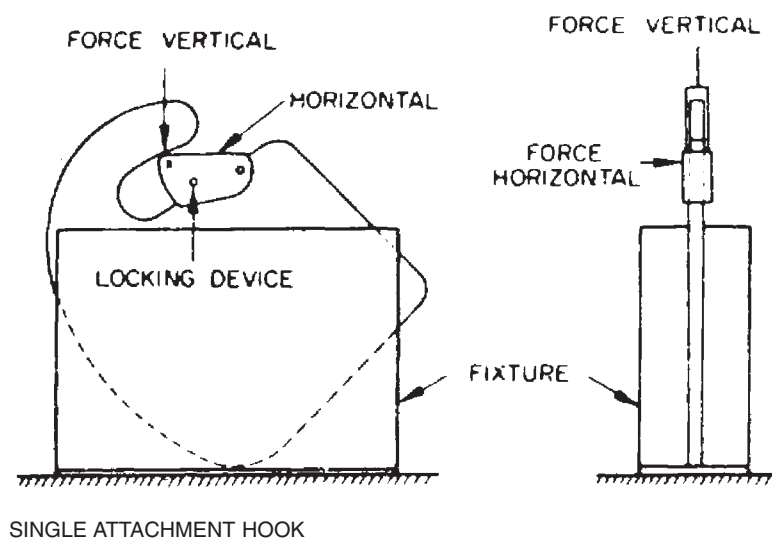


FIGURE 4



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FIGURE 5

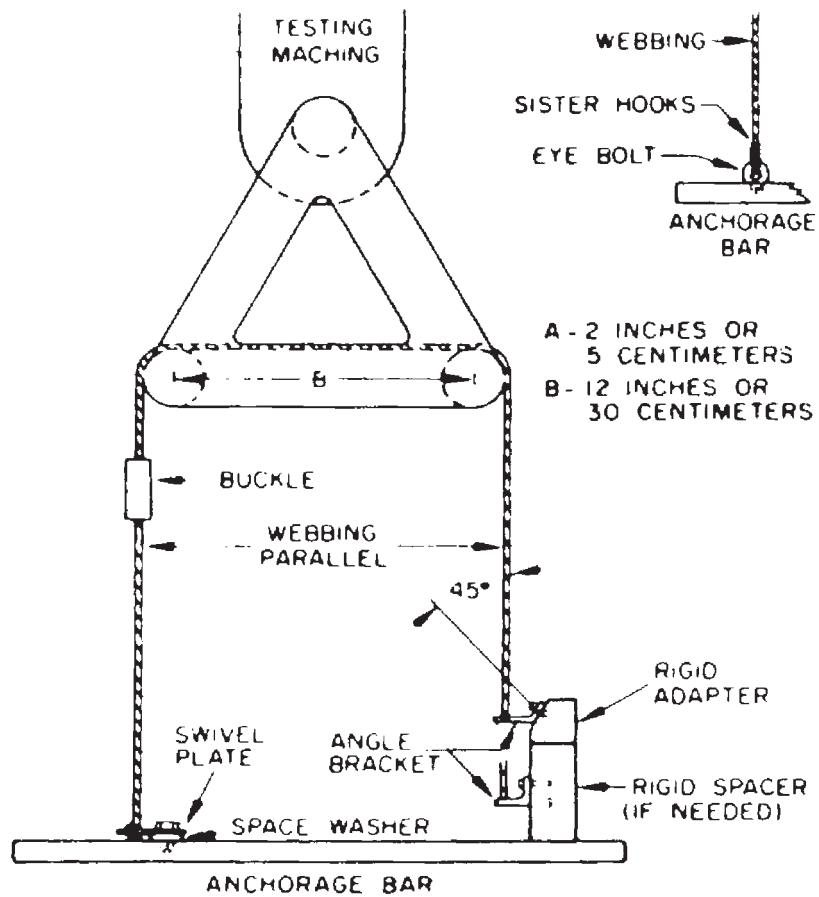
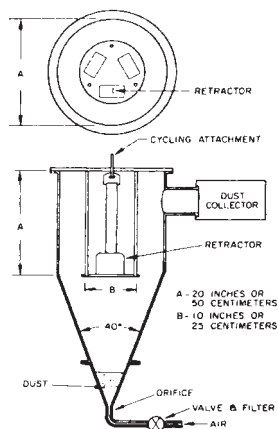


FIGURE 6



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FIGURE 7

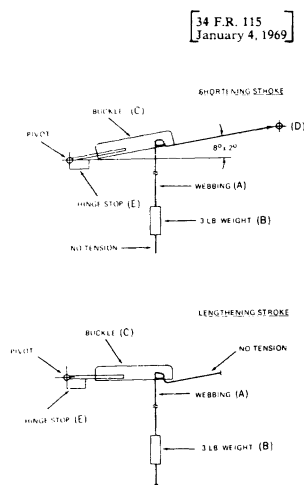
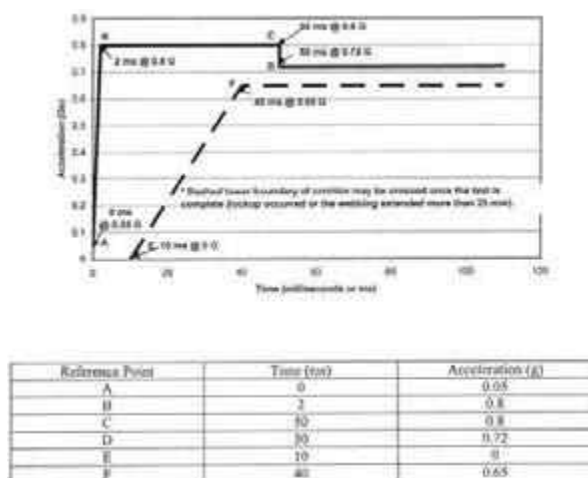


FIGURE 8



§571.210 Standard No. 210; Seat belt assembly anchorages.

S1. Purpose and scope. This standard establishes requirements for seat belt assembly anchorages to insure their proper location for effective occupant restraint and to reduce the likelihood of their failure.

S2. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3. Definitions.

School bus torso belt adjusted height means the vertical height above the seating reference point (SgRP) of the horizontal plane containing a segment of the torso belt centerline located 25 mm to 75 mm forward of the torso belt height adjuster device, when the torso belt retractor is locked and the torso belt is pulled away from the seat back by applying a 20 N horizontal force in the forward direction through the webbing at a loca-

tion 100 mm or more forward of the adjustment device as shown in Figure 5.

School bus torso belt anchor point means the midpoint of the torso belt width where the torso belt first contacts the uppermost torso belt anchorage.

Small occupant seating position is as defined in 49 CFR 571.222.

Seat belt anchorage means any component, other than the webbing or straps, involved in transferring seat belt loads to the vehicle structure, including, but not limited to, the attachment hardware, seat frames, seat pedestals, the vehicle structure itself, and any part of the vehicle whose failure causes separation of the belt from the vehicle structure.

S4. Requirements.

S4.1 Type.

S4.1.1 Seat belt anchorages for a Type 1 or a Type 2 seat belt assembly shall be installed for each designated seating position for which a Type 1 or a Type 2 seat belt assembly is required by Standard No. 208 (49 CFR 571.208). Seat belt anchorages for a Type 2 seat belt assembly shall be installed for each designated seating position for which a Type 2 seat belt assembly is required by Standard No. 208 (49 CFR 571.208).

S4.1.2 (a) Notwithstanding the requirement of S4.1.1, each vehicle manufactured on or after September 1, 1987 that is equipped with an automatic restraint at the front right outboard designated seating position, which automatic restraint cannot be used for securing a child restraint system or cannot be adjusted by the vehicle owner to secure a child restraint system solely through the use of attachment hardware installed as an item of original equipment by the vehicle manufacturer, shall have, at the manufacturer's option, either anchorages for a Type 1 seat belt assembly installed at that position or a Type 1 or Type 2 seat belt assembly installed at that position. If a manufacturer elects to install anchorages for a Type 1 seat belt assembly to comply with this requirement, those anchorages shall consist of, at a minimum, holes threaded to accept bolts that comply with S4.1(f) of Standard No. 209 (49 CFR 571.209).

(b) The requirement in S4.1.1 of this standard that seat belt anchorages for a Type 1 or a Type 2 seat belt assembly shall be installed for certain designated seating positions does not apply to any such seating positions that are equipped with a seat belt assembly that meets the frontal crash protection requirements of S5.1 of Standard No. 208 (49 CFR 571.208).

S4.1.3 School bus passenger seats.

S4.1.3.1 For school buses manufactured on or after October 21, 2011, seat belt anchorages for school bus passenger seats must be attached to the school bus seat structure, including seats with wheelchair positions or side emergency doors behind them. Seats with no other seats behind them, no wheelchair positions behind them and no side emergency door behind them are excluded from the requirement that the seat belt anchorages must be attached to the school bus seat structure. For school buses with a GVWR less than or equal to 4,536 kg (10,000 pounds), the seat belt shall be Type 2 as defined in S3. of FMVSS No. 209 (49 CFR 571.209).

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For school buses with a GVWR greater than 4,536 kg (10,000 pounds), the seat belt shall be Type 1 or Type 2 as defined in S3. of FMVSS No. 209 (49 CFR 571.209).

S4.1.3.2 Type 2 seat belt anchorages on school buses manufactured on or after October 21, 2011 must meet the following location requirements.

(a) For a small occupant seating position of a flexible occupancy seat, as defined in 49 CFR 571.222, the school bus torso belt anchor point must be 400 mm or more vertically above the seating reference point (SgRP) or adjustable to 400 mm or more vertically above the SgRP. For all other seating positions, the school bus torso belt anchor point must be 520 mm or more vertically above the SgRP or adjustable to 520 mm or more vertically above the SgRP. The school bus torso belt adjusted height at each seating position shall be adjustable to no more than 280 mm vertically above the SgRP in the lowest position and no less than the required vertical height of the school bus torso belt anchor point for that seating position in the highest position. (See Figure 4.)

(b) The minimum lateral distance between the vertical centerline of the bolt holes or the centroid of any other means of attachment to the structure specified in 4.1.3.1, simultaneously achievable by all seating positions, must be:

(i) 280 mm for seating positions in a flexible occupancy seat in a maximum occupancy configuration, as defined in 49 CFR 571.222; and

(ii) 330 mm for all other seating positions.

S4.1.3.3 School buses with a GVWR less than or equal to 4,536 kg (10,000 pounds) must meet the requirements of S4.2.2 of this standard.

S4.1.3.4 School buses with a GVWR greater than 4,536 kg (10,000 pounds) manufactured on or after October 21, 2011, with Type 1 seat belt anchorages, must meet the strength requirements specified in S4.2.1 of this standard.

S4.1.3.5 School buses with a GVWR greater than 4,536 kg (10,000 pounds) manufactured on or after October 21, 2011, with Type 2 seat belt anchorages, must meet the strength requirements specified in S4.2.2 of this standard.

S4.2 Strength.

S4.2.1 Except as provided in S4.2.5, the anchorages, attachment hardware, and attachment bolts for any of the following seat belt assemblies shall withstand a 5,000 pound force when tested in accordance with S5.1 of this standard:

(a) Type 1 seat belt assembly; and

(b) Lap belt portion of either a Type 2 or automatic seat belt assembly, if such seat belt assembly is equipped with a detachable upper torso belt.

S4.2.2 Except as provided in S4.2.5, the anchorages, attachment hardware, and attachment bolts for any of the following seat belt assemblies shall withstand a 3,000 pound force applied to the lap belt portion of the seat belt assembly simultaneously with a 3,000 pound force applied to the shoulder belt portion of the seat belt

assembly, when tested in accordance with S5.2 of this standard:

(a) Type 2 and automatic seat belt assemblies that are installed to comply with Standard No. 208 (49 CFR 571.208); and

(b) Type 2 and automatic seat belt assemblies that are installed at a seating position required to have a Type 1 or Type 2 seat belt assembly by Standard No. 208 (49 CFR 571.208).

S4.2.3 Permanent deformation or rupture of a seat belt anchorage or its surrounding area is not considered to be a failure, if the required force is sustained for the specified time.

S4.2.4 Anchorages, attachment hardware, and attachment bolts shall be tested by simultaneously loading them in accordance with the applicable procedures set forth in S5 of this standard if the anchorages are either:

(a) For designated seating positions that are common to the same occupant seat and that face in the same direction, or

(b) For laterally adjacent designated seating positions that are not common to the same occupant seat, but that face in the same direction, if the vertical centerline of the bolt hole for at least one of the anchorages for one of those designated seating positions is within 305 mm of the vertical center line of the bolt hole for an anchorage for one of the adjacent seating positions.

S4.2.5 The attachment hardware of a seat belt assembly, which is subject to the requirements of S5.1 of Standard No. 208 (49 CFR 571.208) by virtue of any provision of Standard No. 208 other than S4.1.2.1(c)(2) of that standard, does not have to meet the requirements of S4.2.1 and S4.2.2 of this standard.

S4.3 Location. As used in this section, "forward" means the direction in which the seat faces, and other directional references are to be interpreted accordingly. Anchorages for seat belt assemblies that meet the frontal crash protection requirements of S5.1 of Standard No. 208 (49 CFR 571.208) are exempt from the location requirements of this section.

S4.3.1 Seat belt anchorages for Type 1 seat belt assemblies and the pelvic portion of Type 2 seat belt assemblies.

S4.3.1.1 In an installation in which the seat belt does not bear upon the seat frame:

(a) If the seat is a nonadjustable seat, then a line from the seating reference point to the nearest contact point of the belt with the anchorage shall extend forward from the anchorage at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

(b) If the seat is an adjustable seat, then a line from a point 64 mm forward of and 10 mm above the seating reference point to the nearest contact point of the belt with the anchorage shall extend forward from the anchorage at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

S4.3.1.2 In an installation in which the belt bears upon the seat frame, the seat belt anchorage, if not on

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the seat structure, shall be aft of the rearmost belt contact point on the seat frame with the seat in the rearmost position. The line from the seating reference point to the nearest belt contact point on the seat frame, with the seat positioned at the seating reference point, shall extend forward from that contact point at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

S4.3.1.3 In an installation in which the seat belt attaches to the seat structure, the line from the seating reference point to the nearest contact point of the belt with the hardware attaching it to the seat structure shall extend forward from that contact point at an angle with the horizontal of not less than 30 degrees and not more than 75 degrees.

S4.3.1.4 Anchorages for an individual seat belt assembly shall be located at least 165 mm apart laterally, measured between the vertical center line of the bolt holes or, for designs using other means of attachment to the vehicle structure, between the centroid of such means.

S4.3.2 Seat belt anchorages for the upper torso portion of Type 2 seat belt assemblies. Adjust the seat to its full rearward and downward position and adjust the seat back to its most upright position. Except a small occupant seating position as defined in 49 CFR 571.222, with the seat and seat back so positioned, as specified by subsection (a) or (b) of this section, the upper end of the upper torso restraint shall be located within the acceptable range shown in Figure 1, with reference to a two-dimensional drafting template described in SAE Standard J826 MAY87 (incorporated by reference, see §571.5). The template's "H" point shall be at the design "H" point of the seat for its full rearward and full downward position, as defined in SAE Recommended Practice J1100 JUN84 (incorporated by reference, see §571.5), and the template's torso line shall be at the same angle from the vertical as the seat back.

(a) For fixed anchorages, compliance with this section shall be determined at the vertical centerline of the bolt holes or, for designs using another means of attachment to the vehicle structure, at the centroid of such means.

(b) For adjustable anchorages, compliance with this section shall be determined at the midpoint of the range of all adjustment positions.

S5. Test procedures. Each vehicle shall meet the requirements of S4.2 of this standard when tested according to the following procedures. Where a range of values is specified, the vehicle shall be able to meet the require-

ments at all points within the range. For the testing specified in these procedures, the anchorage shall be connected to material whose breaking strength is equal to or greater than the breaking strength of the webbing for the seat belt assembly installed as original equipment at that seating position. The geometry of the attachment duplicates the geometry, at the initiation of the test, of the attachment of the originally installed seat belt assembly.

S5.1 Seats with Type 1 or Type 2 seat belt anchorages. With the seat in its rearmost position, apply a force of 22,241 N in the direction in which the seat faces to a pelvic body block as described in Figure 2A, in a plane parallel to the longitudinal centerline of the vehicle for forward and rear facing seats, and in a plane perpendicular to the longitudinal centerline of the vehicle for side facing seats, with an initial force application angle of not less than 5 degrees or more than 15 degrees above the horizontal. Apply the force at the onset rate of not more than 222,411 N per second. Attain the 22,241 N force in not more than 30 seconds and maintain it for 10 seconds. At the manufacturer's option, the pelvic body block described in Figure 2B may be substituted for the pelvic body block described in Figure 2A to apply the specified force to the center set(s) of anchorages for any group of three or more sets of anchorages that are simultaneously loaded in accordance with S4.2.4 of this standard.

S5.2 Seats with Type 2 or automatic seat belt anchorages. With the seat in its rearmost position, apply forces of 13,345 N in the direction in which the seat faces simultaneously to a pelvic body block, as described in Figure 2A, and an upper torso body block, as described in Figure 3, in a plane parallel to the longitudinal centerline of the vehicle for forward and rear facing seats, and in a plane perpendicular to the longitudinal centerline of the vehicle for side facing seats, with an initial force application angle of not less than 5 degrees nor more than 15 degrees above the horizontal. Apply the forces at the onset rate of not more than 133,447 N per second. Attain the 13,345 N force in not more than 30 seconds and maintain it for 10 seconds. At the manufacturer's option, the pelvic body block described in Figure 2B may be substituted for the pelvic body block described in Figure 2A to apply the specified force to the center set(s) of anchorages for any group of three or more sets of anchorages that are simultaneously loaded in accordance with S4.2.4 of this standard.

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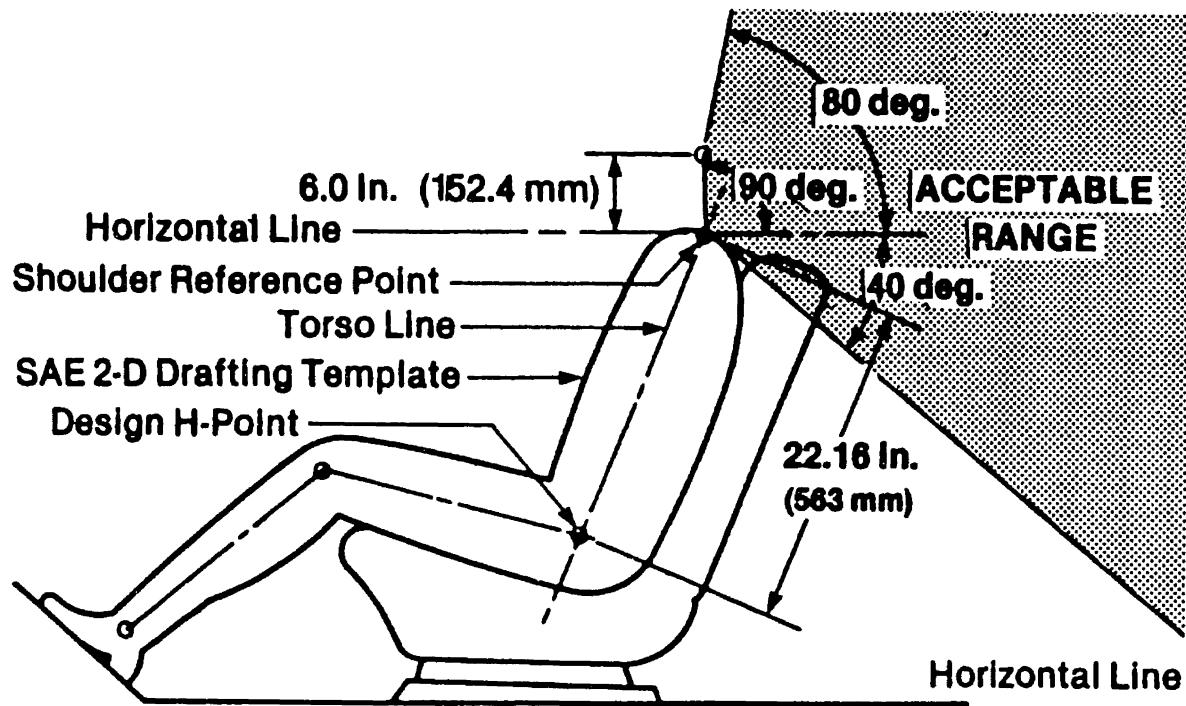


FIGURE 1 - LOCATION OF ANCHORAGE FOR UPPER TORSO RESTRAINT

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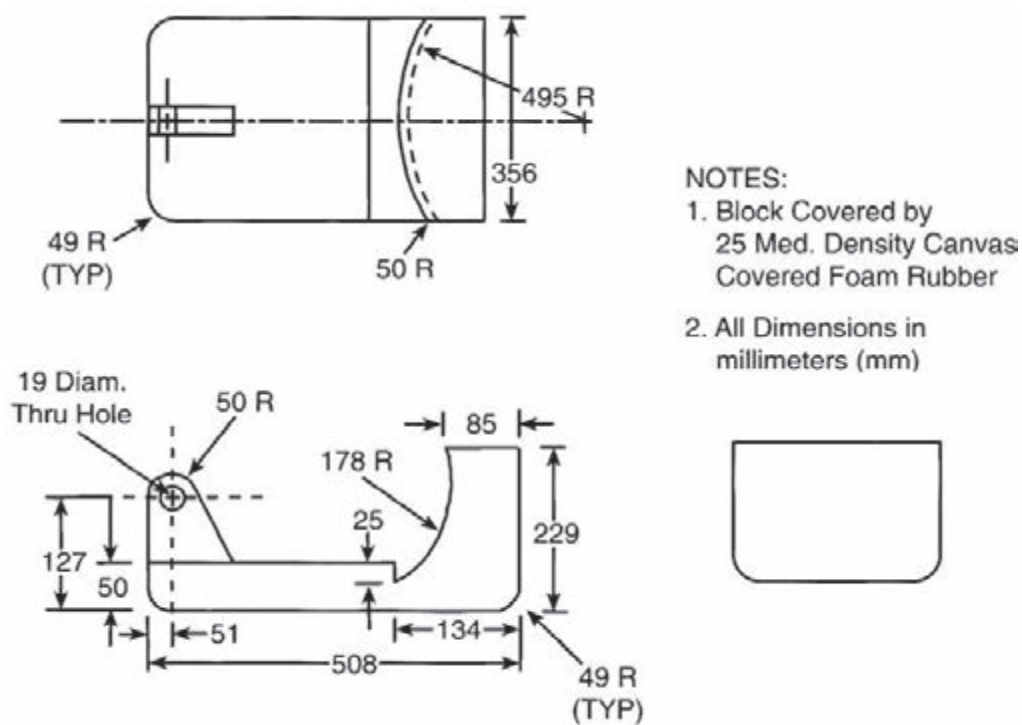


FIGURE 2A. - BODY BLOCK FOR LAP BELT ANCHORAGE

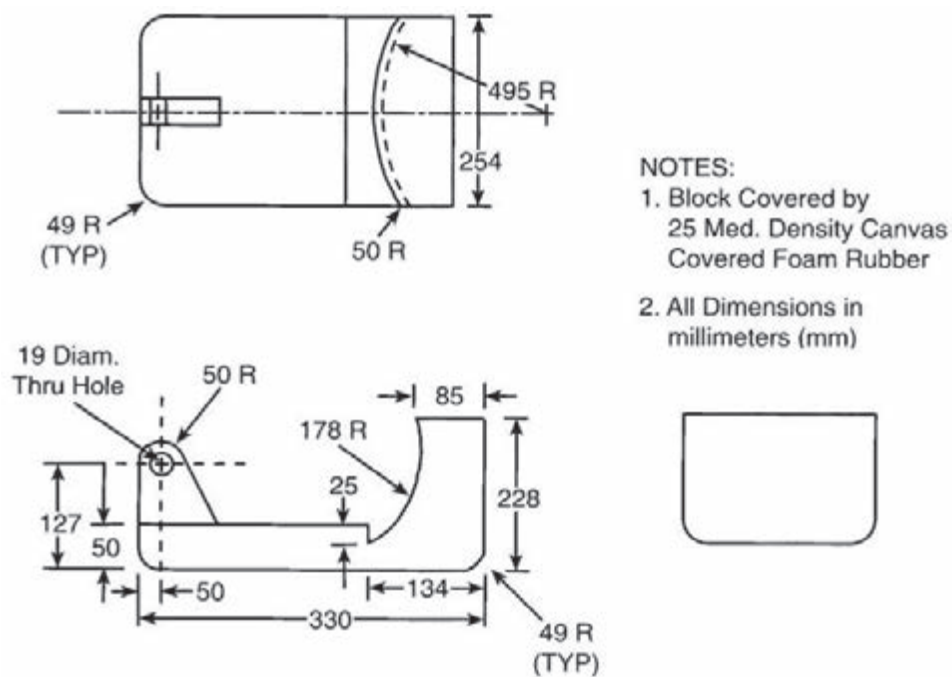


FIGURE 2B. - OPTIONAL BODY BLOCK FOR CENTER SEATING POSITIONS

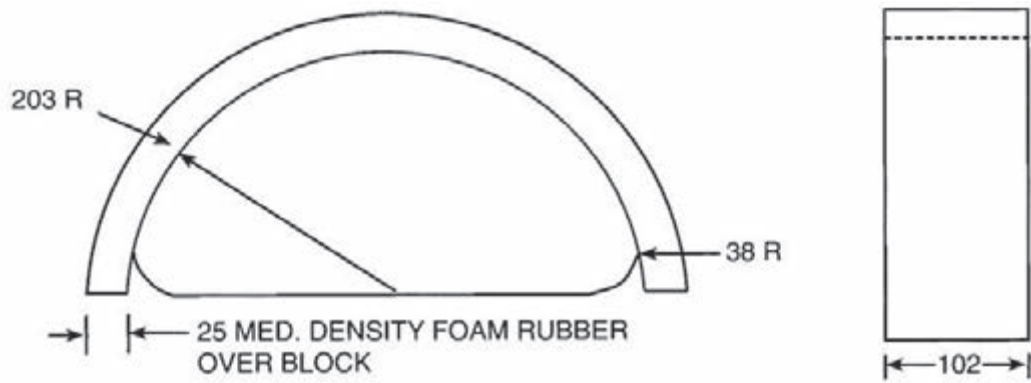
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FIGURE 3. - BODY BLOCK FOR COMBINATION SHOULDER AND LAP BELT ANCHORAGE All dimensions in millimeters (mm)

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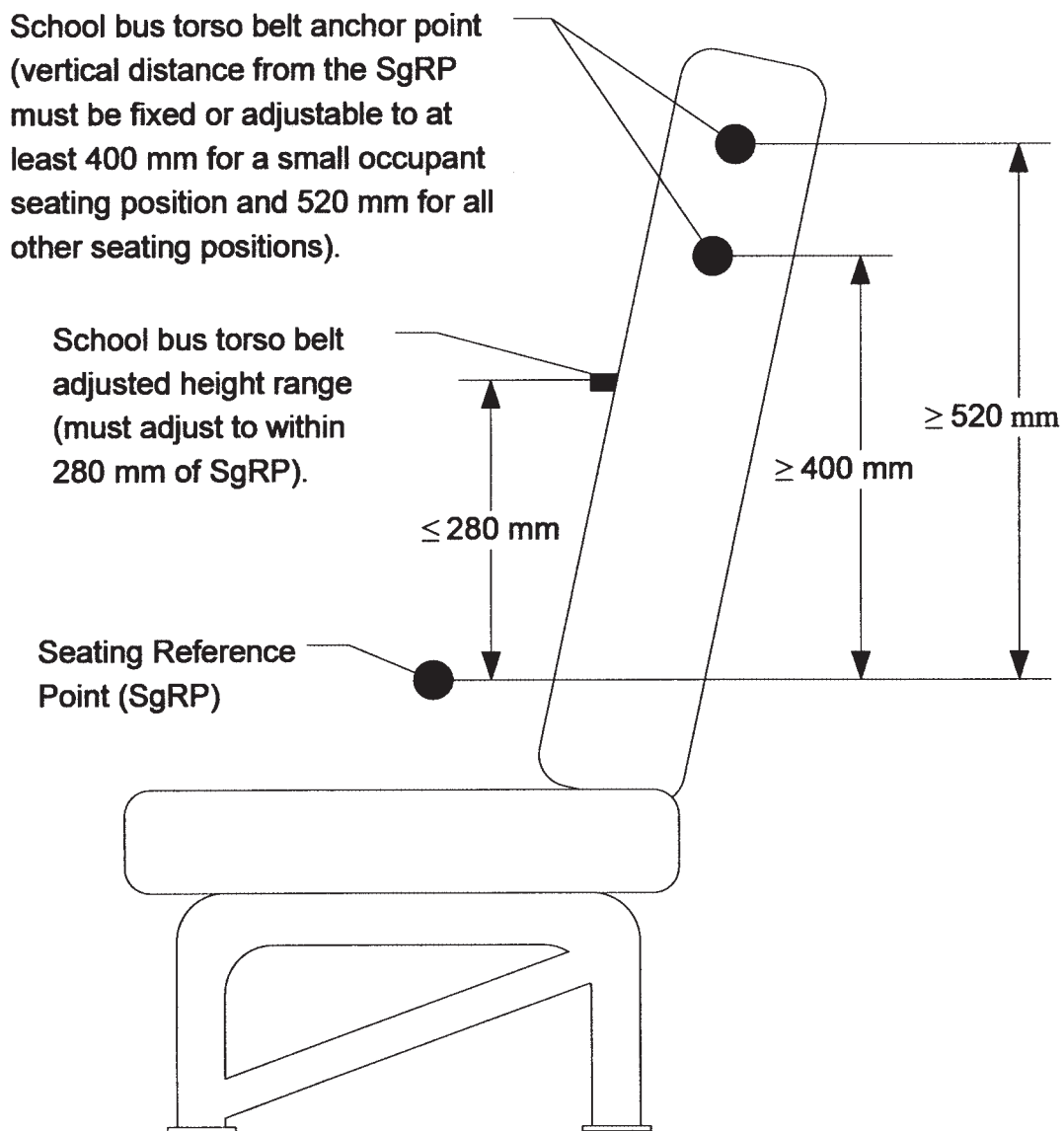
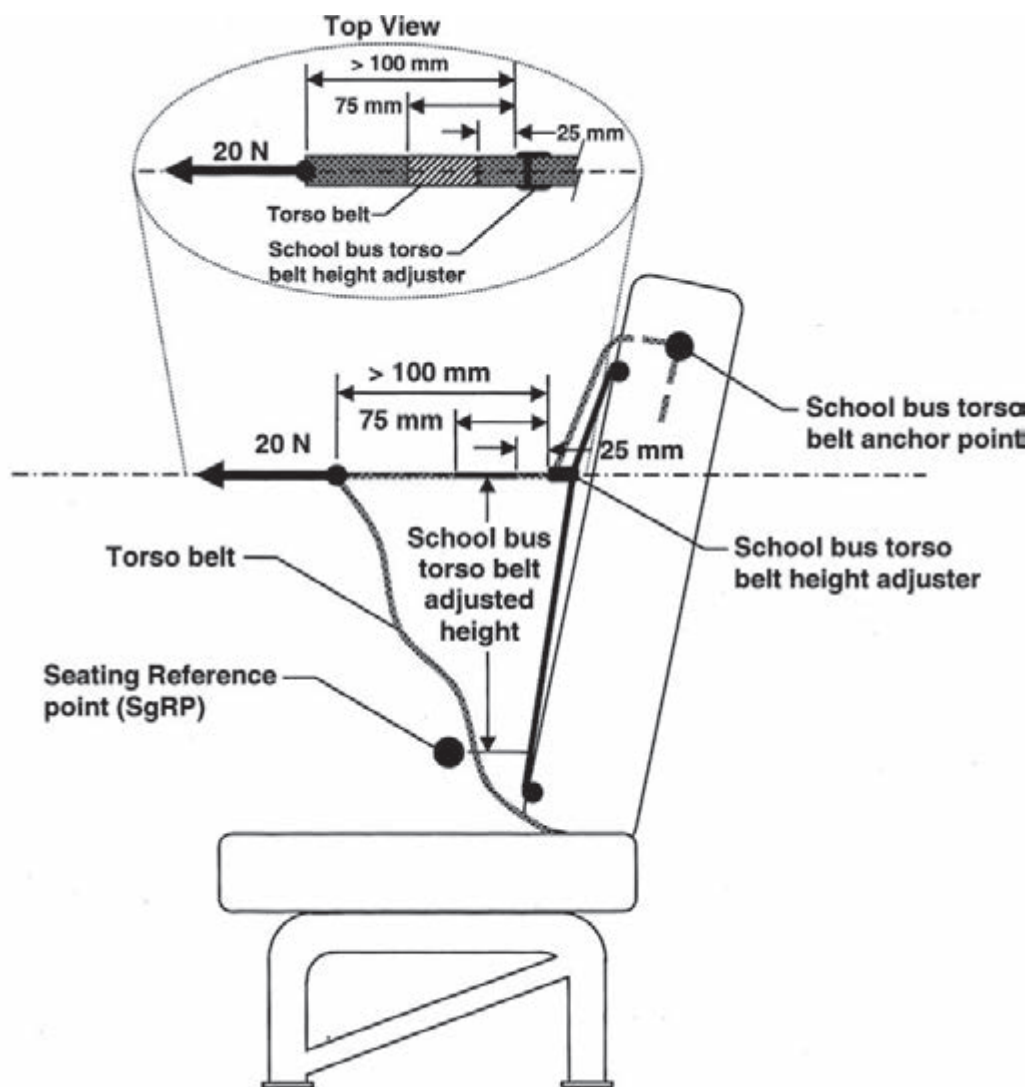


FIGURE 4 - SEAT BELT ANCHORAGE DIAGRAM

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S6. Owner's Manual Information. The owner's manual in each vehicle with a gross vehicle weight rating of 4,536 kg or less manufactured after September 1, 1987 shall include:

(a) A section explaining that all child restraint systems are designed to be secured in vehicle seats by lap belts or the lap belt portion of a lap-shoulder belt. The section shall also explain that children could be endangered in a crash if their child restraints are not properly secured in the vehicle.

(b) In a vehicle with rear designated seating positions, a statement alerting vehicle owners that, according to accident statistics, children are safer when properly restrained in the rear seating positions than in the front seating positions.

§571.217 Standard No. 217, Bus Emergency Exits and Window Retention and Release.

[Editor's Note: Per 68 FR 19752, Apr. 22, 2003, the effective date of this standard is delayed from April 21, 2003 until April 21, 2004.]

S1. Scope. This standard establishes requirements for the retention of windows other than windshields in buses, and establishes operating forces, opening dimensions, and markings for bus emergency exits.

S2. Purpose. The purpose of this standard is to minimize the likelihood of occupants being thrown from the bus and to provide a means of readily accessible emergency egress.

S3. Application. This standard applies to buses, except buses manufactured for the purpose of transporting persons under physical restraint.

S4. Definitions.

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Adjacent seat means a designated seating position located so that some portion of its occupant space is not more than 10 inches from an emergency exit, for a distance of at least 15 inches measured horizontally and parallel to the exit.

Mid-point of the passenger compartment means any point on a vertical transverse plane bisecting the vehicle longitudinal centerline that extends between the two vertical transverse planes which define the foremost and rearmost limits of the passenger compartment.

Occupant space means the space directly above the seat and footwell, bounded vertically by the ceiling and horizontally by the normally positioned seat back and the nearest obstruction of occupant motion in the direction the seat faces.

Passenger compartment means space within the school bus interior that is between a vertical transverse plane located 76 centimeters in front of the forwardmost passenger seating reference point and a vertical transverse plane tangent to the rear interior wall of the bus at the vehicle centerline.

Post and roof bow panel space means the area between two adjacent post and roof bows.

Push-out window means a vehicle window designed to open outward to provide for emergency egress.

Sliding window Sliding window means a bus window designed to open by moving vertically or horizontally to provide emergency egress.

Wheelchair means a wheeled seat frame for the support and conveyance of a physically disabled person, comprising at least a frame, seat, and wheels.

Wheelchair securement anchorage means the provision for transferring wheelchair securement device loads to the vehicle structure.

Wheelchair securement device means a strap, webbing or other device used for securing a wheelchair to the school bus, including all necessary buckles and other fasteners.

S5. Requirements.

S5.1 Window retention. Except as provided in S5.1.2, each piece of window glazing and each surrounding window frame when tested in accordance with the procedure in S5.1.1 under the conditions of S6.1 through S6.3, shall be retained by its surrounding structure in a manner that prevents the formation of any opening large enough to admit the passage of a 4-inch diameter sphere under a force, including the weight of the sphere, of 5 pounds until any one of the following events occurs:

- (a) A force of 1,200 pounds is reached.
- (b) At least 80 percent of the glazing thickness has developed cracks running from the load contact region to the periphery at two or more points, or shattering of the glazing occurs.
- (c) The inner surface of the glazing at the center of force application has moved relative to the window frame, along a line perpendicular to the undisturbed inner surface, a distance equal to one-half of the square root of the minimum surface dimension measured through the center of the area of the entire sheet of window glazing.

S5.1.1 An increasing force shall be applied to the window glazing through the head form specified in Figure 4, outward and perpendicular to the undisturbed inside surface at the center of the area of each sheet of window glazing, with a head form travel of 2 inches per minute.

S5.1.2 The requirements of this standard do not apply to a window whose minimum surface dimension measured through the center of its area is less than 8 inches.

S5.2 Provision of emergency exits.

S5.2.1 Buses other than school buses shall meet the requirements of either S5.2.2 or S5.2.3. School buses shall meet the requirements of S5.2.3.

S5.2.2 Buses other than school buses.

S5.2.2.1 Buses other than school buses shall provide unobstructed openings for emergency exit which collectively amount, in total square centimeters, to at least 432 times the number of designated seating positions on the bus. At least 40 percent of the total required area of unobstructed openings, computed in the above manner, shall be provided on each side of a bus. However, in determining the total unobstructed openings provided by a bus, no emergency exit, regardless of its area, shall be credited with more than 3,458 square centimeters of the total area requirement.

S5.2.2.2 Buses with GVWR of more than 10,000 pounds. Buses with a GVWR of more than 10,000 pounds shall meet the unobstructed openings requirements in S5.2.2.1 by providing side exits and at least one rear exit that conforms to S5.3 through S5.5. The rear exit shall meet the requirements of S5.3 through S5.5 when the bus is upright and when the bus is overturned on either side, with the occupant standing facing the exit. When the bus configuration precludes installation of an accessible rear exit, a roof exit that meets the requirements of S5.3 through S5.5 when the bus is overturned on either side, with the occupant standing facing the exit, shall be provided in the rear half of the bus.

S5.2.2.3 Buses with GVWR of 10,000 pounds or less. Buses other than school buses with GVWR of 10,000 pounds or less may meet the unobstructed openings requirement in S5.2.2.1 by providing:

(a) Devices that meet the requirements of S5.3 through S5.5 without using remote controls or central power systems:

(b) Windows that can be opened manually to a position that provides an opening large enough to admit unobstructed passage, keeping a major axis horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 50 centimeters and a minor axis of 33 centimeters; or

(c) Doors.

S5.2.3 School buses. Except as provided in §5.2.3.4, each school bus shall comply with S5.2.3.1 through S5.2.3.3.

S5.2.3.1 Each school bus shall be equipped with the exits specified in either S5.2.3.1(a) or S5.2.3.1(b), chosen at the option of the manufacturer.

(a) One rear emergency door that opens outward and is hinged on the right side (either side in the case of a bus

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with GVWR of 10, 000 pounds or less), and the additional exits, if any, specified by Table 1.

(b) One emergency door on the vehicle’s left side that is hinged on its forward side and meets the requirements of S5.2.3.2(a), and a push-out rear window that provides a minimum opening clearance 41 centimeters high and 122 centimeters wide and meets requirements of S5.2.3.2(c), and the additional exits, if any, specified by Table 2.

TABLE 1

Seating capacity	Additional exits required*
1-45	None.
46-62	1 left side exit door or 2 exit windows.
63-70	1 left side exit door or 2 exit windows, and 1 roof exit
71 and above ..	1 left side exit door or 2 exit windows, and 1 roof exit, and any combination of door, roof, or windows such that the total capacity credit specified in Table 3 for these exits, plus 70, is greater than the seating capacity of the bus.

*side emergency exit doors must meet the requirements of S5.2.3.2(a), emergency roof exits must meet the requirements of S5.2.3.2(b), emergency window exits must meet the requirements of S5.2.3.2(c).

TABLE 2

Seating capacity	Additional exits required*
1-57	None.
58-74	1 right side exit door or 2 exit windows.
75-82	1 right side exit door or 2 exit windows, and 1 roof exit.
83 and above ..	1 right side exit door or 2 windows, and 1 roof exit, and any combination of door, roof, or windows such that the total capacity credit specified in Table 3 for these exits plus 82 is greater than the capacity of the bus.

*Side emergency exit doors must meet the requirements of S5.2.3.2(a), emergency roof exits must meet the requirements of S5.2.3.2(b), emergency window exits must meet the requirements of S5.2.3.2(c).

TABLE 3

Exit Type	Capacity Credit
Side Door	16
Window	8
Roof Exit	8

(c) The area of an opening equipped with a wheelchair lift may be credited toward the required additional exits if it meets the requirements of paragraphs (a) or (b) of S5.2.3.1 and if the lift folds or stows in such a manner that the area is available for use by persons not needing the lift. With the lift in the folded or stowed position, such opening is considered a side emergency exit door.

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S5.2.3.2 All emergency exits required by S5.2.3.1(a) and S5.2.3.1(b) shall meet the following criteria:

(a) **Side emergency exit doors.** (1) Each side emergency exit door shall be hinged on its forward side.

(2) The first side emergency exit door installed pursuant to Table 1, shall be located on the left side of the bus and as near as practicable to the mid-point of the passenger compartment. A second side emergency exit door installed pursuant to Table 1 shall be located on the right side of the bus. In the case of a bus equipped with three side emergency door exits pursuant to Table 1, the third shall be located on the left side of the bus.

(3) The first side emergency exit door installed pursuant to Table 2 shall be located on the right side of the bus. A second side emergency door exit installed pursuant to Table 2 shall be located on the left side of the bus. In the case of a bus equipped with three side emergency door exits pursuant to Table 2, the third shall be located on the right side of the bus.

(4) No two side emergency exit doors shall be located, in whole or in part, within the same post and roof bow panel space.

(b) **Emergency roof exit.** (1) Each emergency roof exit shall be hinged on its forward side, and shall be operable from both inside and outside the vehicle.

(2) In a bus equipped with a single emergency roof exit, the exit shall be located as near as practicable to the midpoint of the passenger compartment.

(3) In a bus equipped with two emergency roof exits, one shall be located as near as practicable to a point equidistant between the midpoint of the passenger compartment and the foremost limit of the passenger compartment and the other shall be located as near as practicable to a point equidistant between the midpoint of the passenger compartment and the rearmost point of the passenger compartment.

(4) In a bus equipped with three or more emergency roof exits, the roof exits shall be installed so that, to the extent practicable, the longitudinal distance between each pair of adjacent roof exits is the same and equal to the distance from the foremost point of the passenger compartment to the foremost roof exit and to the distance from the rearmost point of that compartment to the rearmost roof exit.

(5) Except as provided in paragraph (b)(6) of this section, each emergency roof exit shall be installed with its longitudinal centerline coinciding with a longitudinal vertical plane passing through the longitudinal centerline of the school bus.

(6) In a bus equipped with two or more emergency roof exits, for each roof exit offset from the longitudinal vertical plane specified in paragraph (b)(5) of this section, there shall be another roof exit offset from that plane an equal distance to the other side.

(c) **Emergency exit windows.** A bus equipped with emergency exit windows shall have an even number of such windows, not counting the push-out rear window required by S5.2.3.1(b). Any side emergency exit windows shall be evenly divided between the right and left sides of the bus. School buses shall not be equipped with horizontally-sliding emergency exit windows. Further,

except for buses equipped with rear push-out emergency exit windows in accordance with S5.2.3.1(b), school buses shall not be equipped with both sliding and push-out emergency exit windows.

S5.2.3.3 The engine starting system of a bus shall not operate if any emergency exit is locked from either inside or outside the bus. For purposes of this requirement, "locked" means that the release mechanism cannot be activated and the exit opened by a person at the exit without a special device such as a key or special information such as a combination.

S5.2.3.4 Each school bus manufactured before September 1, 1994 may, at the manufacturer's option, comply with either §5.2.3.4(a) or §5.2.3.4(b) instead of §5.2.3.1 through §5.2.3.3.

(a) Each bus shall be equipped with one rear emergency door that opens outward and is hinged on the right side (either side in the case of a bus with a GVWR of 4,536 kilograms or less); or

(b) Each bus shall be equipped with one emergency door on the vehicle's left side that is hinged on its forward side and meets the requirements of §5.2.3.2.(a), and a push-out rear window that provides a minimum opening clearance 41 centimeters high and 122 centimeters wide and meets the requirements of §5.2.3.2.(c).

S5.3 Emergency exit release.

S5.3.1 Each emergency exit not required by S5.2.3 shall be releasable by operating one or two mechanisms located within the regions specified in Figure 1, Figure 2, or Figure 3. The lower edge of the region in Figure 1, and Region B in Figure 2, shall be located 13th centimeters above the adjacent seat, or 5 centimeters above the arm rest, if any, whichever is higher.

S5.3.2 When tested under the conditions of S6., both before and after the window retention test required by S5.1, each emergency exit not required by S5.2.3 shall allow manual release of the exit by a single occupant using force applications each of which conforms, at the option of the manufacturer, either to S5.3.2 (a) or (b) of this section. Each exit shall have not more than two release mechanisms. In the case of exits with one release mechanism, the mechanism shall require two force applications to release the exit. In the case of exits with two release mechanisms, each mechanism shall require one force application to release the exit. At least one of the force applications for each exit shall differ from the direction of the initial motion to open the exit by not less than 90° and no more than 180°.

(a) Low-force application.

(1) **Location.** As shown in Figure 1 or Figure 3.

(2) **Type of motion.** Rotary or straight.

(3) **Magnitude.** Not more than 20 pounds.

(b) High force application.

(1) **Location.** As shown in Figure 2 or Figure 3.

(2) **Type of motion.** Straight, perpendicular to the undisturbed exit surface.

(3) **Magnitude.** Not more than 60 pounds.

S5.3.3 School bus emergency exit release.

S5.3.3.1 When tested under the conditions of S6., both before and after the window retention test required by

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S5.1, each school bus emergency exit door shall allow manual release of the door by a single person, from both inside and outside the passenger compartment, using a force application that conforms to S5.3.3.1 (a) through (c) of this section, except a school bus with a GVWR of 10,000 pounds or less is not required to conform to S5.3.3.1(a). The release mechanism shall operate without the use of remote controls or tools, and notwithstanding any failure of the vehicle's power system. When the release mechanism is not in the position that causes an emergency exit door to be closed and the vehicle's ignition is in the "on" position, a continuous warning sound shall be audible at the driver's seating position and in the vicinity of the emergency exit door.

(a) **Location:** Within the high force access region shown in Figure 3A for a side emergency door, and in figure 3D for a rear emergency door.

(b) **Type of motion:** Upward from inside the bus and, at the discretion of the manufacturer, from outside the bus. Buses with a GVWR of 10,000 pounds or less shall provide interior release mechanisms that operate by either an upward or pull-type motion. the pull-type motion shall be used only when the release mechanism is recessed in such a manner that the handle, level, or other activating device, before being activated, does not protrude beyond the rim of the recessed receptacle.

(c) **Magnitude of force:** Not more than 178 newtons.

S5.3.3.2. When tested under the conditions of S6., both before and after the window retention test required by S5.1, each school bus emergency exit window shall allow manual release of the exit by a single person, from inside the passenger compartment, using not more than two release mechanisms located in specified low-force or high-force regions (at the option of the manufacturer) with force applications and types of motions that conform to either S5.3.3.2(a) or (b) of this section. In the case of windows with one release mechanism, the mechanism shall require two force applications to release the exit. In the case of windows with two release mechanisms, each mechanism shall require one application to release the exit. At least one of the force applications for each window shall differ from the direction of the initial motion to open the exit by no less than 90° and no more than 180°. Each release mechanism shall operate without the use of remote controls or tools, and notwithstanding any failure of the vehicle's power system. When a release mechanism is open and the vehicle's ignition is in the "on" position, a continuous warning shall be audible at the drivers seating position and in the vicinity of that emergency exit.

(a) **Emergency exit windows—Low-force application.**

(1) **Location:** Within the low-force access regions shown in Figures 1 and 3 for an emergency exit window.

(2) **Type of motion:** Straight and perpendicular to the undisturbed exit surface.

(3) **Magnitude:** Not more than 89 newtons.

(b) **Emergency exit windows—High-force application.**

(1) **Location:** Within the high-force access regions shown in Figures 2 and 3 for an emergency exit window.

(2) **Type of motion:** Straight and perpendicular to the undisturbed exit surface.

(3) **Magnitude:** Not more than 178 newtons.

S5.3.3.3 When tested under the conditions of S6., both before and after the window retention test required by S5.1, each school bus emergency roof exit shall allow manual release of the exit by a single person from both inside and outside the passenger compartment, using not more than two release mechanisms located at specified low-force or high-force regions (at the option of the manufacturer) with force applications and types of motions that conform either to S5.3.3.3 (a) or (b) of this section. In the case of roof exits with one release mechanism, the mechanism shall require two force applications to release the exit. In the case of roof exits with two release mechanisms, each mechanism shall require one application to release the exit. At least one of the force applications for each roof exit shall differ from the direction of the initial push-out motion of the exit by no less than 90°F. and no more than 180°F.

(a) **Emergency roof exits—Low-force application.**

(1) **Location:** Within the low-force access regions shown in Figure 3B, in the case of buses whose roof exits are not offset from the plane specified in S5.2.3.2(b)(5). In the case of buses which have roof exits offset from the plane specified in S5.2.3.2(b)(5), the amount of offset shall be used to recalculate the dimensions in Figure 3B for the offset exits.

(2) **Type of motion:** Rotary or straight.

(3) **Magnitude:** Not more than 89 newtons.

(b) **Emergency roof exits—High-force application.**

(1) **Location:** Within the high-force access regions shown in Figure 3B, in the case of buses whose roof exits are not offset from the plane specified in S5.2.3.2(b)(5). In the case of buses which have roof exits offset from the plane specified in S5.2.3.2(b)(5), the amount of offset shall be used to recalculate the dimensions in Figure 3B for the offset exits.

(2) **Type of motion:** Straight and perpendicular to the undisturbed exit surface.

(3) **Magnitude:** Not more than 178 newtons.

S5.4 Emergency exit opening.

S5.4.1 After the release mechanism has been operated, each emergency exit not required by S5.2.3 shall, under the conditions of S6., both before and after the window retention test required by S5.1, using the reach distances and corresponding force levels specified in S5.3.2, allow manual opening by a single occupant to a position that provides an opening large enough to admit unobstructed passage, keeping a major axis horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 50 centimeters and a minor axis of 33 centimeters.

S5.4.2 School bus emergency exit opening.

S5.4.2.1 School buses with a GVWR of more than 10,000 pounds.

(a) **Emergency exit doors.** After the release mechanism has been operated, each emergency exit door of a school bus shall, under the conditions of S6., before and after the window retention test required by S5.1, using

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the force levels specified in S5.3.3, be manually extendable by a single person to a position that permits:

(1) In the case of a rear emergency exit door, an opening large enough to permit unobstructed passage into the bus of a rectangular parallelepiped 1,145 millimeters (45 inches) high, 610 millimeters (24 inches) wide, and 305 millimeters (12 inches) deep, keeping the 1,145 millimeter (45 inch) dimension vertical, the 610 (24 inch) millimeter dimension parallel to the opening, and the lower surface in contact with the floor of the bus at all times, until the bottom edge of the rearmost surface of the parallelepiped is tangent to the plane of the door opening; and

(2) In the case of a side emergency exit door, an opening at least 114 centimeters high and 61 centimeters wide.

(i) except as provided in paragraph (a)(2)(ii) of this section, no portion of a seat or a restraining barrier shall be installed within the area bounded by the opening of a side emergency exit door, a vertical transverse plane tangent to the rearward edge of the door opening frame, a vertical transverse plane parallel to that plane at a distance of 30 centimeters forward of that plane, and a longitudinal vertical plane passing through the longitudinal centerline of the bus. (See Figure 5A).

(ii) A seat bottom may be located within the area described in paragraph (a)(2)(i) of this section if the seat bottom pivots and automatically assumes and retains a vertical position when not in use, so that no portion of the seat bottom is within the area described in paragraph (i) when the seat bottom is vertical. (See Figure 5B).

(iii) No portion of a seat or restraining barrier located forward of the area described in paragraph (a)(2)(i) of this section and between the door opening and a longitudinal vertical plane passing through the centerline of the bus shall extend rearward of a vertical transverse plane tangent to the forwardmost portion of a latch mechanism on the door. (See Figures 5B and 5C).

(3)(i) Each emergency exit door of a school bus shall be equipped with a positive door opening device that, after the release mechanism has been operated, under the conditions of S6, before and after the window retention test required by S5.1—

(A) Bears the weight of the door;

(B) Keeps the door from closing past the point at which the door is perpendicular to the side of the bus body, regardless of the body's orientation; and

(C) Provides a means for release or override.

(ii) The positive door opening device shall perform the functions specified in paragraph (a)(3)(i)(A) and (B) of this section without the need for additional action beyond opening the door past the point at which the door is perpendicular to the side of the bus body.

(b) **Emergency roof exits.** After the release mechanism has been operated, each emergency roof exit of a school bus shall, under the conditions of S6, before and after the window retention test required by S5.1, using the force levels specified in S5.3.3, be manually extendable by a single person to a position that permits an

opening at least 41 centimeters high and 41 centimeters wide.

(c) Emergency exit windows. After the release mechanism has been operated, each emergency exit window of a school bus shall, under the conditions of S6, both before and after the window retention test of S5.1, using force levels specified in S5.3.3.2, be manually extendable by a single occupant to a position that provides an opening large enough to admit unobstructed passage, keeping a major axis horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 50 centimeters and a minor axis of 33 centimeters.

S5.4.2.2 School buses with a GVWR of 10,000 pounds or less. A school bus with a GVWR of 10,000 pounds or less shall conform to all the provisions of S5.4.2, except that the parallelepiped dimension for the opening of the rear emergency door or doors shall be 45 inches high, 22 inches wide, and 6 inches deep.

S5.4.3. Restriction on wheelchair anchorage location.

S5.4.3.1. Except as provided in paragraph S5.4.3.2 of this section, no portion of a wheelchair securement anchorage shall be located in a school bus such that:

(a) In the case of side emergency exit doors, any portion of the wheelchair securement anchorage is within the space bounded by the interior side wall and emergency exit door opening, traverse vertical plans 305 mm (12 inches) forward and rearward of the center of any side emergency exit door restricted area, and a longitudinal centerline of the school bus, as shown in Figure 6A and Figure 6B.

(b) In the case of rear emergency exit doors in school buses, using the parallelepiped described in S5.4.2.1(a)(1) (for school buses with a GVWR greater than 10,000 lb) or S5.4.2.2 (for school buses with a GVWR of 10,000 lb or less), when the parallelepiped is positioned, as described in S5.4.2.1(a), flush with the floor and with the rear surface of the parallelepiped tangent to the opening of the rear emergency exit door, there must not be any portion of a wheelchair securement anchorage within the space occupied by the parallelepiped or within the downward vertical projection of the parallelepiped, as shown in Figure 6C.

S5.4.3.2 The restriction in S5.4.3.1(a) of this section does not apply to tracks or track-type devices that are used for mounting seats and/or for wheelchair securement devices.

S5.5 Emergency exit identification.

S5.5.1 In buses other than school buses, and except for windows serving as emergency exits in accordance with S5.2.2.3(b) and doors in buses with a GVWR of 10,000 pounds or less, each emergency exit doors shall have the designation "Emergency Door" or "Emergency Exit," and every other emergency exit shall have the designation "Emergency Exit" followed by concise operating instructions describing each motion necessary to unlatch and open the exit, located within 16 centimeters of the release mechanism.

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EXAMPLES

- (1) Lift to Unlatch, Push to Open
- (2) Lift Handle and Push out to Open

When a release mechanism is not located within an occupant space of an adjacent seat, a label meeting the requirements of S5.5.2 that indicates the location of the nearest release mechanism shall be placed within the occupant space.

EXAMPLE

Emergency exit instructions located next to seat ahead.

Example: “Emergency Exit Instructions
Located Next to Seat Ahead”

S5.5.2 In buses other than school buses. Except as provided in S5.5.2.1, each marking shall be legible, when the only source of light is the normal nighttime illumination of the bus interior, to occupants having corrected visual acuity of $\geq 20/40$ (Snellen ratio) seated in the adjacent seat, seated in the seat directly adjoining the adjacent seat, and standing in the aisle location that is closest to that adjacent seat. The marking shall be legible from each of these locations when the other two corresponding locations are occupied.

S5.5.2.1 If the exit has no adjacent seat, the marking must meet the legibility requirements of S5.5.2 for occupants standing in the aisle location nearest to the emergency exit, except for a roof exit, which must meet the legibility requirements for occupants positioned with their backs against the floor opposite the roof exit.

S5.5.3 School Bus.

(a) Each school bus emergency exit provided in accordance with S5.2.3.1 shall have the designation “Emergency Door” or “Emergency Exit,” as appropriate, in letters at least 5 centimeters high, of a color that contrasts with its background. For emergency exit doors, the designation shall be located at the top of, or directly above, the emergency exit door on both the inside and outside surfaces of the bus. The designation for roof exits shall be located on an inside surface of the exit, or within 30 centimeters of the roof exit opening. For emergency window exits, the designation shall be located at the top of, or directly above, or at the bottom

of the emergency window exit on both the inside and outside surfaces of the bus.

(b) Concise operating instructions describing the motions necessary to unlatch and open the emergency exit shall be located within 15 centimeters of the release mechanism on the inside surface of the bus. These instructions shall be in letters at least 1 centimeter high and of a color that contrasts with its background.

Example:

- (1) Lift to Unlatch, Push to Open
- (2) Turn Handle. Push Out to Open

(c) Each opening for a required emergency exit shall be outlined around its outside perimeter with a retroreflective tape with a minimum width of 2.5 centimeters and either red, white, or yellow in color, that when tested under the conditions specified in S6.1 of Standard No. 131 (49 CFR 571.131), meets the criteria specified in Table 1 of that section.

(d) On the inside surface of each school bus with one or more wheelchair anchorage positions, there shall be a label directly beneath or above each “Emergency Door” or “Emergency Exit” designation specified by paragraph (a) of S5.5.3 of this standard for an emergency exit door or window. The label shall state in letters at least 25 mm (one inch) high, the words “DO NOT BLOCK” in a color that contrasts with the background of the label.

S6. Test conditions.

S6.1 The vehicle is on a flat, horizontal surface.

S6.2 The inside of the vehicle and the outside environment are kept at any temperature from 70 to 85 Fahrenheit for 4 hours immediately preceding the tests, and during the tests.

S6.3 For the window retention test, windows are installed, closed, and latched (where latches are provided) in the condition intended for normal bus operation.

S6.4 For the emergency exit release and extension tests, windows are installed as in S6.3, seats, armrests, and interior objects near the windows are installed as for normal use, and seats are in the upright position.

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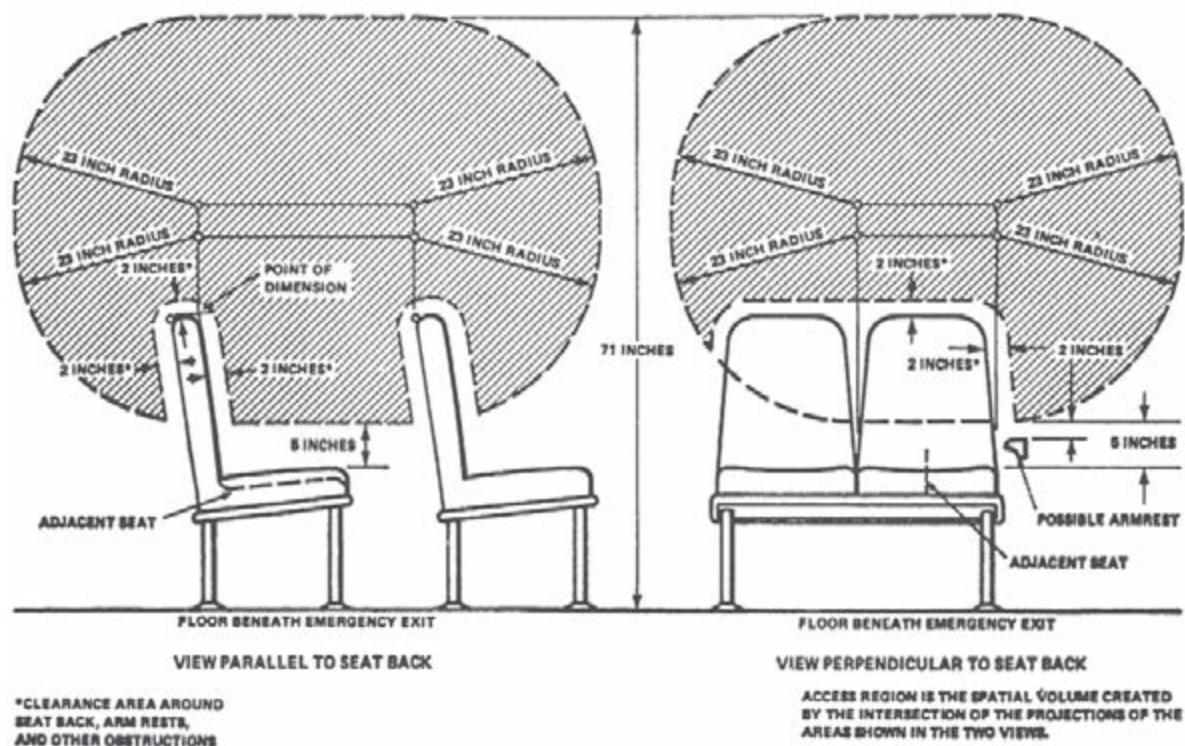


FIGURE 1 LOW-FORCE ACCESS REGION FOR EMERGENCY EXITS HAVING ADJACENT SEATS

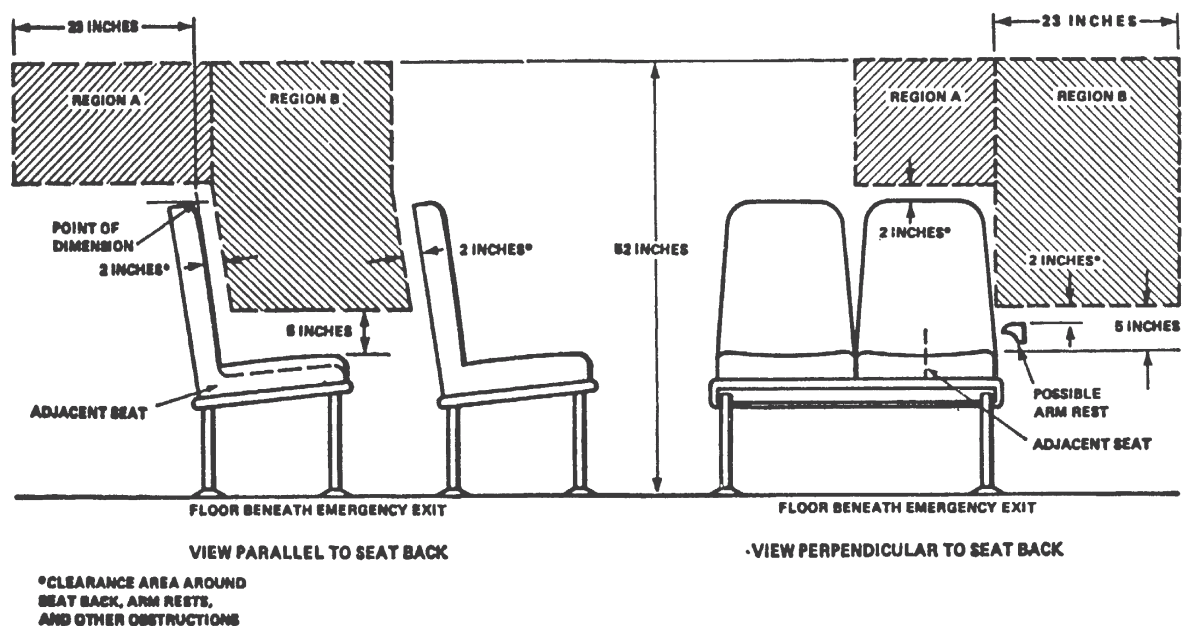
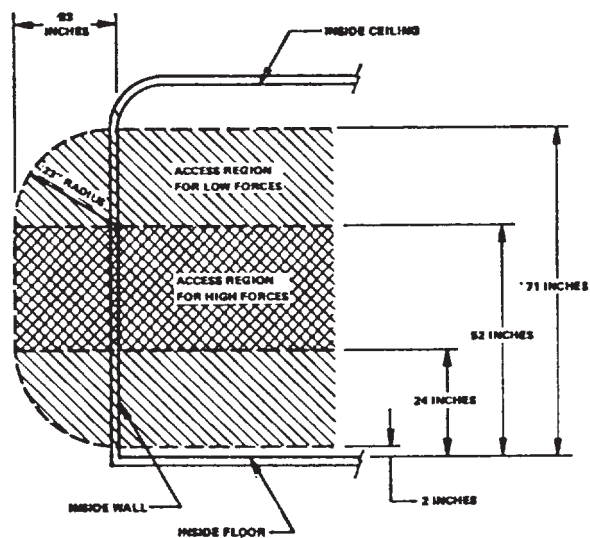
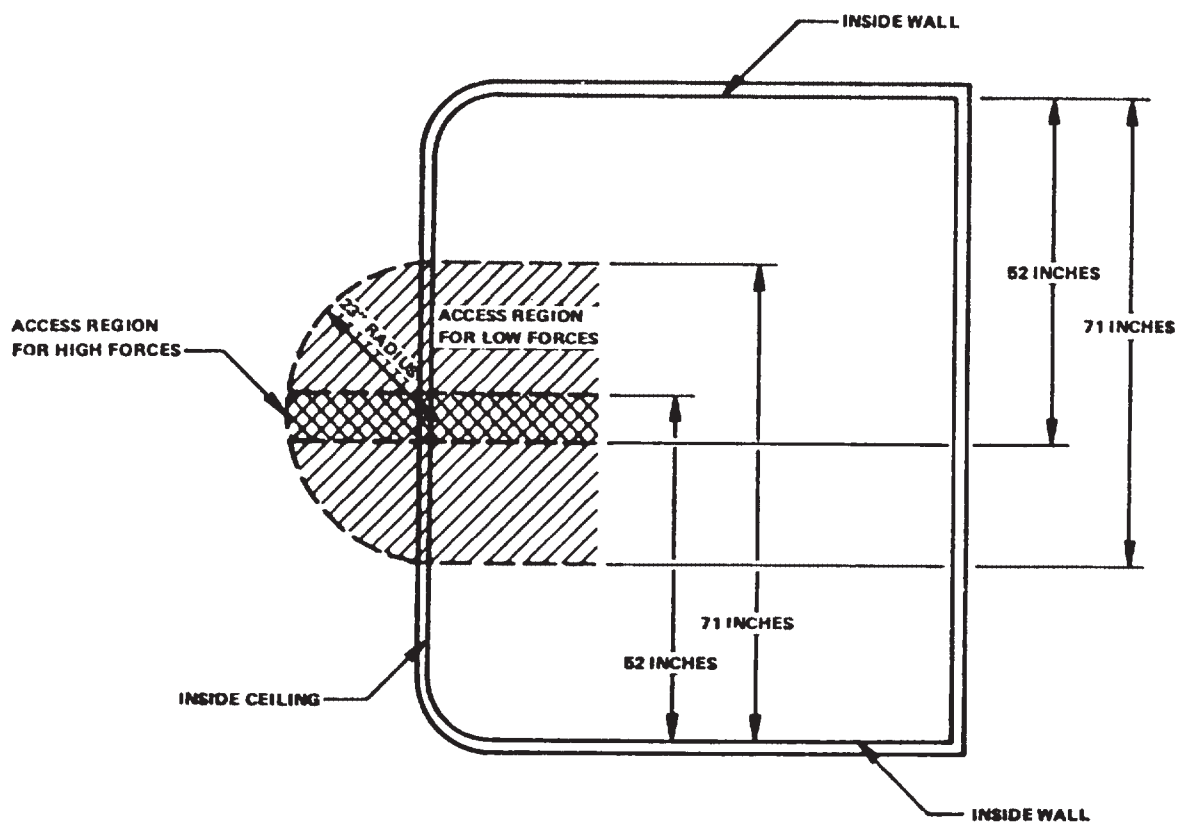


FIGURE 2 HIGH-FORCE ACCESS REGIONS FOR EMERGENCY EXITS HAVING ADJACENT SEATS

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3A SIDE EMERGENCY EXIT



3B ROOF EMERGENCY EXIT

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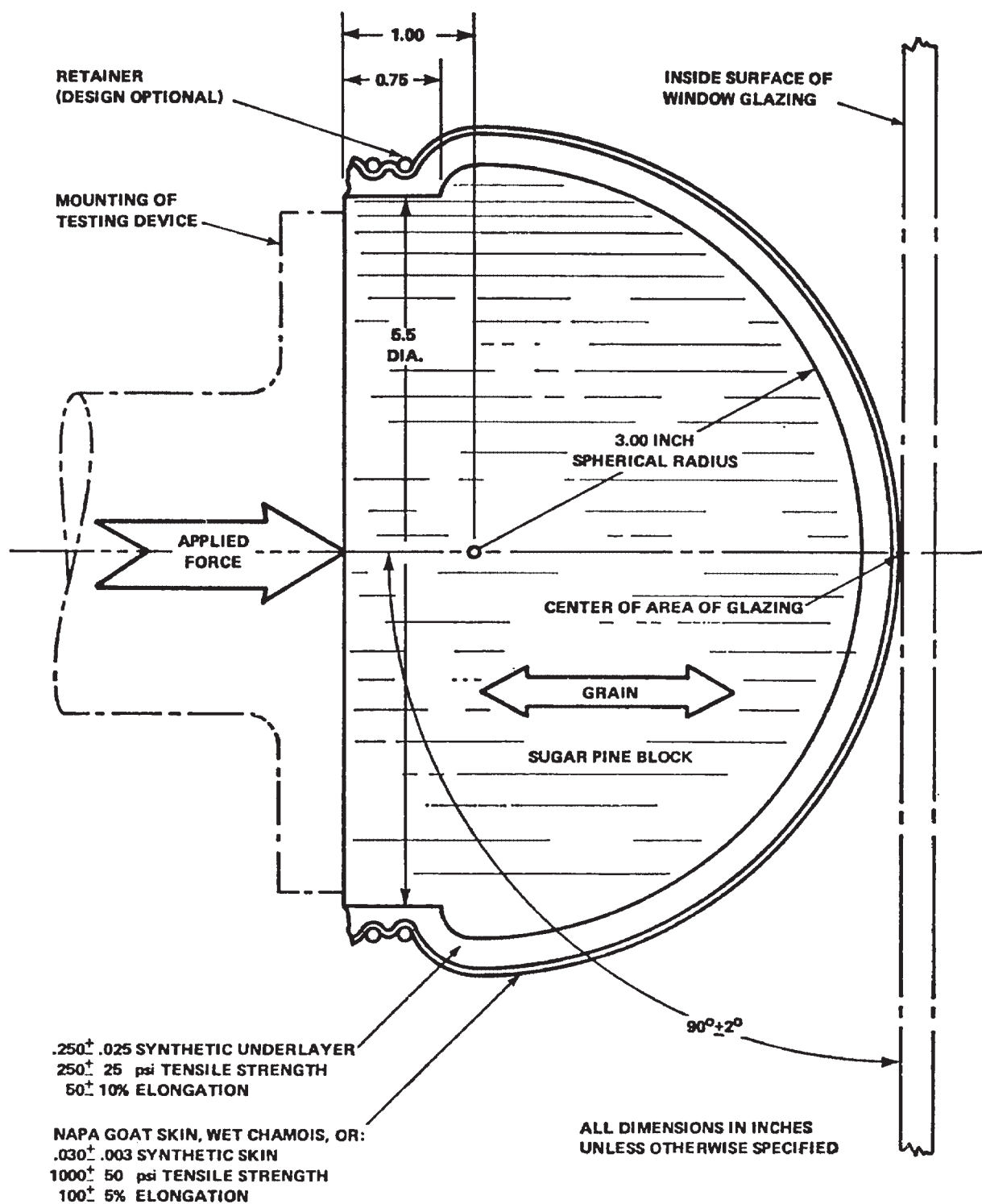


FIGURE 4 HEAD FORM

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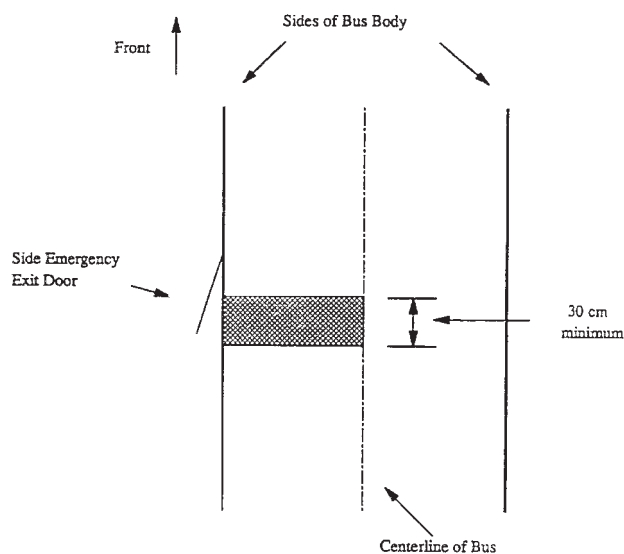


Figure 5A. Minimum side Emergency Exit Clearance Specification(Plan View)

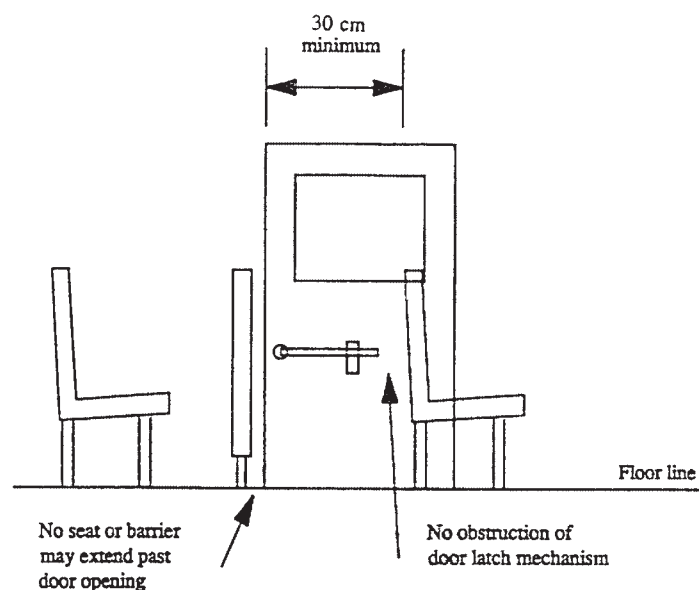


Figure 5C. Minimum Side Emergency Exit Clearance Specifications

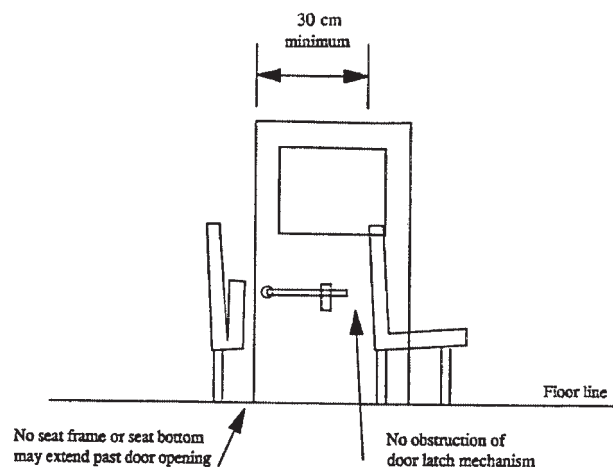


Figure 5B. Minimum Side Emergency Exit Flip-Up Seat Clearance Specifications

(Candelas per Footcandle Per Square Foot)

Type III Retroreflective Material

A - Glass Bead Retroreflective Element Material

Observation Angle (°)	Entrance Angle (°)	White	Red	Yellow
0.2	-4	250	45	170
0.2	+30	150	25	100
0.5	-4	95	15	62
0.5	+30	65	10	45

B - Prismatic Retroreflective Element Material

Observation Angle (°)	Entrance Angle (°)	White	Red	Yellow
0.2	-4	250	45	170
0.2	+30	95	13.3	64
0.5	-4	200	28	136
0.5	+30	65	10	45

Table 1. Minimum Specific intensity Per Unit Area (SIA)

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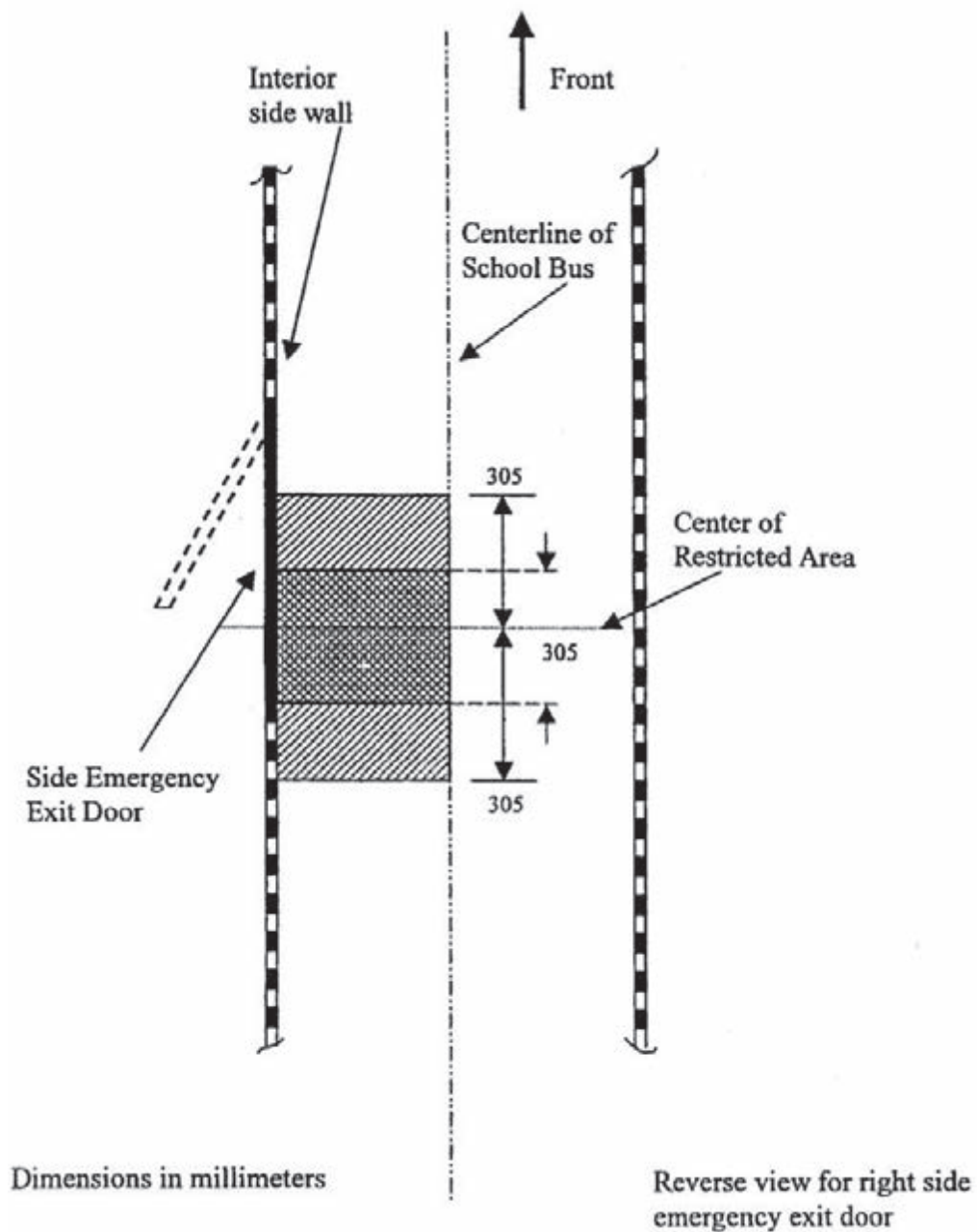


Figure 6A. Side Emergency Exit-No Wheelchair Anchorages Within the Shaded region

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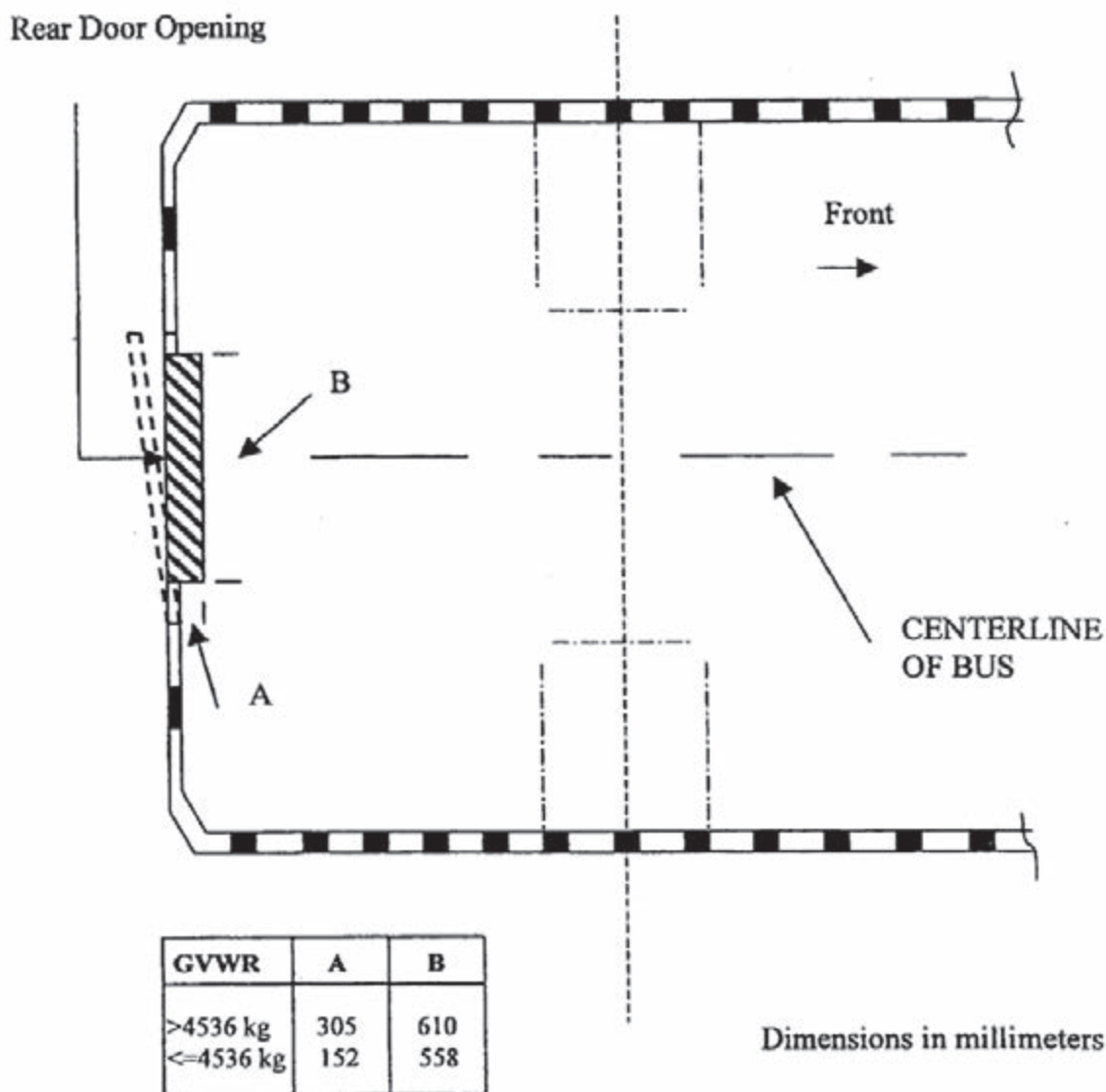


Figure 6C. Rear Door Emergency Exit-No Wheelchair Anchorages Within the Shaded region

§571.220 Standard No. 220; School bus rollover protection.

S1. **Scope.** This standard establishes performance requirements for school bus rollover protection.

S2. **Purpose.** The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from failure of the school bus body structure to withstand forces encountered in rollover crashes.

S3. **Applicability.** This standard applies to school buses.

S4. **Requirements.** When a force in Newtons equal to $1 \frac{1}{2}$ times the unloaded vehicle weight in kilograms multiplied by 9.8 m/sec^2 is applied to the roof of the vehicle's body structure through a force application plate as specified in S5, Test procedures—

(a) The downward vertical movement at any point on the application plate shall not exceed 130 mm and

(b) Each emergency exit of the vehicle provided in accordance with Standard No. 217 (§571.217) shall be capable of opening as specified in that standard during the full application of the force and after release of the force, except that an emergency exit located in the roof of the vehicle is not required to be capable of being opened during the application of the force. A particular vehicle (i.e., test specimen) need not meet the emergency exit opening requirement after release of force if it is subjected to the emergency exit opening requirements during the full application of the force.

S5. **Test procedures.** Each vehicle shall be capable of meeting the requirements of S4, when tested in accordance with the procedures set forth below.

S5.1 With any non-rigid chassis-to-body mounts replaced with equivalent rigid mounts, place the vehicle on a rigid horizontal surface so that the vehicle is

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entirely supported by means of the vehicle frame. If the vehicle is constructed without a frame, place the vehicle on its body sills. Remove any components which extend upward from the vehicle roof.

S5.2 Use a flat, rigid, rectangular force application plate that is measured with respect to the vehicle roof longitudinal and lateral centerlines,

(a) In the case of a vehicle with a GVWR of more than 4,536 kg, 305 mm shorter than the vehicle roof and 914 mm wide; and

(b) In the case of a vehicle with a GVWR of 4,536 kg or less, 127 mm longer and 127 mm wider than the vehicle roof. For purposes of these measurements, the vehicle roof is that structure, seen in the top projected view, that coincides with the passenger and driver compartment of the vehicle.

S5.3 Position the force application plate on the vehicle roof so that its rigid surface is perpendicular to a vertical longitudinal plane and it contacts the roof at not less than two points, and so that, in the top projected view, its longitudinal centerline coincides with the longitudinal centerline of the vehicle, and its front and rear edges are an equal distance inside the front and rear edges of the vehicle roof at the centerline.

S5.4 Apply an evenly-distributed vertical force in the downward direction to the force application plate at any rate—not more than 13 mm per second, until a force of 2,224 N has been applied.

S5.5 Apply additional vertical force in the downward direction to the force application plate at a rate of not more than 13 mm per second until the force specified in S4. has been applied, and maintain this application of force.

S5.6 Measure the downward movement of any point on the force application plate which occurred during the application of force in accordance with S5.5.

S5.7 To test the capability of the vehicle's emergency exits to open in accordance with S4.(b)—

(a) In the case of testing under the full application of force, open the emergency exits as specified in S4.(b) while maintaining the force applied in accordance with S5.4 and S5.5; and

(b) In the case of testing after the release of all force, release all downward force applied to the force application plate and open the emergency exits as specified in S4.(b).

S6. Test conditions. The following conditions apply to the requirements specified in S4.

S6.1 Temperature. The ambient temperature is any level between 0° C and 32° C.

S6.2 Windows and doors. Vehicle windows, doors, and emergency exits are in the fully-closed position, and latched but not locked.

§571.221 Standard No. 221; School bus body joint strength.

S1. Scope. This standard establishes requirements for the strength of the body panel joints in school bus bodies.

S2. Purpose. The purpose of this standard is to reduce deaths and injuries resulting from the structural collapse of school bus bodies during crashes.

S3. Application. This standard applies to school buses.

S4. Definitions.

Body component means a part of a bus body made from a single piece of homogeneous material or from a single piece of composite material such as plywood.

Body panel means a body component used on the exterior or interior surface to enclose the bus' occupant space.

Body panel joint means the area of contact or close proximity between the edges of a body panel and another body component, including but not limited to floor panels, and body panels made of composite materials such as plastic or plywood, excluding trim and decorative parts which do not contribute to the strength of the bus body, members such as rub rails which are entirely outside of body panels, ventilation panels, components provided for functional purposes, and engine access covers.

Bus body means that portion of a bus that encloses the bus occupant space, including the floor, but excluding the bumpers and chassis frame and any structure forward of the passenger compartment.

Maintenance access panel means a body panel which must be moved or removed to provide access to one or more serviceable component(s).

Passenger compartment means space within the school bus interior that is between a vertical transverse plane located 762 mm in front of the forwardmost passenger seating reference point and including a vertical transverse plane tangent to the rear interior wall of the bus at the vehicle centerline.

Serviceable component means any part of the bus, of either a mechanical or electrical nature, which is explicitly identified by the bus chassis and/or body manufacturer in the owner's manual or factory service manual as requiring routine maintenance actions at intervals of one year or less. Tubing, wires and harnesses are considered to be serviceable components only at their attachments.

S5. Requirements.

S5.1 Except as provided in S5.2, each body panel joint, including small, curved, and complex joints, when tested in accordance with the procedure of S6, shall hold the body panel to the member to which it is joined when subjected to a force of 60 percent of the tensile strength of the weakest joined body panel determined pursuant to S6.2.

S5.1.1 Body panels attached to each other shall have no unattached segment at the joint longer than 203 mm.

S5.2 Exclusions.

S5.2.1 The requirements of S5.1 do not apply to —

(a) Any interior maintenance access panel or joint which lies forward of the passenger compartment.

(b) Any interior maintenance access panel within the passenger compartment that does not exceed 305 mm

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when measured across any two points diametrically on opposite sides of the opening.

(c) Trim and decorative parts which do not contribute to the strength of the joint, support members such as rub rails which are entirely outside of body panels, doors and windows, ventilation panels, and engine access covers.

S6 Procedure

S6.1 Preparation of the test specimen.

S6.1.1 If a body panel joint is 203 mm or longer, cut a test specimen that consists of any 203 mm segment of the joint, together with a portion of the bus body whose dimensions are those specified in Figure 1, so that the specimen's centerline is perpendicular to the joint at the midpoint of the joint segment. Where the body panel joint is not fastened continuously, select the segment so that it does not bisect a spot weld or a discrete fastener. Support members which contribute to the strength of a body panel joint, such as rub rails on the outside of body panels or underlying structure attached to joint members, shall remain attached to the test specimen, except that material may be removed from the support members as necessary to clear the gripping areas of the joint members being tested.

S6.1.2 If a joint is less than 203 mm long, cut a test specimen with enough of the adjacent material to permit it to be held in the tension testing machine specified in S6.3.

S6.1.3 Prepare the test specimen in accordance with the preparation procedures specified in ASTM E8-89 (incorporated by reference, see §571.5).

S6.2 Determination of minimum allowable strength. For purposes of determining the minimum

allowable joint strength, determine the tensile strengths of the joined body components as follows:

(a) If the mechanical properties of a joint component material are specified in ASTM E8-89 (incorporated by reference, see §571.5), the lowest value of that material's thickness and tensile strength per unit of area shown in that source shall be used.

(b) If the mechanical properties of a material are not specified in ASTM E8-89 (incorporated by reference, see §571.5), determine its tensile strength by cutting a sheet specimen from outside the joint region of the bus body in accordance with Figure 1 of ASTM E8-89, and by testing it in accordance with S6.3.

(c) The cross sectional area of material removed to facilitate the installation of fasteners shall be subtracted from the cross-sectional area of the panel in the determination of the tensile strength of the weakest joined body panel.

S6.3 Strength Test.

S6.3.1 The joint specimen is gripped on opposite sides of the joint in a tension testing machine in accordance with ASTM E8-89 (incorporated by reference, see §571.5).

S6.3.2 Adjust the testing machine grips so that the applied force on the joint is at 90 degrees plus or minus 3 degrees from the joint centerline, as shown in Figure 1.

S6.3.3 A tensile force is applied to the specimen by separating the heads of the testing machine at any uniform rate not less than 3 mm and not more than 10 mm per minute until the specimen separates.

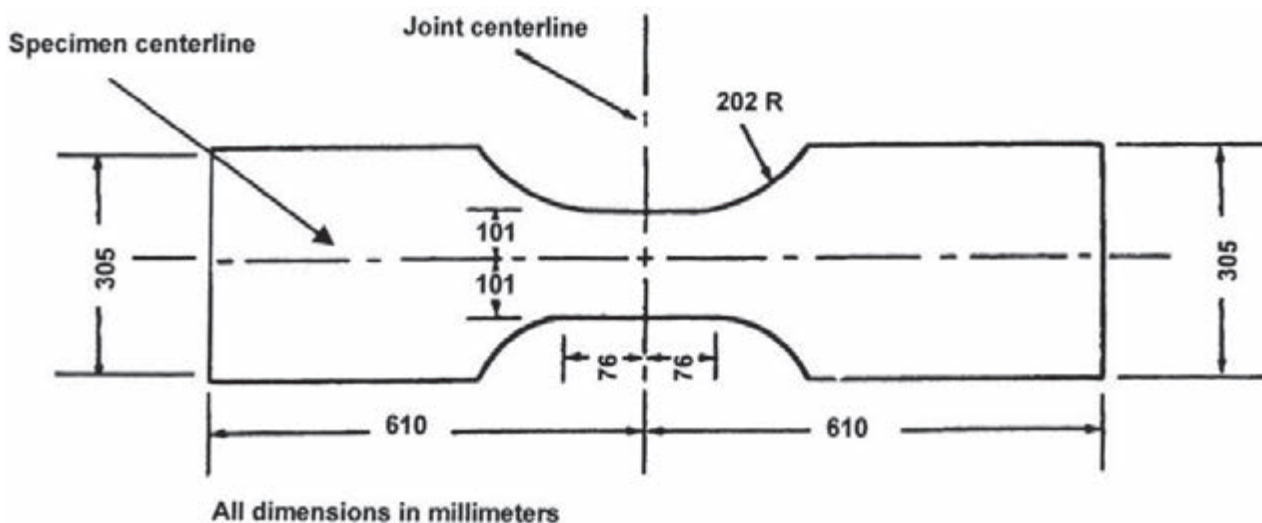


FIGURE 1

EDITORIAL NOTE : At 65 FR 11754, Mar. 6, 2000, §571.221 was amended by revising S5.2.1(a), effective Apr. 5, 2000. However, paragraph S5.2.1(a) does not exist in the text in effect at that time. The revised text reads as follows:

§571.221 Standard No. 221, School bus bodyjoint strength.

S5.2.1 The requirements of S5.1.1 and S5.1.2 do not apply to—
(a) Any interior maintenance access panel which lies forward of the passenger compartment, or which is less than 305 mm when measured across any two points diametrically on opposite sides of the opening.

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§571.222 Standard No. 222; School bus passenger seating and crash protection.

S1. Scope. This standard establishes occupant protection requirements for school bus passenger seating and restraining barriers.

S2. Purpose. The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from the impact of school bus occupants against structures within the vehicle during crashes and sudden driving maneuvers.

S3. Application. This standard applies to school buses.

S4. Definitions.

Contactable surface means any surface within the zone specified in S5.3.1.1 that is contactable from any direction by the test device described in S6.6, except any surface on the front of a seat back or restraining barrier 76 mm or more below the top of the seat back or restraining barrier.

Fixed occupancy seat means a bench seat equipped with Type 2 seat belts that has a permanent configuration regarding the number of seating positions on the seat. The number of seating positions on the bench seat cannot be increased or decreased.

Flexible occupancy seat means a bench seat equipped with Type 2 seat belts that can be reconfigured so that the number of seating positions on the seat can change. The seat has a minimum occupancy configuration and maximum occupancy configuration, and the number of passengers capable of being carried in the minimum occupancy configuration must differ from the number of passengers capable of being carried in the maximum occupancy configuration.

Maximum occupancy configuration means, on a bench seat equipped with Type 2 seat belts, an arrangement whereby the lap belt portion of the Type 2 seat belts is such that the maximum number of occupants can be belted.

Minimum occupancy configuration means, on a bench seat equipped with Type 2 seat belts, an arrangement whereby the lap belt portion of the Type 2 seat belts is such that the minimum number of occupants can be belted.

School bus passenger seat means a seat in a school bus, other than the driver's seat.

Seat bench width means the maximum transverse width of the bench seat cushion.

Small occupant seating position means the center seating position on a flexible occupancy seat in a maximum occupancy configuration, if the torso belt portion of the Type 2 seat belt is intended to restrain occupants whose dimensions range from those of a 50th percentile

6 year-old child only to those of a 50th percentile 10 year-old child and the torso belt anchor point cannot achieve a minimum height of 520 mm above the seating reference point, as specified by S4.1.3.2(a) of 49 CFR 571.210.

Wheelchair means a wheeled seat frame for the support and conveyance of a physically disabled person, comprised of at least a frame, seat, and wheels.

Wheelchair occupant restraint anchorage means the provision for transferring wheelchair occupant restraint system loads to the vehicle structure.

Wheelchair securement anchorage means the provision for transferring wheelchair securement device loads to the vehicle structure.

Wheelchair securement device means a strap, webbing or other device used for securing a wheelchair to the school bus, including all necessary buckles and other fasteners.

S4.1 The number of seating positions considered to be in a bench seat is expressed by the symbol W, and calculated as the bench width in millimeters divided by 381 and rounded to the nearest whole number.

(a) The number of seating positions considered to be in a bench seat for vehicles manufactured before October 21, 2011 is expressed by the symbol W, and calculated as the seat bench width in millimeters divided by 381 and rounded to the nearest whole number.

(b) The number of seating positions and the number of Type 1 seat belt positions considered to be in a bench seat for vehicles manufactured on or after October 21, 2011 is expressed by the symbol W, and calculated as the seat bench width in millimeters divided by 380 and rounded to the nearest whole number.

(c) Except as provided in S4.1(d), the number of Type 2 seat belt positions on a flexible occupancy seat in a minimum occupancy configuration or a fixed occupancy seat for vehicles manufactured on or after October 21, 2011 is expressed by the symbol Y, and calculated as the seat bench width in millimeters divided by 380 and rounded to the next lowest whole number. The minimum seat bench width for a seat equipped with a Type 2 seat belt is 380 mm. See Table 1 for an illustration.

(d) A flexible occupancy seat meeting the requirements of S4.1(c) may also have a maximum occupancy configuration with Y +1 Type 2 seat belt positions, if the minimum seat bench width for this configuration is Y +1 times 330 mm. See Table 1 for an illustration.

(e) A flexible occupancy seat equipped with Type 2 seat belts in a maximum occupancy configuration may have up to one single small occupant seating position.

TABLE 1—NUMBER OF SEATING POSITIONS AS A FUNCTION OF SEAT BENCH WIDTH

Seating configuration	Seat bench width (mm)				
	380–659	660–759	760–989	990–1139	1140–1319
Minimum or Fixed Occupancy	1	1	2	2	3
Maximum Occupancy	1	2	2	3	3

S5. Requirements.

(a) **Large school buses.**

(1) Each school bus manufactured before October 21, 2011 with a gross vehicle weight rating of more than

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4,536 kg (10,000 pounds) shall be capable of meeting any of the requirements set forth under this heading when tested under the conditions of S6. However, a particular school bus passenger seat (i.e., a test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or having been subjected to either S5.1.3, S5.1.4, or S5.3.

(2) Each school bus manufactured on or after October 21, 2011 with a gross vehicle weight rating of more than 4,536 kg (10,000 pounds) shall be capable of meeting any of the requirements set forth under this heading when tested under the conditions of S6 of this standard or §571.210. However, a particular school bus passenger seat (i.e., a test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or having been subjected to either S5.1.3, S5.1.4, S5.1.6 (if applicable), or S5.3. If S5.1.6.5.5(b) is applicable, a particular test specimen need only meet S5.1.6.5.5(b)(1) or (2) as part of meeting S5.1.6 in its entirety. Each vehicle with voluntarily installed Type 1 seat belts and seat belt anchorages at W seating positions in a bench seat, voluntarily installed Type 2 seat belts and seat belt anchorages at Y seat belt positions in a fixed occupancy seat, or voluntarily installed Type 2 seat belts and seat belt anchorages at Y and Y + 1 seat belt positions in a flexible occupancy seat, shall also meet the requirements of:

(i) S4.4.3.3 of Standard No. 208 (49 CFR 571.208);

Editor's Note: Paragraph S5(a)(2)(i) introductory text is revised effective November 28, 2016. Optional early compliance is permitted.

(i) S4.4.3.2 of Standard No. 208 (49 CFR 571.208);

Editor's Note: Paragraph S5(a)(2)(ii) is removed and reserved effective November 28, 2016. Optional early compliance is permitted.

(ii) Standard No. 209 (49 CFR 571.209), as they apply to school buses; and,

(iii) Standard No. 210 (49 CFR 571.210) as it applies to school buses with a gross vehicle weight rating greater than 10,000 pounds.

(b) **Small school buses.** Each vehicle with a gross vehicle weight rating of 4,536 kg (10,000 pounds) or less shall be capable of meeting the following requirements at all seating positions:

(1)(i) In the case of vehicles manufactured before September 1, 1991, the requirements of §§571.208, 571.209, and 571.210 as they apply to multipurpose passenger vehicles;

(ii) In the case of vehicles manufactured on or after September 1, 1991, the requirements of S4.4.3.3 of § 571.208 and the requirements of §§571.209 and 571.210 as they apply to school buses with a gross vehicle weight rating of 4,536 kg or less;\

(iii) In the case of vehicles manufactured on or after October 21, 2011 the requirements of S4.4.3.3(b) of §571.208 and the requirements of §§571.207, 571.209 and 571.210 as they apply to school buses with a gross vehicle weight rating of 4,536 kg or less; and,

Editor's Note: Paragraph S5(b)(1)(iii) introductory text is revised effective November 28, 2016. Optional early compliance is permitted.

(iii) In the case of vehicles manufactured on or after October 21, 2011 the requirements of S4.4.3.2 of §571.208 and the requirements of §§571.207, 571.209 and 571.210 as they apply to school buses with a gross vehicle weight rating of 4,536 kg or less; and,

(2) The requirements of S5.1.2, S5.1.3, S5.1.4, S5.1.5, S5.1.6, S5.1.7, S5.3, S5.4 and S5.5 of this standard. However, the requirements of §§ 571.208 and 571.210 shall be met at Y seat belt positions in a fixed occupancy seat, and at Y and Y + 1 seat belt positions for a flexible occupancy seat. A particular school bus passenger seat (i.e. a test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or after having been subjected to either S5.1.3, S5.1.4, S5.1.6, or S5.3 of this standard or § 571.207, § 571.210 or § 571.225.

S5.1 Seating requirements. School bus passenger seats shall be forward facing.

S5.1.1 [Reserved]

S5.1.2 Seat back height, position, and surface area.

(a) For school buses manufactured before October 21, 2009, each school bus passenger seat must be equipped with a seat back that has a vertical height of at least 508 mm (20 inches) above the seating reference point. Each school bus passenger seat must be equipped with a seat back that, in the front projected view, has front surface area above the horizontal plane that passes through the seating reference point, and below the horizontal plane 508 mm (20 inches) above the seating reference point, of not less than 90 percent of the seat bench width in millimeters multiplied by 508.

(b) For school buses manufactured on or after October 21, 2009, each school bus passenger seat must be equipped with a seat back that has a vertical height of at least 610 mm (24 inches) above the seating reference point. The minimum total width of the seat back at 610 mm (24 inches) above the seating reference point shall be 75 percent of the maximum width of the seat bench. Each school bus passenger seat must be equipped with a seat back that, in the front projected view, has front surface area above the horizontal plane that passes through the seating reference point, and below the horizontal plane 610 mm (24 inches) above the seating reference point, of not less than 90 percent of the seat bench width in millimeters multiplied by 610.

S5.1.3 Seat performance forward. When a school bus passenger seat that has another seat behind it is subjected to the application of force as specified in S5.1.3.1 and S5.1.3.2, and subsequently, the application of additional force to the seat back as specified in S5.1.3.3 and S5.1.3.4:

(a) The seat back force/deflection curve shall fall within the zone specified in Figure 1;

(b) Seat back deflection shall not exceed 356 mm; (for determination of (a) and (b) the force/deflection curve

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describes only the force applied through the upper loading bar, and only the forward travel of the pivot attachment point of the upper loading bar, measured from the point at which the initial application of 44 N of force is attained.)

(c) The seat shall not deflect by an amount such that any part of the seat moves to within 102 mm of any part of another school bus passenger seat or restraining barrier in its originally installed position;

(d) The seat shall not separate from the vehicle at any attachment point; and

(e) Seat components shall not separate at any attachment point.

S5.1.3.1 Position the loading bar specified in S6.5 so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in any horizontal plane between 102 mm above and 102 mm below the seating reference point of the school bus passenger seat behind the test specimen.

S5.1.3.2 Apply a force of 3,114W newtons horizontally in the forward direction through the loading bar at the pivot attachment point. Reach the specified load in not less than 5 nor more than 30 seconds.

S5.1.3.3 No sooner than 1.0 second after attaining the required force, reduce that force to 1,557W newtons and, while maintaining the pivot point position of the first loading bar at the position where the 1,557W newtons is attained, position a second loading bar described in S6.5 so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 406 mm above the seating reference point of the school bus passenger seat behind the test specimen, and move the bar forward against the seat back until a force of 44 N has been applied.

S5.1.3.4 Apply additional force horizontally in the forward direction through the upper bar until 452W joules of energy have been absorbed in deflecting the seat back (or restraining barrier). Apply the additional load in not less than 5 seconds nor more than 30 seconds. Maintain the pivot attachment point in the maximum forward travel position for not less than 5 seconds nor more than 10 seconds and release the load in not less than 5 nor more than 30 seconds. (For the determination of S5.1.3.4 the force/deflection curve describes only the force applied through the upper loading bar, and the forward and rearward travel distance of the upper loading bar pivot attachment point measured from the position at which the initial application of 44 N of force is attained.)

S5.1.4 Seat performance rearward. When a school bus passenger seat that has another seat behind it is subjected to the application of force as specified in S5.1.4.1 and S5.1.4.2:

(a) Seat back force shall not exceed 9,786 N;

(b) Seat back deflection shall not exceed 254 mm; (for determination of (a) and (b) the force/deflection curve describes only the force applied through the loading bar, and only the rearward travel of the pivot attachment point of the loading bar, measured from the point at which the initial application of 222 N is attained.

(c) The seat shall not deflect by an amount such that any part of the seat moves to within 102 mm of any part of another passenger seat in its originally installed position;

(d) The seat shall not separate from the vehicle at any attachment point; and

(e) Seat components shall not separate at any attachment point.

S5.1.4.1 Position the loading bar described in S6.5 so that it is laterally centered forward of the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 343 mm above the seating reference point of the test specimen, and move the loading bar rearward against the seat back until a force of 222 N has been applied.

S5.1.4.2 Apply additional force horizontally rearward through the loading bar until 316W joules (J) of energy has been absorbed in deflecting the seat back. Apply the additional load in not less than 5 seconds nor more than 30 seconds. Maintain the pivot attachment point in the maximum rearward travel position for not less than 5 seconds nor more than 10 seconds and release the load in not less than 5 seconds nor more than 30 seconds. (For determination of S5.1.4.2 the force deflection curve describes the force applied through the loading bar and the rearward and forward travel distance of the loading bar pivot attachment point measured from the position at which the initial application of 222 N of force is attained.)

S5.1.5 Seat cushion latching and retention.

(a) School bus passenger seat cushions equipped with attachment devices that allow for the seat cushion to be removable without tools or to flip up must have a self-latching mechanism that latches when subjected to the conditions specified in S5.1.5.1. The seat cushion shall not separate from the seat at any attachment point when subjected to the conditions specified in S5.1.5.2 after being subjected to the conditions of S5.1.5.1.

(b) School bus passenger seat cushions that are removable only with the use of tools shall not separate from the seat at any attachment point when subjected to the conditions of S5.1.5.2.

S5.1.5.1 Release the seat cushion self-latching mechanism. Lift the seat cushion then place the seat cushion back in the down position without activating the self-latching mechanism, if possible. Apply a downward force of 216 N (48.4 pounds) to the center of the seat cushion. The downward force shall be applied in any period of not less than 1 and not more than 5 seconds, and maintained for 5 seconds.

S5.1.5.2 Apply an upward force of 5 times the weight of the seat cushion to the center of the bottom of the seat cushion. The upward force shall be applied in any period of not less than 1 and not more than 5 seconds, and maintained for 5 seconds.

S5.1.6 Quasi-static test of compartmentalization and Type 2 seat belt performance. This section applies

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to school buses manufactured on or after October 21, 2011 with a gross vehicle weight rating expressed in the first column of Tables 2 through 4, and that are equipped with Type 2 seat belt assemblies.

(a) Except as provided in S5.1.6(b), when tested under the conditions of S5.1.6.5.1 through S5.1.6.5.6, the criteria specified in S5.1.6.1 and S5.1.6.2 must be met.

(b) A school bus passenger seat that does not have another seat behind it is not loaded with the upper and lower loading bars as specified in S5.1.6.5.2, S5.1.6.5.3, and S5.1.6.5.7 and is excluded from the requirements of S5.1.6.1(b).

S5.1.6.1 Displacement limits. In Tables 2 and 3, AH is the height in millimeters of the school bus torso belt anchor point specified by S4.1.3.2(a) of Standard No. 210 (49 CFR 571.210) and Φ is the angle of the posterior surface of the seat back defined in S5.1.6.3 of this standard.

(a) Any school bus torso belt anchor point, as defined in S3 of Standard No. 210, must not displace horizontally forward from its initial position (when Φ was determined) more than the value in millimeters calculated from the following expression in the second column of Table 2:

TABLE 2—TORSO BELT ANCHOR POINT DISPLACEMENT LIMIT

Gross vehicle weight rating	Displacement limit in millimeters
More than 4,536 kg (10,000 pounds).	$(AH + 100) (\tan\Phi + 0.242/\cos\Phi)$
Less than or equal to 4,536 kg (10,000 pounds).	$(AH + 100) (\tan\Phi + 0.356/\cos\Phi)$

(b) A point directly rearward of any school bus torso belt anchor point, as defined in S3 of Standard No. 210 (49 CFR 571.210) on the rear facing surface of the seat back, must not displace horizontally forward from its initial position (when Φ was determined) more than the value in millimeters calculated from the following expression in the second column of Table 3:

TABLE 3—SEAT BACK POINT DISPLACEMENT LIMIT

Gross vehicle weight rating	Displacement limit in millimeters
More than 4,536 kg (10,000 pounds).	$(AH + 100) (\tan\Phi + 0.174/\cos\Phi)$
Less than or equal to 4,536 kg (10,000 pounds).	$(AH + 100) (\tan\Phi + 0.259/\cos\Phi)$

S5.1.6.2 Slippage of device used to achieve torso belt adjusted height. If the torso belt adjusted height, as defined in S3 of Standard No. 210 (49 CFR 571.210), is achieved without the use of an adjustable torso belt anchorage, the adjustment device must not slip more than 25 mm (1.0 inches) along the webbing or guide material upon which it moves for the purpose of adjusting the torso belt height.

S5.1.6.3 Angle of the posterior surface of a seat back. If the seat back inclination is adjustable, the seat back is placed in the manufacturer's normal design riding position. If such a position is not specified, the seat back is positioned so it is in the most upright position. Position the loading bar specified in S6.5 of this stan-

dard so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle in a horizontal plane within 6 mm (0.25 inches) of the horizontal plane passing through the seating reference point and move the bar forward against the seat back until a force of 44 N (10 pounds) has been applied. Position a second loading bar as described in S6.5 of this standard so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 406 mm (16 inches) above the seating reference point, and move the bar forward against the seat back until a force of 44 N (10 pounds) has been applied. Determine the angle from vertical of a line in the longitudinal vehicle plane that passes through the geometric center of the cross-section of each cylinder, as shown in Figure 8. That angle is the angle of the posterior surface of the seat back.

S5.1.6.4 The seat back must absorb 452W joules of energy when subjected to the force specified in S5.1.6.5.7.

S5.1.6.5 Quasi-static test procedure.

S5.1.6.5.1 Adjust the seat back as specified in S5.1.6.3. Place all torso anchor points in their highest position of adjustment. If the torso belt adjusted height, as defined in S3 of FMVSS No. 210, is achieved by a method other than an adjustable anchor point, initially place the torso belt adjusted height at its highest position. Then move the adjustment device 38 mm (1.5 inches) downward with respect to its webbing or guide material.

S5.1.6.5.2 Position the lower loading bar specified in S6.5 of this standard so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in any horizontal plane between 102 mm (4 inches) above and 102 mm (4 inches) below the seating reference point of the school bus passenger seat behind the test specimen. Position the upper loading bar described in S6.5 so that it is laterally centered behind the seat back with the bar's longitudinal axis in a transverse plane of the vehicle and in the horizontal plane 406 mm (16 inches) above the seating reference point of the school bus passenger seat behind the test specimen.

S5.1.6.5.3 Apply a force of 3,114W N (700W pounds) horizontally in the forward direction through the lower loading bar specified at S6.5 at the pivot attachment point. Reach the specified load in not less than 5 and not more than 30 seconds. No sooner than 1.0 second after attaining the required force, reduce that force to 1,557W N (350W pounds) and maintain the pivot point position of the loading bar at the position where the 1,557W N (350W pounds) is attained until the completion of S5.1.6.5.7 of this standard.

S5.1.6.5.4 Position the body block specified in Figure 3 of FMVSS No. 210 (49 CFR 571.210) under each torso belt (between the torso belt and the seat back) in the passenger seat and apply a preload force of 600 50 N (135 11 pounds) on each body block in a forward direction parallel to the longitudinal centerline of the vehicle pursuant to the specifications of Standard No. 210 (49 CFR 571.210). After preload application is complete, the origin of the 203 mm body block radius at any point across the 102 mm body block thickness shall lie within

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the zone defined by S5.1.6.5.4(a) and S5.1.6.5.4(b) as shown in Figure 9:

- (a) At or rearward of a transverse vertical plane of the vehicle located 100 mm longitudinally forward of the seating reference point.
- (b) Within 75 mm of the horizontal plane located midway between the horizontal plane passing through the school bus torso belt adjusted height, specified in S3 of

Standard No. 210 (49 CFR 571.210), and the horizontal plane 100 mm below the seating reference point.

S5.1.6.5.5 Load application.

- (a) **Fixed Occupancy Seat.** For school buses with the gross vehicle weight rating listed in the first column of Table 4, if the expression in the second column is true, simultaneously apply the force listed in the third column to each body block.

TABLE 4—TORSO BODY BLOCK FORCES FOR FIXED OCCUPANCY SEATS

Gross vehicle weight rating	True expression	Applied force
More than 4,536 kg (10,000 pounds).....	((seat bench width in mm)—(380Y)) ≤ 25 mm (1 inch).	3,300 N (742 pounds).
More than 4,536 kg (10,000 pounds).....	((seat bench width in mm)—(380Y)) > 25 mm (1 inch).	5,000 N (1,124 pounds).
Less than or equal to 4,536 kg (10,000 pounds).	((seat bench width in mm)—(380Y)) ≤ 25 mm (1 inch).	5,000 N (1,124 pounds).
Less than or equal to 4,536 kg (10,000 pounds).	((seat bench width in mm)—(380Y)) > 25 mm (1 inch).	7,500 N (1,686 pounds).

(b) Flexible Occupancy Seat.

- (b)(1) For school buses with the gross vehicle weight rating listed in the first column of Table 5 and a bench seat in the maximum occupancy configuration for a flexible occupancy seat of Y+1 seat belt positions as specified in S4.1(d), simultaneously apply the force listed in the second column of Table 5 to each body block.

TABLE 5—TORSO BODY BLOCK FORCES IN MAXIMUM OCCUPANCY CONFIGURATION

Gross vehicle weight rating	Applied force
More than 4,536 kg (10,000 pounds).	3,300 N (742 pounds).
Less than or equal to 4,536 kg (10,000 pounds).	5,000 N (1,124 pounds).

- (2) For a flexible occupancy seat in the minimum occupant configuration, apply the forces to each body block as specified in S5.1.6.5.5(a).

S5.1.6.5.6 Reach the specified load in not less than 5 and not more than 30 seconds. While maintaining the load, measure the school bus torso belt anchor point and seat back point horizontal displacement and then remove the body block.

S5.1.6.5.7 Move the upper bar forward against the seat back until a force of 44 N has been applied. Apply an additional force horizontally in the forward direction through the upper bar until 452W joules of energy have been absorbed in deflecting the seat back. The maximum travel of the pivot attachment point for the upper loading bar shall not exceed 356 mm as measured from the position at which the initial application of 44 N of force is attained and the maximum load must stay below the upper boundary of the force/deflection zone in Figure 1. Apply the additional load in not less than 5 seconds and not more than 30 seconds. Maintain the pivot attachment point at the maximum forward travel position for not less than 5 seconds, and not more than 10 seconds and release the load in not less than 5 seconds and not more than 30 seconds. (For the determination of S5.1.6.5.7, the energy calculation describes only the force applied through the upper loading bar, and the forward and rearward travel distance of the upper loading bar

pivot attachment point measured from the position at which the application in this section of 44 N of force is attained.)

S5.1.7 **Buckle side length limit.** This section applies to rear passenger seats on school buses manufactured on or after October 21, 2011 that are equipped with Type 1 or Type 2 seat belt assemblies. All portions of the buckle/latchplate assembly must remain rearward of the limit plane defined in S5.1.7.1 when tested under the conditions of S5.1.7.2.

S5.1.7.1 **Buckle/latchplate limit plane.** Establish a transverse limit plane 65 mm from the SgRP that is perpendicular to a transverse plane that passes through the SgRP at an angle of 50 degrees to the horizontal.

S5.1.7.2 **Load application.** Insert the seat belt latchplate into the seat belt buckle. Apply a 20 N load to the buckle/latchplate assembly whose vector is in a vertical longitudinal plane. Apply the load along the centerline of the webbing attached to the latchplate at least 100mm from the nearest point on the latchplate. The load may be applied at any angle in the range of 30 to 75 degrees from horizontal.

S5.2 **Restraining barrier requirements.** Each vehicle shall be equipped with a restraining barrier forward of any designated seating position that does not have the rear surface of another school bus passenger seat within 610 mm of its seating reference point, measured along a horizontal longitudinal line through the seating reference point in the forward direction.

S5.2.1 **Barrier-seat separation.** The horizontal distance between the restraining barrier's rear surface and the seating reference point of the seat in front of which the barrier is required shall not be more than 610 mm measured along a horizontal longitudinal line through the seating reference point in the forward direction.

S5.2.2 **Barrier position and rear surface area.** The position and rear surface area of the restraining barrier shall be such that, in a front projected view of the bus, each point of the barrier's perimeter coincides with or lies outside of the perimeter of the seat back of the seat for which it is required.

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S5.2.3 Barrier performance forward. When force is applied to the restraining barrier in the same manner as specified in S5.1.3.1 through S5.1.3.4 for seating performance tests:

(a) The restraining barrier force/deflection curve shall fall within the zone specified in Figure 1;

(b) Restraining barrier deflection shall not exceed 356 mm; (for computation of (a) and (b) the force/deflection curve describes only the force applied through the upper loading bar, and only the forward travel of the pivot attachment point of the loading bar, measured from the point at which the initial application of 44 N of force is attained.)

(c) Restraining barrier deflection shall not interfere with normal door operation;

(d) The restraining barrier shall not separate from the vehicle at any attachment point; and

(e) Restraining barrier components shall not separate at any attachment point.

S5.3 Impact zone requirements.

S5.3.1 Head protection zone. Any contactable surface of the vehicle within any zone specified in S5.3.1.1 shall meet the requirements of S5.3.1.2 and S5.3.1.3. However, a surface area that has been contacted pursuant to an impact test need not meet further requirements contained in S5.3.

S5.3.1.1 The head protection zones in each vehicle are the spaces in front of each school bus passenger seat which are not occupied by bus sidewall, window, or door structure and which, in relation to that seat and its seating reference point, are enclosed by the following planes;

(a) Horizontal planes 305 mm and 1016 mm above the seating reference point;

(b) A vertical longitudinal plane tangent to the inboard (aisle side) edge of the seat; and

(c) A vertical longitudinal plane 83 mm inboard of the outboard edge of the seat;

(d) Vertical transverse planes through and 762 mm forward of the reference point.

S5.3.1.2 Head form impact requirement. When any contactable surface of the vehicle within the zones specified in S5.3.1.1 is impacted from any direction at 6.7 m/s by the head form described in S6.6, the axial acceleration at the center of gravity of the head form shall be such that the expression

$$\left[\frac{1}{(t_1 - t_2)} \int_{t_1}^{t_2} a dt \right]^{25} (t_1 - t_2)$$

shall not exceed 1,000 where “a” is the axial acceleration expressed as a multiple of “g” (the acceleration due to gravity), and “t₁” and “t₂” are any two points in time during the impact.

S5.3.1.3 Head form force distribution. When any contactable surface of the vehicle within the zones specified in S5.3.1.1 is impacted from any direction at 6.7 m/s by the head form described in S6.6, the energy necessary

to deflect the impacted material shall be not less than 4.5 joules before the force level on the head form exceeds 667 N. When any contactable surface within such zones is impacted by the head form from any direction at 1.5 m/s the contact area on the head form surface shall be not less than 1,935 mm².

S5.3.2 Leg protection zone. Any part of the seat backs or restraining barriers in the vehicle within any zone specified in S5.3.2.1 shall meet the requirements of S5.3.2.2.

S5.3.2.1 The leg protection zones of each vehicle are those parts of the school bus passenger seat backs and restraining barriers bounded by horizontal planes 305 mm above and 102 mm below the seating reference point of the school bus passenger seat immediately behind the seat back or restraining barrier.

S5.3.2.2 When any point on the rear surface of that part of a seat back or restraining barrier within any zone specified in S5.3.2.1 is impacted from any direction at 4.9 m/s by the knee form specified in S6.7, the resisting force of the impacted material shall not exceed 2,669 N and the contact area on the knee form surface shall not be less than 1,935 mm².

S5.4.1.2 The wheelchair securement anchorages at each wheelchair location shall be situated so that—

(a) A wheelchair can be secured in a forward-facing position.

(b) The wheelchair can be secured by wheelchair securement devices at two locations in the front and two locations in the rear.

(c) The front wheel of a three-wheeled wheelchair can be secured.

S5.4.1.3 Each wheelchair securement anchorage shall be capable of withstanding a force of 13,344 Newtons applied as specified in paragraphs (a) through (d) of this section. When more than one securement device share a common anchorage, the anchorage shall be capable of withstanding a force of 13,344 Newtons multiplied by the number of securement devices sharing that anchorage.

(a) The initial application force shall be applied at an angle of not less than 30 degrees, but not more than 60 degrees, measured from the horizontal. (See Figure 4.)

(b) The horizontal projection of the force direction shall be within a horizontal arc of ±45 degrees relative to a longitudinal line which has its origin at the anchorage location and projects rearward for an anchorage whose wheelchair securement device is intended to secure the front of the wheelchair and forward for an anchorage whose wheelchair securement device is intended to secure the rear of the wheelchair. (See Figure 4.)

(c) The force shall be applied at the onset rate of not more than 133,440 Newtons per second.

(d) The 13,344 Newton force shall be attained in not more than 30 seconds, and shall be maintained for 10 seconds.

S5.4.2 Wheelchair securement devices. Each wheelchair securement device shall—

(a) If incorporating webbing or a strap—

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(1) Comply with the requirements for Type 1 safety belt systems in S4.2, S4.3, and S4.4(a) of FMVSS No. 209, **Seat Belt Assemblies**; and

(2) Provide a means of adjustment to remove slack from the device.

(b) If not incorporating webbing or a strap, limit movement of the wheelchair through either the equipment design or a means of adjustment.

S5.4.3 Wheelchair occupant restraint anchorages.

S5.4.3.1 Each wheelchair location shall have:

(a) Not less than one anchorage for the upper end of the upper torso restraint; and

(b) Not less than two floor anchorages for wheelchair occupant pelvic and upper torso restraint.

S5.4.3.2 Each wheelchair occupant restraint floor anchorage shall be capable of withstanding a force of 13,344 Newtons applied as specified in paragraphs (a) through (d). When more than one wheelchair occupant restraint share a common anchorage, the anchorage shall be capable of withstanding a force of 13,344 Newtons multiplied by the number of occupant restraints sharing that anchorage.

(a) The initial application force shall be applied at an angle of not less than 45 degrees, but not more than 80 degrees, measured from the horizontal. (See Figure 5.)

(b) The horizontal projection of the force direction shall be within a horizontal arc of ± 45 degrees relative to a longitudinal line which has its origin at the anchorage and projects forward. (See Figure 5.)

(c) The force shall be applied at an onset rate of not more than 133,440 Newtons per second.

(d) The 13,344 Newton force shall be attained in not more than 30 seconds, and shall be maintained for 10 seconds.

(e) When a wheelchair securement device and an occupant restraint share a common anchorage, including occupant restraint designs that attach the occupant restraint to the securement device or the wheelchair, the loads specified by S5.4.1.3 and S5.4.3.2 shall be applied simultaneously, under the conditions specified in S5.4.3.2 (a) and (b). (See Figure 6.)

S5.4.3.3 Each anchorage for a wheelchair occupant upper torso restraint shall be capable of withstanding a force of 6,672 Newtons applied as specified in paragraphs (a) through (d).

(a) The initial application force shall be applied at a vertical angle of not less than zero degrees, but not more than 40 degrees, below a horizontal plane which passes through the anchorage. (See Figure 7.)

(b) The projection of the force direction onto the horizontal plane shall be within zero degrees and 45 degrees as measured from a longitudinal line with its origin at the anchorage and projecting forward. (See Figure 7.)

(c) The force shall be applied at the onset rate of not more than 66,720 Newtons per second.

(d) The 6,672 Newton force shall be attained in not more than 30 seconds, and shall be maintained for 10 seconds.

S5.4.4 Wheelchair occupant restraints.

(a) Each wheelchair location shall have wheelchair occupant pelvic and upper torso restraints attached to the anchorages required by S5.4.3.

(b) Each wheelchair occupant restraint shall comply with the requirements for Type 2 safety belt systems in S4.2, S4.3, and S4.4(b) of FMVSS No. 209, **Seat Belt Assemblies**.

S5.5 Labeling.

(a) A small occupant seating position must be permanently and legibly marked or labeled with the phrase: "Do Not Sit In Middle Seat If Over Age 10". The phrase must be comprised of no more than two lines of text. The label must be placed on the torso belt portion of the Type 2 seat belt. It must be plainly visible and easily readable when the seat belt is in a stored position. The distance from the top edge of the top line of text to the bottom edge of the bottom line of text must be at least 35 mm. If the label is sewn on, it must be stitched around its entire perimeter.

(b) [Reserved]

S6. **Test conditions.** The following conditions apply to the requirements specified in S5.

S6.1 **Test surface.** The bus is at rest on a level surface.

S6.2 **Tires.** Tires are inflated to the pressure specified by the manufacturer for the gross vehicle weight rating.

S6.3 **Temperature.** The ambient temperature is any level between 0 degrees C and 32 degrees C.

S6.4 **Seat back position.** If adjustable, a seat back is adjusted to its most upright position.

S6.5 **Loading bar.** The loading bar is a rigid cylinder with an outside diameter of 152 mm that has hemispherical ends with radii of 76 mm and with a surface roughness that does not exceed 6 μm , root mean square. The length of the loading bar is 102 mm less than the width of the seat back in each test. The stroking mechanism applies force through a pivot attachment at the center point of the loading bar which allows the loading bar to rotate in a horizontal plane 30 degrees in either direction from the transverse position.

S6.5.1 A vertical or lateral force of 17,792 N applied externally through the pivot attachment point of the loading bar at any position reached during a test specified in this standard shall not deflect that point more than 25 mm.

S6.6 **Head form.** The head form for the measurement of acceleration is a rigid surface comprised of two hemispherical shapes, with total equivalent mass of 5.2 kg. The first of the two hemispherical shapes has a diameter of 166 mm. The second of the two hemispherical shapes has a 50 mm diameter and is centered as shown in Figure 3 to protrude from the outer surface of the first hemispherical shape. The surface roughness of the hemispherical shapes does not exceed 1.6 μm , root mean square.

S6.6.1 The direction of travel of the head form is coincidental with the straight line connecting the centerpoints of the two spherical outer surfaces which constitute the head form shape.

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S6.6.2 The head form is instrumented with an acceleration sensing device whose output is recorded in a data channel that conforms to the requirements for a 1,000 Hz channel class as specified in SAE Recommended Practice J211a (1971) (incorporated by reference, see §571.5). The head form exhibits no resonant frequency below three times the frequency of the channel class. The axis of the acceleration sensing device coincides with the straight line connecting the centerpoints of the two hemispherical outer surfaces which constitute the head form shape.

S6.6.3 The head form is guided by a stroking device so that the direction of travel of the head form is not affected by impact with the surface being tested at the levels called for in the standard.

S6.7 **Knee form.** The knee form for measurement of force is a rigid 76 millimeter-diameter cylinder, with an equivalent weight of 44 N that has one hemispherical end with a 38 mm radius forming a contact surface of the knee form. The hemispherical surface roughness does not exceed 1.6 μm , root mean square.

S6.7.1 The direction of travel of the knee form is coincidental with the centerline of the rigid cylinder.

S6.7.2 The knee form is instrumented with an acceleration sensing device whose output is recorded in a data channel that conforms to the requirements of a 600 Hz channel class as specified in SAE Recommended Practice J211a (1971) (incorporated by reference, see §571.5). The knee form exhibits no resonant frequency below three times the frequency of the channel class. The axis of the acceleration sensing device is aligned to measure acceleration along the centerline of the cylindrical knee form.

S6.7.3 The knee form is guided by a stroking device so that the direction of travel of the knee form is not affected by impact with the surface being tested at the levels called for in the standard.

S6.8 The head form, knee form, and contactable surfaces are clean and dry during impact testing.

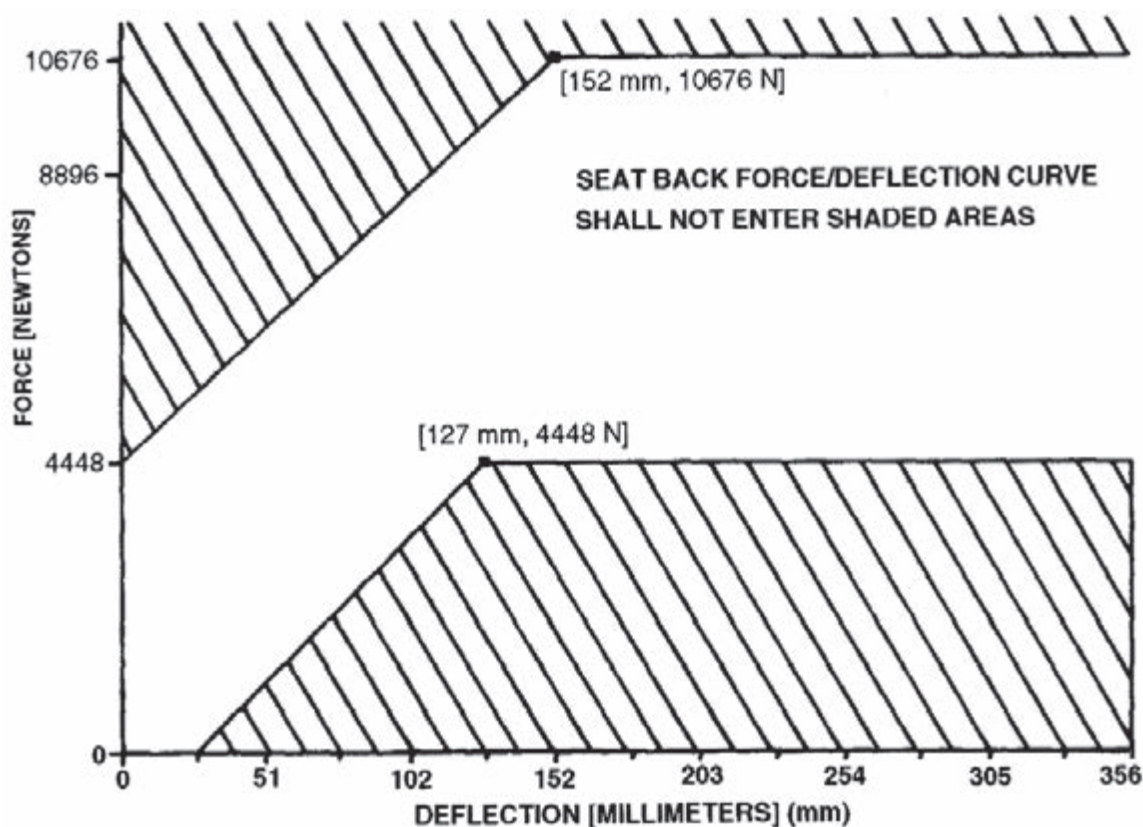


Figure 1.—Force/Deflection Zone

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Reserved

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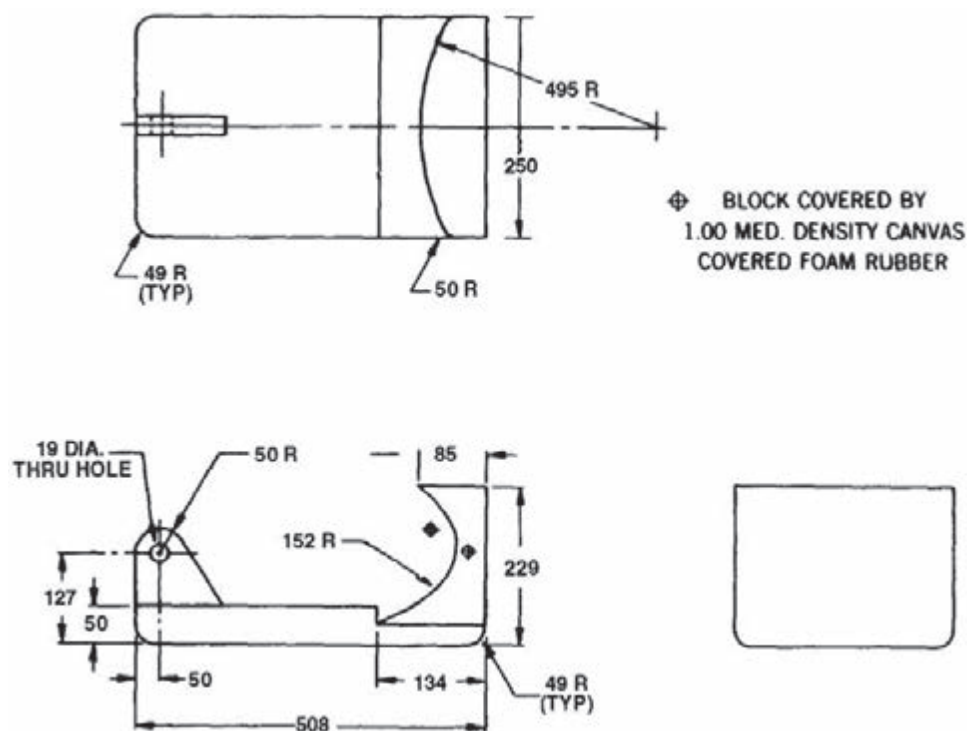


Figure 2-Body Block for Lap Belt All Dimension in Millimeters(mm)

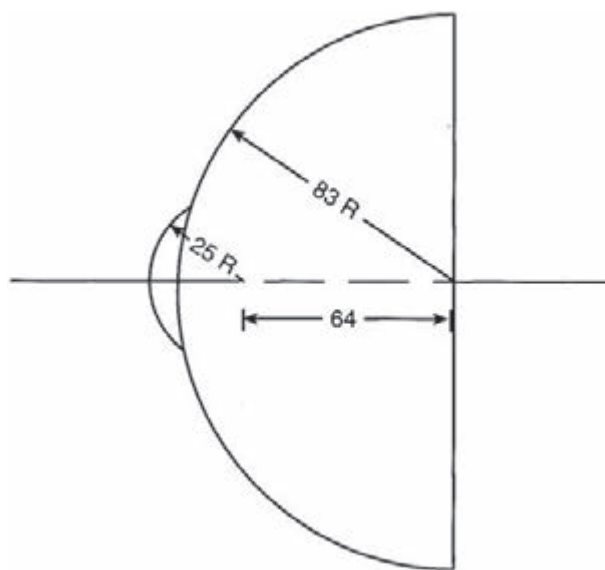


Figure 3

All dimensions in millimeters (mm)

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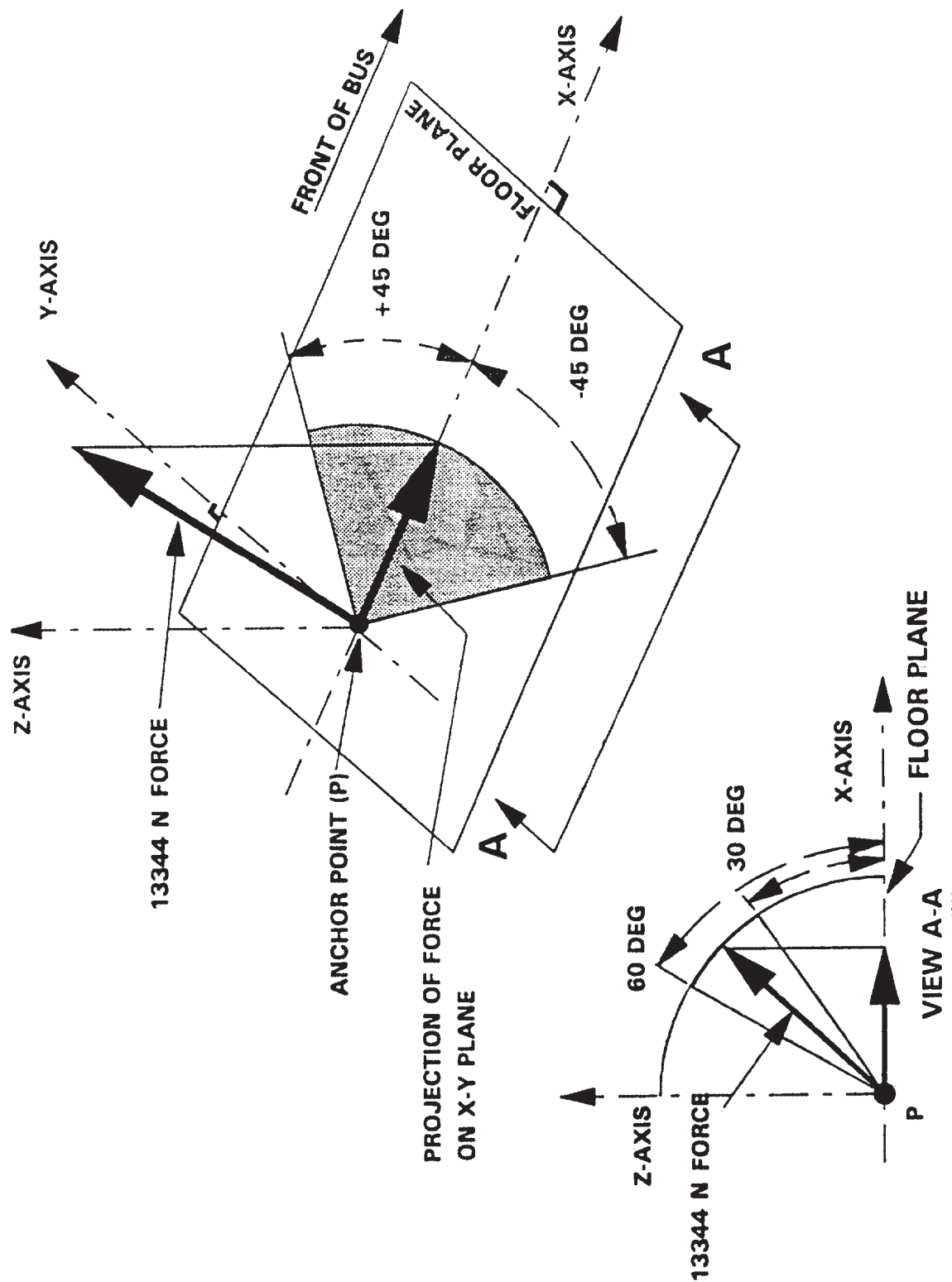


Figure 4. Wheelchair Securement Anchorage Loading Direction (Rear Anchorage Shown)

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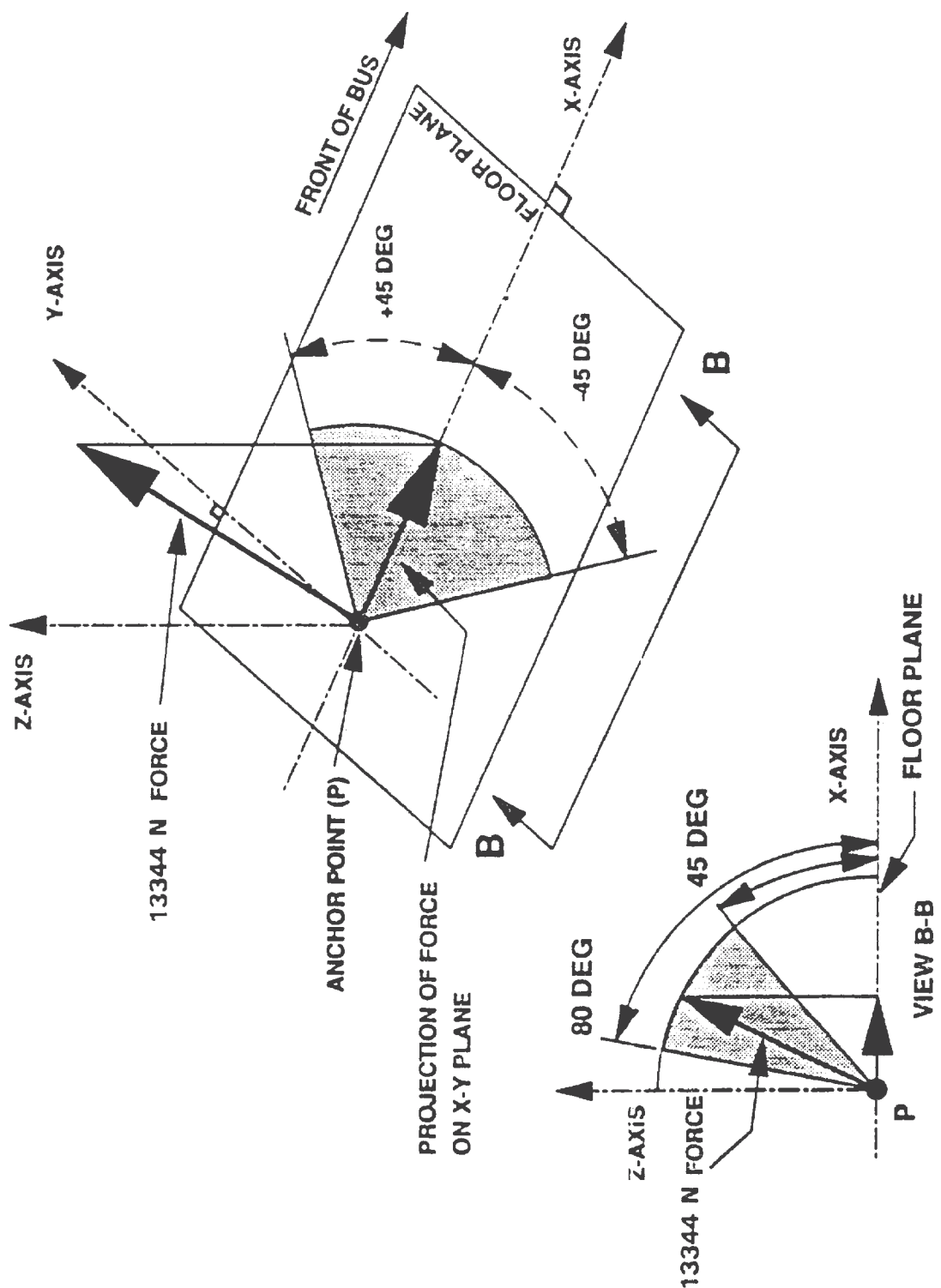


Figure 5. Pelvic Restraint Anchorage Loading Direction

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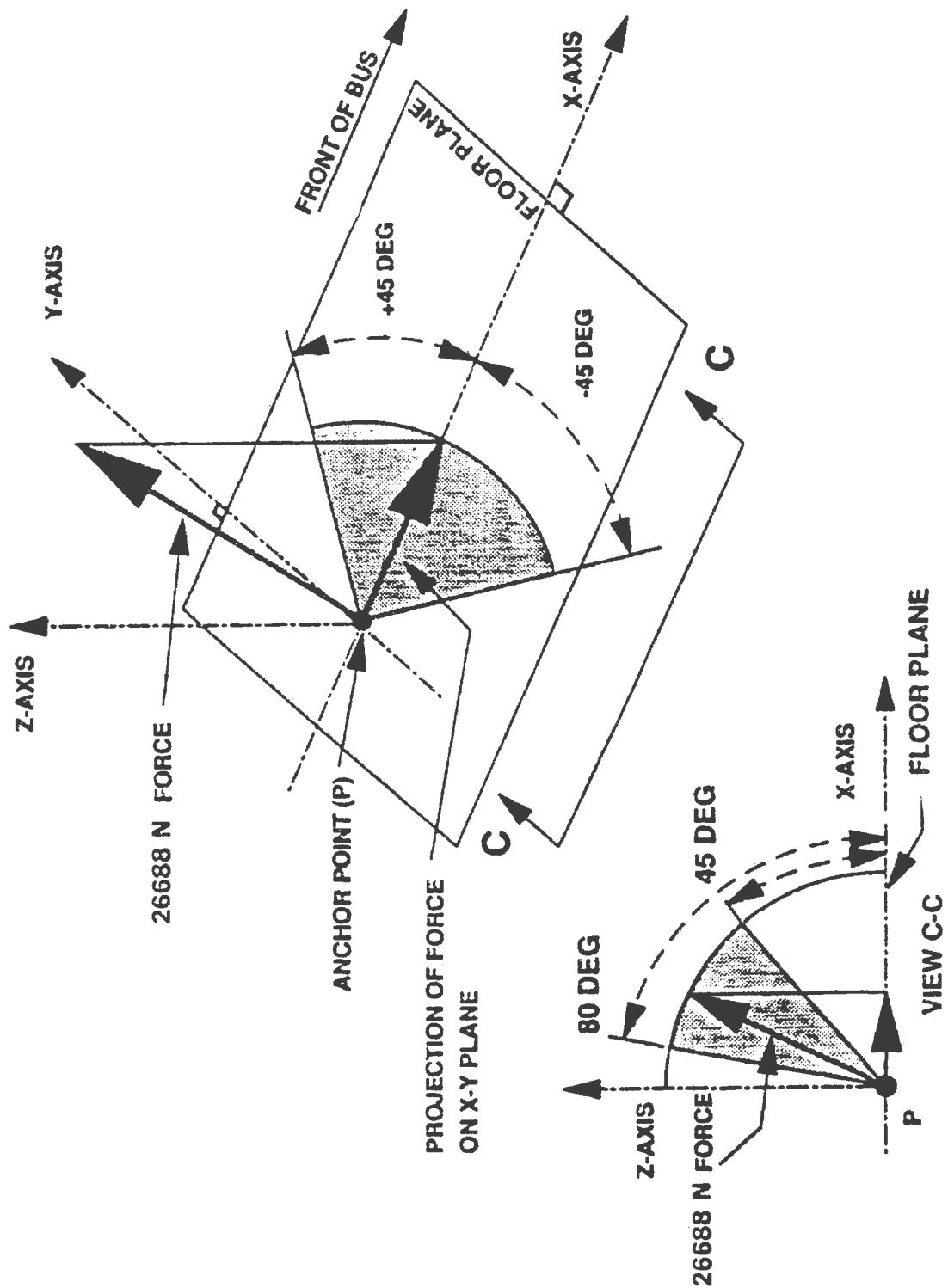


Figure 6. Pelvic Restraint and Wheelchair Securement Common Anchorage Loading Direction(Rear Direction Only)

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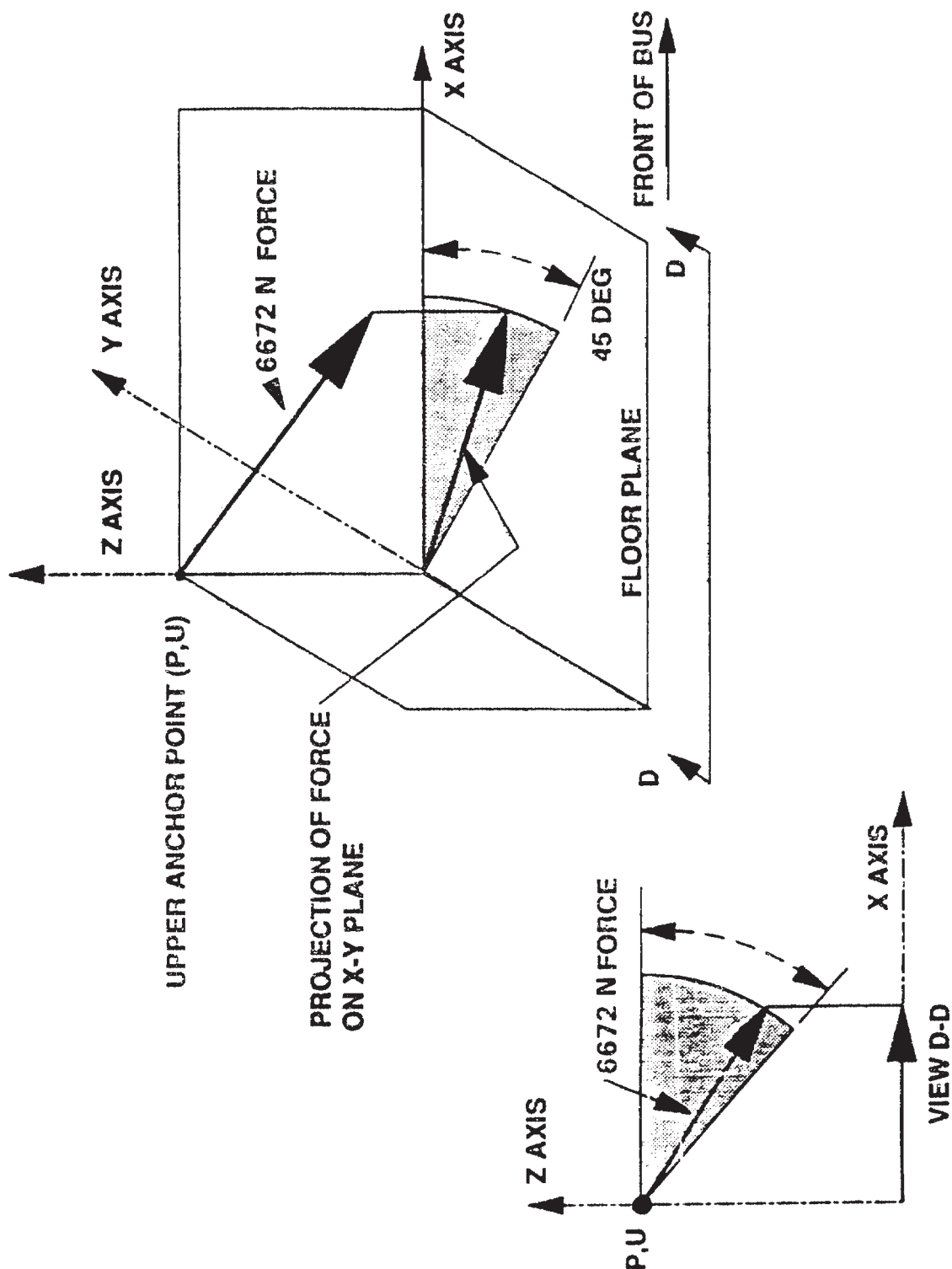


Figure 7. Upper Torso Restraint and Torso Harness Anchorage Loading Location

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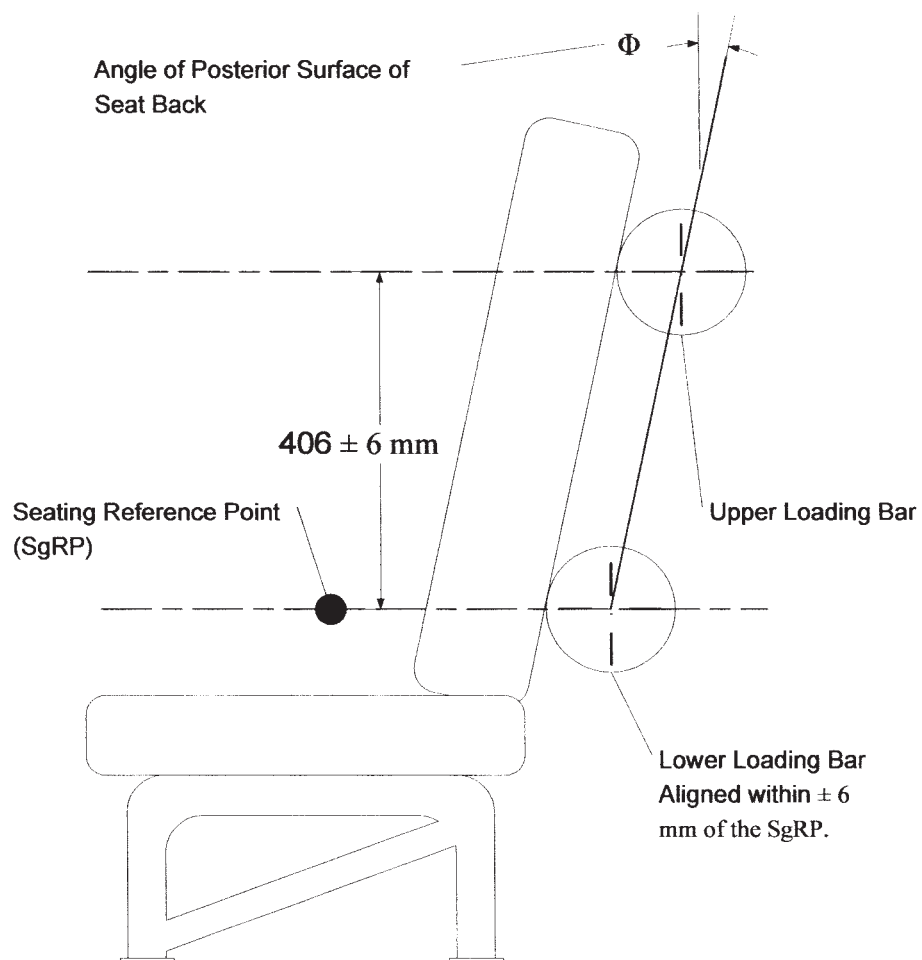


Figure 8—Definition of angle of compartmentalizing seat back surface

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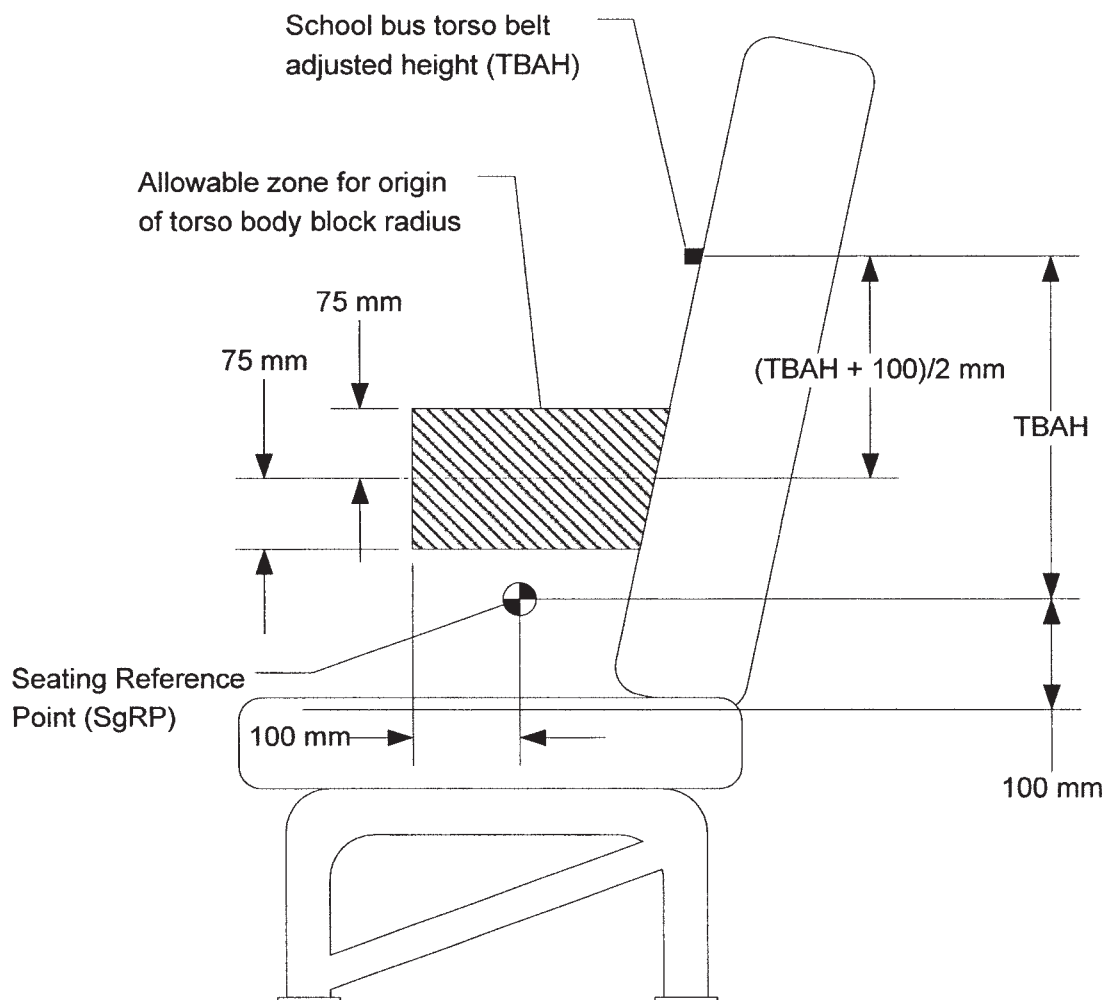


Figure 9—Torso block zone

§571.223 Standard No. 223; rear impact guards.

S1. Scope. This standard specifies requirements for rear impact guards for trailers and semitrailers.

S2. Purpose. The purpose of this standard is to reduce the number of deaths and serious injuries that occur when light duty vehicles collide with the rear end of trailers and semitrailers.

S3. Application. This standard applies to rear impact guards for trailers and semitrailers subject to Federal Motor Safety Standard No. 224, *Rear Impact Protection* (Sec. 571.224).

S4. Definitions.

In this standard, directional terms such as **bottom**, **center**, **height**, **horizontal**, **longitudinal**, **transverse**, and **rear** refer to directions relative to the vehicle orientation when the guard is oriented as if it were installed on a vehicle according to the installation instructions in S5.5 of this section.

Chassis means the load supporting frame structure of a motor vehicle.

Guard width means the maximum horizontal guard dimension that is perpendicular to the longitudinal vertical plane passing through the longitudinal centerline of the vehicle when the guard is installed on the vehicle according to the installation instructions in S5.5 of this section.

Horizontal member means the structural member of the guard that meets the configuration requirements of S5.1.1 through 5.1.3 of Sec. 571.224, *Rear Impact Protection*, when the guard is installed on a vehicle according to the guard manufacturer's installation instructions.

Hydraulic guard means a guard designed to use fluid properties to provide resistance force to deformation.

Rear impact guard means a device installed on or near the rear of a vehicle so that when the vehicle is struck from the rear, the device limits the distance that the striking vehicle's front end slides under the rear end of the impacted vehicle.

Rigid test fixture means a supporting structure on which a rear impact guard can be mounted in the same manner it is mounted to a vehicle. The rigid test fixture is designed to resist the forces applied to the rear impact

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guard without significant deformation, such that a performance requirement of this standard must be met no matter how small an amount of energy is absorbed by the rigid test fixture.

S5. Requirements.

S5.1 Projected Vertical Height. The horizontal member of each guard, when viewed from the rear as it would be installed on a trailer pursuant to the installation instructions or procedures required by S5.5 of this standard, shall have a vertical height of at least 100 mm at each point across the guard width, when projected horizontally on a transverse vertical plane. Those installation instructions or procedures shall specify that the guard is to be mounted so that all portions of the horizontal member necessary to achieve a 100 mm high projected vertical height are located not more than 305 mm forward of the vehicle's rear extremity, as defined in S4 of 49 CFR 571.224, Rear Impact Protection. See Figure 1 of this section.

S5.2 Strength and Energy Absorption. When tested under the procedures of S6 of this section, each guard shall comply with the strength requirements of S5.2.1 of this section at each test location and the energy absorption requirements of S5.2.2 of this section at test location P3, as specified in S6.4 of this section. However, a particular guard (*i.e.*, test specimen) need not be tested at more than one location.

S5.2.1 Guard Strength. The guard must resist the force levels specified in S5.2.1 (a) through (c) of this section without deflecting by more than 125 mm.

(a) A force of 50,000 N at test location P1 on either the left or the right side of the guard as defined in S6.4(a) of this section.

(b) A force of 50,000 N at test location P2 as defined in S6.4(b) of this section.

(c) A force of 100,000 N at test location P3 on either the left or the right side of the guard as defined in S6.4(c) of this section.

S5.2.2 Guard Energy Absorption. A guard, other than a hydraulic guard, shall absorb by plastic deformation within the first 125 mm of deflection at least 5,650 J of energy at each test location P3. See Figure 2 of this section.

S5.3 Labeling. Each guard shall be permanently labeled with the information specified in S5.3 (a) through (c) of this section. The information shall be in English and in letters that are at least 2.5 mm high. The label shall be placed on the forward-facing surface of the horizontal member of the guard, 305 mm inboard of the right end of the guard.

(a) The guard manufacturer's name and address.

(b) The statement: "Manufactured in _____" (inserting the month and year of guard manufacture).

(c) The letters "DOT", constituting a certification by the guard manufacturer that the guard conforms to all requirements of this standard.

S5.4 Guard Attachment Hardware. Each guard, other than a guard that is to be installed on a vehicle manufactured by the manufacturer of the guard, shall be accompanied by all attachment hardware necessary

for installation of the guard on the chassis of the motor vehicle for which it is intended.

S5.5 Installation Instructions. The manufacturer of rear impact guards for sale to vehicle manufacturers shall include with each guard printed instructions in English for installing the guard, as well as a diagram or schematic depicting proper guard installation. The manufacturer of a rear impact guard for one of its own vehicles shall prepare and keep a copy of installation procedures applicable to each vehicle/guard combination for a period of one year from the date of vehicle manufacture and provide them to NHTSA on request. The instructions or procedures shall specify:

(a) Vehicles on which the guard can be installed. Vehicles may be designated by listing the make and model of the vehicles for which the guard is suitable, or

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by specifying the design elements that would make any vehicle an appropriate host for the particular guard (e.g., vehicles with frame rails of certain spacing and gauge of steel).

(b) A description of the chassis surface to which the guard will be attached, including frame design types with dimensions, material thickness, and tire track width. This description shall be detailed enough to permit the agency to locate and duplicate the chassis surface during compliance testing.

(c) An explanation of the method of attaching the guard to the chassis of each vehicle make and model listed or to the design elements specified in the instructions or procedures. The principal aspects of vehicle chassis configuration that are necessary to the proper functioning of the guard shall be specified. If the chassis strength is inadequate for the guard design, the instructions or procedures shall specify methods for adequately reinforcing the vehicle chassis. Procedures for properly installing any guard attachment hardware shall be provided.

S6. Guard Test Procedures. The procedures for determining compliance with S5.2 of this section are specified in S6.1 through S6.6 of this section.

S6.1 Preparation of Hydraulic Guards. For hydraulic guards, the horizontal member of the guard is deflected in a forward direction until the hydraulic unit(s) have reached the full extent of their designed travel or 610 mm, whichever occurs first. The hydraulic units are compressed before the application of force to the guard in accordance with S6.6 of this section and maintained in this condition throughout the testing under S6.6 of this section.

S6.2 Guard Installation for Strength and Energy Absorption Tests.

(a) The rear impact guard is attached to a test device.

(b) The test device for the compliance test will be whichever of the following devices, if either was used, the manufacturer used as a basis for its certification of the guard in S5.3(c) of this section. If the manufacturer did not use one of these devices or does not specify a device when asked by the agency, the agency may choose either of the following devices—

(1) A rigid test fixture. In the case of testing on a rigid test fixture NHTSA will consult the installation instructions or procedures to determine the surface or structure that the guard is supposed to be mounted to and mount it to the rigid test fixture in the same way.

(2) A complete trailer for which installation of the guard is suitable, as provided in the manufacturer's installation instructions or procedures required by S5.5 of this section. The trailer chassis is secured so that it behaves essentially as a fixed object during the test, such that the test must be passed no matter how little it moves during the test.

(c) The guard is attached in accordance with the instructions or procedures for guard attachment provided by the guard manufacturer for that guard as required by S5.5 of this section.

S6.3 Force Application Device. The force application device employed in S6.6 of this section consists of a

rectangular solid made of rigid steel. The steel solid is 203 mm in height, 203 mm in width, and 25 mm in thickness. The 203 mm by 203 mm face of the block is used as the contact surface for application of the forces specified in S5.2.1 (a) through (c) of this section. Each edge of the contact surface of the block has a radius of curvature of 5 mm plus or minus 1 mm.

S6.4 Test Locations. With the guard mounted to the rigid test fixture or to a complete trailer, determine the test locations P1, P2, and P3 in accordance with the procedure set forth in S6.4 (a) through (c) of this section. See Figure 1 of this section.

(a) Test location P1 is the point on the rearmost surface of the horizontal member of the guard that:

(1) Is located at a distance of $\frac{3}{8}$ of the guard width from the vertical longitudinal plane passing through center of the guard;

(2) Lies on either side of the center of the guard's horizontal member; and

(3) Is 50 mm above the bottom of the guard.

(b) Test location P2 is the point on the rearmost surface of the horizontal member of the guard that:

(1) Lies in the longitudinal vertical plane passing through the center of the guard's horizontal member; and

(2) Is 50 mm above the bottom of the guard.

(c) Test location P3 is any point on the rearmost surface of the horizontal member of the guard that:

(1) Is not less than 355 mm and not more than 635 mm from the vertical longitudinal plane passing through center of the guard;

(2) Lies on either the right or left side of the horizontal member of the guard; and

(3) Is 50 mm above the bottom of the guard.

S6.5 Positioning of Force Application Device. Before applying any force to the guard, locate the force application device such that:

(a) The center point of the contact surface of the force application device is aligned with and touching the guard test location, as defined by the specifications of S6.4 of this section.

(b) The longitudinal axis of the force application device passes through the test location and is perpendicular to the transverse vertical plane that is tangent to the rearmost surface of the guard's horizontal member.

S6.6 Force Application. After the force application device has been positioned according to S6.5 of this section, apply the loads specified in S5.2.1 of this section. Load application procedures are specified in the S6.6 (a) through (d) of this section.

(a) Using the force application device, apply force to the guard in a forward direction such that the displacement rate of the force application device is the rate, plus or minus 10 percent, designated by the guard manufacturer within the range of 2.0 cm per minute to 9.0 cm per minute. If the guard manufacturer does not designate a rate within that range may be chosen.

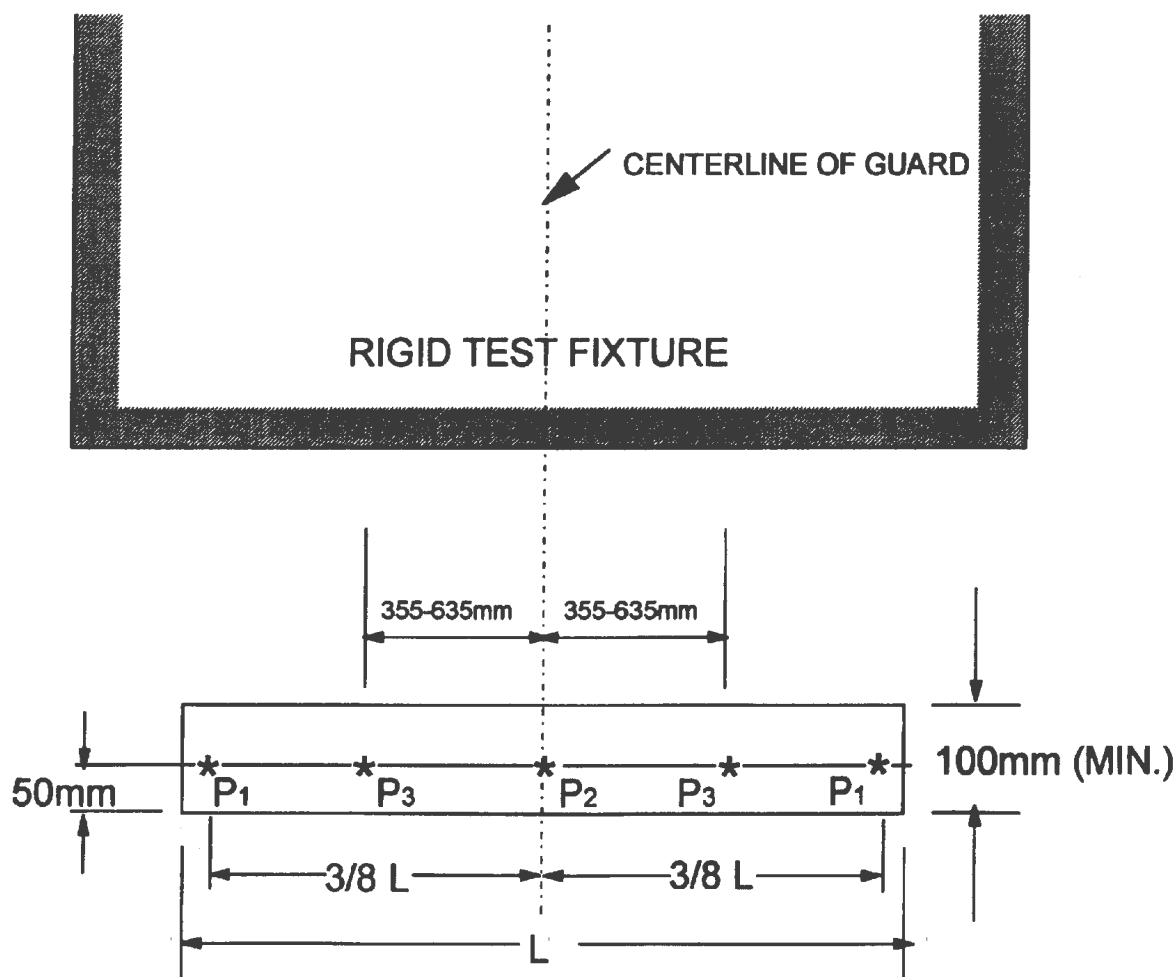
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(b) If conducting a strength test to satisfy the requirement of S5.2.1 of this section, the force is applied until the forces specified in S5.2.1 of this section have been exceeded, or until the displacement of the force application device has reached at least 125 mm, whichever occurs first.

(c) If conducting a test to be used for the calculation of energy absorption levels to satisfy the requirement of S5.2.2 of this section, apply the force to the guard until displacement of the force application device has reached 125 mm. For calculation of guard energy absorption, the value of force is recorded at least ten times per 25 mm of displacement of the contact surface of the loading

device. Reduce the force until the guard no longer offers resistance to the force application device. Produce a force vs. deflection diagram of the type shown in Figure 2 of this section using this information. Determine the energy absorbed by the guard by calculating the shaded area bounded by the curve in the force vs. deflection diagram and the abscissa (X-axis).

(d) During each force application, the force application device is guided so that it does not rotate. At all times during the application of force, the location of the longitudinal axis of the force application device remains constant.



REAR VIEW OF GUARD HORIZONTAL MEMBER

FIGURE 1. PERFORMANCE REQUIREMENTS

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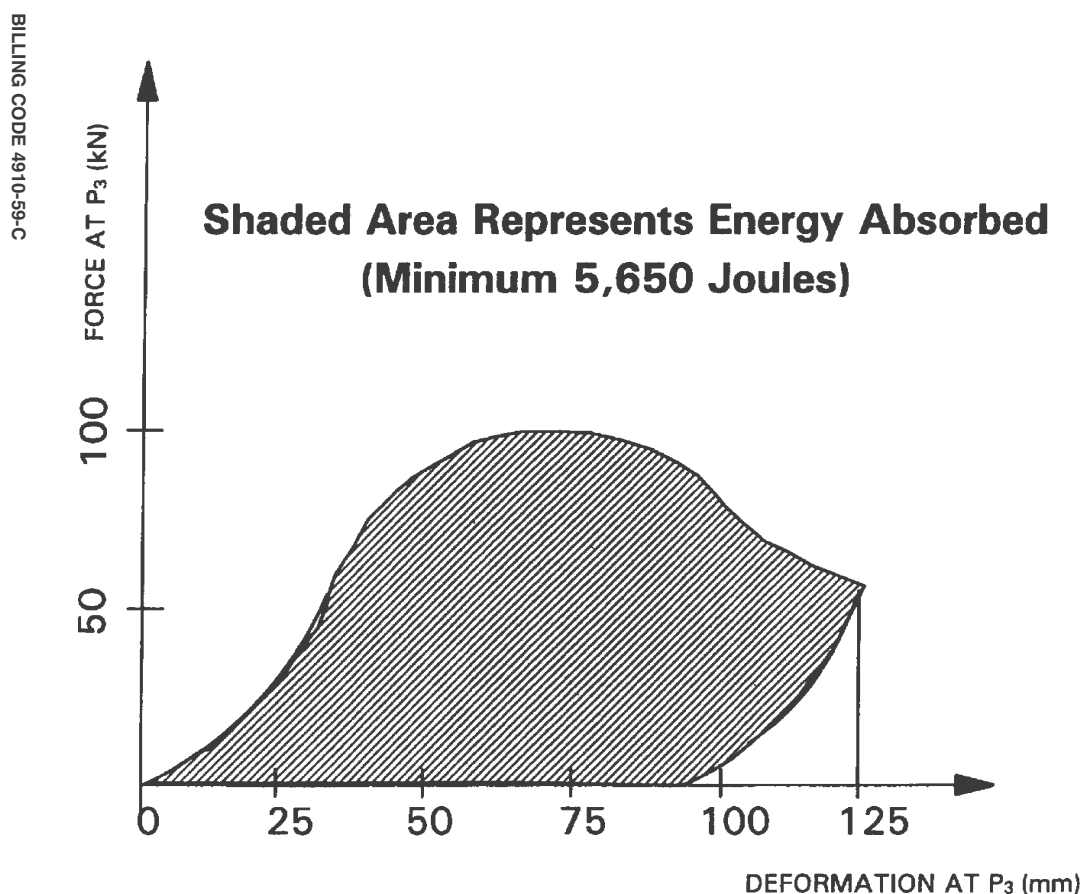


FIGURE 2. GUARD ENERGY ABSORPTION (TYPICAL FORCE-DEFLECTION CURVE AT P3)

§571.224 Standard No. 224; rear impact protection.

S1. Scope. This standard establishes requirements for the installation of rear impact guards on trailers and semitrailers with a gross vehicle weight rating (GVWR) of 4,536 kg or more.

S2. Purpose. The purpose of this standard is to reduce the number of deaths and serious injuries occurring when light duty vehicles impact the rear of trailers and semitrailers with a GVWR of 4,536 kg or more.

S3. Application. This standard applies to trailers and semitrailers with a GVWR of 4,356 kg or more. The standard does not apply to pole trailers, pulpwood trailers, road construction controlled horizontal discharge trailers, special purpose vehicles, wheels back vehicles, or temporary living quarters as defined in 49 CFR 529.2. If a cargo tank motor vehicle, as defined in 49 CFR 171.8, is certified to carry hazardous materials and has a rear bumper or rear end protection device conforming with 49 CFR part 178 located in the area of the horizontal member of the rear underride guard required by this standard, the guard need not comply with the energy absorption requirement (S5.2.2) of 49 CFR 571.223.

S4. Definitions.

Chassis means the load supporting frame structure of a motor vehicle.

Horizontal member means the structural member of the guard that meets the configuration requirements of S5.1 of this section when the guard is installed on the vehicle according to the installation instructions or procedures required by S5.5 of Sec. 571.223, Rear Impact Guards.

Low chassis vehicle means a trailer or semitrailer having a chassis that extends behind the rearmost point of the rearmost tires and a lower rear surface that meets the configuration requirements of S5.1.1 through 5.1.3 of this section.

Outer or Outboard means away from the trailer center-line and toward the side extremities of the trailer.

Pulpwood trailer means a trailer that is designed exclusively for harvesting logs or pulpwood and constructed with a skeletal frame with no means for attachment of a solid bed, body, or container.

Rear extremity means the rearmost point on a vehicle that is above a horizontal plane located 560 mm above the ground and below a horizontal plane located

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1,900 mm above the ground when the vehicle is configured as specified in S5.1 of this section and when the vehicle's cargo doors, tailgate, or other permanent structures are positioned as they normally are when the vehicle is in motion. Nonstructural protrusions such as taillights, rubber bumpers, hinges and latches are excluded from the determination of the rearmost point.

Road construction controlled horizontal discharge trailer means a trailer or semitrailer that is equipped with a mechanical drive and a conveyor to deliver asphalt and other road building materials, in a controlled horizontal manner, into a lay down machine or paving equipment for road construction and paving operations.

Rounded corner means a guard's outermost end that curves upward or forward toward the front of the vehicle, or both.

Side extremity means the outermost point on a vehicle's side that is located above a horizontal plane 560 mm above the ground, below a horizontal plane located 190 cm above the ground, and between a transverse vertical plane tangent to the rear extremity of the vehicle and a transverse vertical plane located 305 mm forward of that plane when the vehicle is configured as specified in S5.1 of this section. Non-structural protrusions such as taillights, hinges, rubber bumpers, and latches are excluded from the determination of the outermost point.

Special purpose vehicle means a trailer or semitrailer that:

(1) Has work performing equipment that, while the vehicle is in transit, resides in or moves through any portion of the space bounded:

(i) Vertically from the ground to a horizontal plane 660 mm above the ground;

(ii) Laterally the full width of the trailer, determined by the trailer's side extremities as defined in S4 of this section; and

(iii) From the rear extremity of the trailer as defined in S4 of this section to a transverse vertical plane 305 mm forward of the rear extremity of the trailer; or

(2) Is equipped with a loading platform that, while the vehicle is in transit, is completely stowed in the space bounded by a plane tangent to the underside of the vehicle, the ground, the rear extremity of the vehicle, and the rearmost axle, and that, when operated, deploys from its stowed position to the rear of the vehicle through any portion of the space described above.

Wheels back vehicle means a trailer or semitrailer whose rearmost axle is permanently fixed and is located

such that the rearmost surface of tires of the size recommended by the vehicle manufacturer for the vehicle on that axle is not more than 305 mm forward of the transverse vertical plane tangent to the rear extremity of the vehicle.

S5. Requirements.

S5.1 Installation; vehicle configuration. Each vehicle shall be equipped with a rear impact guard certified as meeting Federal Motor Vehicle Safety Standard No. 223, *Rear Impact Guards* (Sec. 571.223). When the vehicle to which the guard is attached is resting on level ground, unloaded, with its full capacity of fuel, and with its tires inflated and air suspension, if so equipped, pressurized in accordance with the manufacturer's recommendations, the guard shall comply with the requirements of S5.1.1 through S5.1.3 of this section. See Figure 1 of this section.

S5.1.1 Guard width. The outermost surfaces of the horizontal member of the guard shall extend outboard to within 100 mm of the longitudinal vertical planes that are tangent to the side extremities of the vehicle, but shall not extend outboard of those planes. See Figure 1 of this section.

S5.1.2 Guard height. The vertical distance between the bottom edge of the horizontal member of the guard and the ground shall not exceed 560 mm at any point across the full width of the member. Notwithstanding this requirement, guards with rounded corners may curve upward within 255 mm of the longitudinal vertical planes that are tangent to the side extremities of the vehicle. See Figure 1 of this section.

S5.1.3 Guard rear surface. At any height 560 mm or more above the ground, the rearmost surface of the horizontal member of the guard shall be located as close as practical to a transverse vertical plane tangent to the rear extremity of the vehicle, but no more than 305 mm forward of that plane. Notwithstanding this requirement, the horizontal member may extend rearward of the plane, and guards with rounded corners may curve forward within 255 mm of the longitudinal vertical planes that are tangent to the side extremities of the vehicle.

S5.2 Installation Requirements. Guards shall be attached to the vehicle's chassis by the vehicle manufacturer in accordance with the installation instructions or procedures provided pursuant to S5.5 of Standard No. 223, *Rear Impact Guards* (Sec. 571.223). The vehicle must be of a type identified in the installation instructions as appropriate for the guard.

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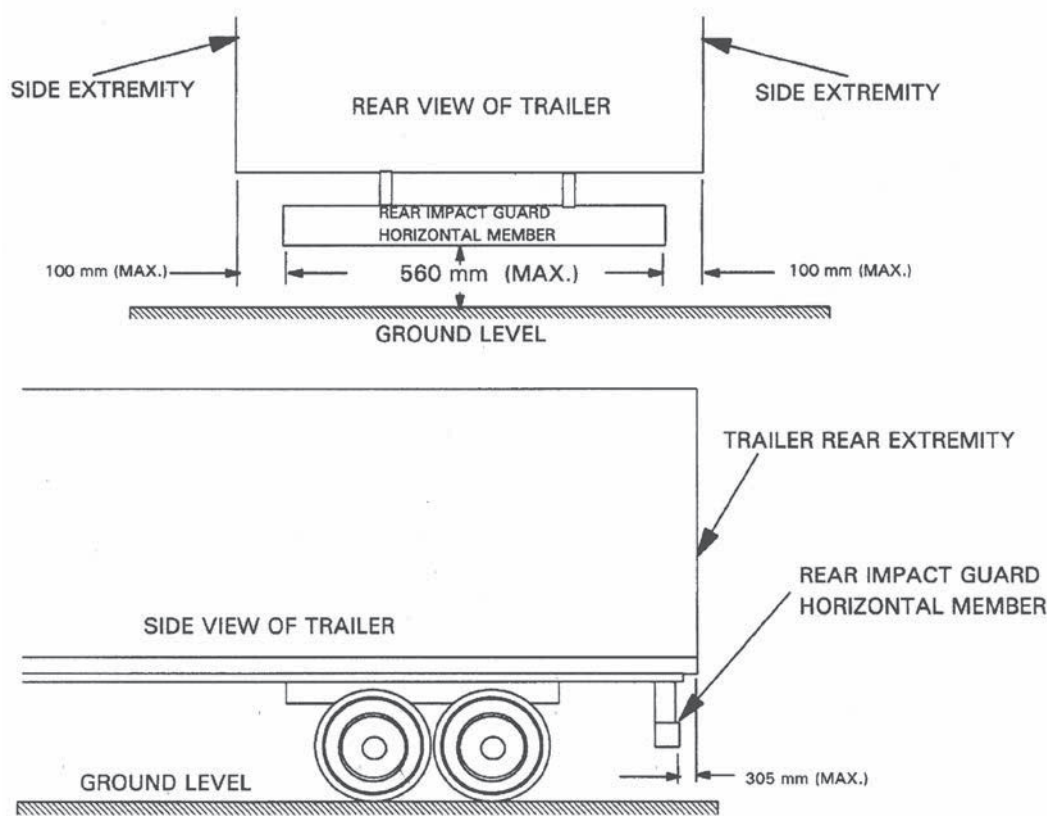


Figure 1. Configuration requirements

§571.301 Standard No. 301; Fuel system integrity.

S1. Scope. This standard specifies requirements for the integrity of motor vehicle fuel systems.

S2. Purpose. The purpose of this standard is to reduce deaths and injuries occurring from fires that result from fuel spillage during and after motor vehicle crashes, and resulting from ingestion of fuels during siphoning.

S3. Application. This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses that have a GVWR of 4,536 kg or less and use fuel with a boiling point above 0 °C, and to school buses that have a GVWR greater than 4,536 kg and use fuel with a boiling point above 0 °C.

S4. Definition.

Fuel spillage means the fall, flow, or run of fuel from the vehicle but does not include wetness resulting from capillary action.

S5. General requirements.

S5.1 Passenger cars, and multipurpose passenger vehicles, trucks, and buses with a GVWR of 10,000 pounds or less. Each passenger car and each multipurpose passenger vehicle, truck, and bus with a GVWR of 10,000 pounds or less shall meet the requirements of S6.1 through S6.4. Each of these types of vehicles that is manufactured to use alcohol fuels shall also meet the requirements of S6.6.

S5.2 [Reserved]

S5.3 [Reserved]

S5.4 Schoolbuses with a GVWR greater than 10,000 pounds. Each schoolbus with a GVWR greater than 10,000 pounds shall meet the requirements of S6.5. Each schoolbus with a GVWR greater than 10,000 pounds that is manufactured to use alcohol fuels shall meet the requirements of S6.6.

S5.5 Fuel spillage; Barrier crash. Fuel spillage in any fixed or moving barrier crash test shall not exceed 28 g from impact until motion of the vehicle has ceased, and shall not exceed a total of 142 g in the 5-minute period following cessation of motion. For the subsequent 25-minute period, fuel spillage during any 1 minute interval shall not exceed 28 g.

S5.6 Fuel spillage; rollover. Fuel spillage in any rollover test, from the onset of rotational motion, shall not exceed a total of 142 g for the first 5 minutes of testing at each successive 90° increment. For the remaining test period, at each increment of 90° fuel spillage during any 1 minute interval shall not exceed 28 g.

S5.7. Alcohol fuel vehicles. Each vehicle manufactured to operate on an alcohol fuel (e.g., methanol, ethanol) or a fuel blend containing at least 20 percent alcohol fuel shall meet the requirements of S6.6.

S6. Test requirements. Each vehicle with a GVWR of 4,536 kg or less shall be capable of meeting the requirements of any applicable barrier crash test followed by a static rollover, without alteration of the vehicle during

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the test sequence. A particular vehicle need not meet further requirements after having been subjected to a single barrier crash test and a static rollover test. Where manufacturer options are specified in this standard, the manufacturer must select an option not later than the time it certifies the vehicle and may not thereafter select a different option for that vehicle. Each manufacturer must, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S6.1 Frontal barrier crash. When the vehicle travelling longitudinally forward at any speed up to and including 48 km/h impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at any angle up to 30° in either direction from the perpendicular to the line of travel of the vehicle, with 50th-percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208, under the applicable conditions of S7., fuel spillage shall not exceed the limits of S5.5.

S6.2 Rear moving barrier crash.(a) **Vehicles manufactured before September 1, 2006.** When the vehicle is impacted from the rear by the barrier specified in S7.3(a) of this standard moving at 48 km/h, with 50th percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position, under the applicable conditions of S7, fuel spillage must not exceed the limits of S5.5.

(b) **Vehicles manufactured on or after September 1, 2006.** When the vehicle is impacted from the rear by a moving deformable barrier 80 ±1.0 km/h with a 70 percent overlap, with 50th percentile test dummies as specified in part 572 of this chapter at each front outboard designated seating position, under the applicable conditions of S7, fuel spillage must not exceed the limits of S5.5.

(c) **Small volume manufacturers.** Notwithstanding S6.2(b) of this standard, vehicles manufactured on or after September 1, 2004 and before September 1, 2008 by a manufacturer that produces fewer than 5,000 vehicles annually for sale in the United States may meet the requirements of S6.2(a). Vehicles manufactured on or after September 1, 2008 by small volume manufacturers must meet the requirements of S6.2(b).

S6.3 Side moving barrier crash.(a) **Vehicles manufactured before September 1, 2004.** When the vehicle is impacted laterally on either side by a barrier moving at 32 km/h with 50th percentile test dummies as specified in part 572 of this chapter at positions required for testing to Standard No. 208 (49 CFR 571.208), under the applicable conditions of S7, fuel spillage must not exceed the limits of S5.5.

(b) **Vehicles manufactured on or after September 1, 2004.** When the vehicle is impacted laterally on either side by a moving deformable barrier at 53 ± 1.0 km/h with the appropriate 49 CFR part 572 test dummies specified in 571.214 at positions required for testing by S7.1.1, S7.2.1, or S7.2.2 of Standard 214, under the applicable

conditions of S7 of this standard, fuel spillage shall not exceed the limits of S5.5 of this standard.

(c)(1) Notwithstanding S6.3(b) of this standard, vehicles having a GVWR greater than 6,000 lb (2,722 kg) may meet S6.3(a) instead of S6.3(b) of this standard until September 1, 2005.

(2) Notwithstanding S6.3(b) of this standard, vehicles having a GVWR greater than 6,000 lb (2,722 kg) manufactured on or after September 1, 2005 must meet the requirements of S6.3(b) of this standard unless they are excluded from S6.3(b) under the phase-in specified in this paragraph. Excluded vehicles must meet the requirements of S6.3(a) of this standard. For vehicles having a GVWR greater than 6,000 lb (2,722 kg) manufactured on or after September 1, 2005 and before September 1, 2006, the number of vehicles complying with S6.3(b) shall be not less than 90 percent of:

(i) The manufacturer's average annual production of vehicles with a GVWR greater than 6,000 lb (2,722 kg) manufactured on or after September 1, 2002 and before September 1, 2005; or

(ii) The manufacturer's production of vehicles with a GVWR greater than 6,000 lb (2,722 kg) on or after September 1, 2004 and before September 1, 2005.

(iii) Vehicles that have a GVWR greater than 6,000 lb (2,722 kg) and that are manufactured on or after September 1, 2006 must meet the requirements of S6.3(b) of this standard.

(3) **Vehicles produced by more than one manufacturer.** For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S6.3(c)(2)(i) and S6.3(c)(2)(ii) of this standard, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S6.3(c)(4).

(i) A vehicle which is imported shall be attributed to the importer.

(ii) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

(4) A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR 568.6, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S6.3(c)(3).

(d) Notwithstanding S6.3(b) of this standard, vehicles with a GVWR of 6,000 lb (2,722 kg) or less that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with Part 567 of this chapter may meet S6.3(a) of this standard until September 1, 2005. Vehicles with a GVWR of 6,000 lb (2,722 kg) or less that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with Part 567 of this chapter and that are manufactured on or after September 1, 2005 must meet the requirements of S6.3(b)

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(e) Notwithstanding S6.3(b) and (c) of this standard, vehicles with a GVWR greater than 6,000 lb (2,722 kg) that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with Part 567 of this chapter may meet S6.3(a) of this standard until September 1, 2006. Vehicles with a GVWR greater than 6,000 lb (2,722 kg) that are manufactured in two or more stages or altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with Part 567 of this chapter and that are manufactured on or after September 1, 2006 must meet the requirements of S6.3(b).

S6.4 Static rollover. When the vehicle is rotated on its longitudinal axis to each successive increment of 90°, following an impact crash of S6.1, S6.2, or S6.3, fuel spillage shall not exceed the limits of S5.6.

S6.5 Moving contoured barrier crash. When the moving contoured barrier assembly traveling longitudinally forward at any speed up to and including 48 km/h impacts the test vehicle (school bus with a GVWR exceeding 4,536 kg) at any point and angle, under the applicable conditions of S7.1 and S7.5, fuel spillage shall not exceed the limits of S5.5.

S6.6 Anti-siphoning test for alcohol fuel vehicles. Each vehicle shall have means that prevent any hose made of vinyl plastic or rubber, with a length of not less than 1200 millimeters (mm) and an outside diameter of not less than 5.2 mm, from contacting the level surface of the liquid fuel in the vehicle's fuel tank or fuel system, when the hose is inserted into the filler neck attached to the fuel tank with the fuel tank filled to any level from 90 to 95 percent of capacity.

S7. Test conditions. The requirements of S5.1 through S5.6 and S6.1 through S6.5 shall be met under the following conditions. Where a range is specified, the vehicle must be capable of meeting the requirements at all points within the range.

S7.1 General test conditions. The following conditions apply to all tests.

S7.1.1 The fuel tank is filled to any level from 90 to 95 percent of capacity with Stoddard solvent, having the physical and chemical properties of type 1 solvent, Table I of ASTM D484-71 (incorporated by reference, see §571.5).

S7.1.2 The fuel system other than the fuel tank is filled with Stoddard solvent to its normal operating level.

S7.1.3 In meeting the requirements of S6.1 through S6.3, if the vehicle has an electrically driven fuel pump that normally runs when the vehicle's electrical system is activated, it is operating at the time of the barrier crash.

S7.1.4 The parking brake is disengaged and the transmission is in neutral, except that in meeting the requirements of S6.5 the parking brake is set.

S7.1.5 Tires are inflated to manufacturer's specifications.

S7.1.6 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) Except as specified in S7.1.1, a passenger car is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the necessary test dummies as specified in S6., restrained only by means that are installed in the vehicle for protection at its seating position.

(b) Except as specified in S7.1.1, a multipurpose passenger vehicle, truck, or bus with a GVWR of 4,536 kg or less is loaded to its unloaded vehicle weight, plus the necessary test dummies as specified in S6, plus 136 kg or its rated cargo and luggage capacity weight, whichever is less, secured in the load carrying area and distributed as nearly as possible in proportion to its GAWR. For the purpose of this standard, unloaded vehicle weight does not include the weight of workperforming accessories. Each dummy is restrained only by means that are installed in the vehicle for protection at its seating position.

(c) Except as specified in S7.1.1, a school bus with a GVWR greater than 4,536 kg is loaded to its unloaded vehicle weight, plus 54 kg of unsecured mass at each designated seating position.

S7.2 Side moving barrier test conditions. (a) **Vehicles manufactured before September 1, 2004.** The side moving barrier crash test conditions are those specified in S8.2 of Standard No. 208 (49 CFR 571.208).

(b) **Vehicles manufactured on or after September 1, 2004.** The side moving deformable barrier crash test conditions are those specified in S8 of Standard 214 (49 CFR 571.214).

S7.3 Rear moving barrier test conditions. (a) **Vehicles manufactured before September 1, 2006.** The rear moving barrier test conditions are those specified in S8.2 of Standard No. 208 (49 CFR 571.208), except for the positioning of the barrier and the vehicle. The barrier and test vehicle are positioned so that at impact—

(1) The vehicle is at rest in its normal attitude;

(2) The barrier is traveling at 48 km/h with its face perpendicular to the longitudinal centerline of the vehicle; and

(3) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface coincides with the longitudinal centerline of the vehicle.

(b) **Vehicles manufactured on or after September 1, 2006.** The rear moving deformable barrier is the same as that shown in Figure 2 of Standard No. 214 (49 CFR 571.214) and specified in 49 CFR part 587, except as otherwise specified in paragraph S7.3 (b). The barrier and test vehicle are positioned so that at impact—

(1) The vehicle is stationary;

(2) The deformable face of the barrier is mounted on the barrier 50 mm (2 inches) lower than the height from the ground specified in Figure 2 of Standard No. 214 (49 CFR 571.214) (All dimensions from the ground in Figure 2, Front View should be reduced by 50 mm (2 inches.));

(3) The barrier is traveling 80 ±1.0 km/h; and

(4) The barrier impacts the test vehicle with the longitudinal centerline of the vehicle parallel to the line of

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travel and perpendicular to the barrier face within a tolerance of ± 5 degrees. The test vehicle and barrier face are aligned so that the barrier strikes the rear of the vehicle with 70 percent overlap toward either side of the vehicle. So aligned, the barrier face fully engages one half of the rear of the vehicle and partially engages the other half. At impact, the vehicle's longitudinal centerline is located inboard either of the side edges of the barrier by a distance equal to 20 percent of the vehicle's width ± 50 mm (see Figure 3). The vehicle's width is the maximum dimension measured across the widest part of the vehicle, including bumpers and molding, but excluding such components as exterior mirrors, flexible mud flaps, marker lamps, and dual rear wheel configurations.

S7.4 Static rollover test conditions. The vehicle is rotated about its longitudinal axis, with the axis kept horizontal, to each successive increment of 90° , 180° , and 270° at a uniform rate, with 90° of rotation taking place in any time interval from 1 to 3 minutes. After reaching each 90° increment the vehicle is held in that position for 5 minutes.

S7.5 Moving contoured barrier test conditions. The following conditions apply to the moving contoured barrier crash test.

S7.5.1 The moving barrier, which is mounted on a carriage as specified in Figure 1, is of rigid construction, symmetrical about a vertical longitudinal plane. The contoured impact surface, which is 629 mm high and 1,981 mm wide, conforms to the dimensions shown in Figure 2, and is attached to the carriage as shown in that figure. The ground clearance to the lower edge of the impact surface is 133 mm ± 13 mm. The wheelbase is 3,048 mm ± 50 mm.

S7.5.2 The moving contoured barrier, including the impact surface, supporting structure, and carriage, has a mass of 1,814 kg ± 23 kg with the mass distributed so that 408 kg ± 11 kg is at each rear wheel and 499 kg ± 11 kg is at each front wheel. The center of gravity is located 1,372 mm ± 38 mm rearward of the front wheel axis, in the vertical longitudinal plane of symmetry, 401 mm ± 13 mm above the ground.

S7.5.3 The moving contoured barrier has a solid non-steerable front axle and fixed rear axle attached directly to the frame rails with no spring or other type of suspension system on any wheel. (The moving barrier assembly is equipped with a braking device capable of stopping its motion.)

S7.5.4 The concrete surface upon which the vehicle is tested is level, rigid, and of uniform construction, with a skid number of 75 when measured in accordance with ASTM E274-65T (incorporated by reference, see §571.5) at 64 km/h, omitting water delivery as specified in paragraph 7.1 of that method.

S7.5.5 The barrier assembly is released from the guidance mechanism immediately prior to impact with the vehicle.

S7.6 The moving barrier assemblies specified in S7.2, S7.3 and S7.5 are equipped with P205/75R15 pneumatic tires inflated to 200 kPa ± 21 kPa.

S8 Phase-In schedule.

S8.1 Rear impact test upgrade. (a) **Vehicles manufactured on or after September 1, 2006 and before September 1, 2007.** For vehicles manufactured on or after September 1, 2006, and before September 1, 2007, the number of vehicles complying with S6.2(b) of this standard must not be less than 40 percent of:

(1) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2004, and before September 1, 2007; or

(2) The manufacturer's production on or after September 1, 2006, and before September 1, 2007.

(b) **Vehicles manufactured on or after September 1, 2007 and before September 1, 2008.** For vehicles manufactured on or after September 1, 2007 and before September 1, 2008, the number of vehicles complying with S6.2(b) of this standard must not be less than 70 percent of:

(1) The manufacturer's average annual production of vehicles manufactured on or after September 1, 2005, and before September 1, 2008; or

(2) The manufacturer's production on or after September 1, 2007, and before September 1, 2008.

(c) **Vehicles manufactured on or after September 1, 2008.** For vehicles manufactured on or after September 1, 2008, the number of vehicles complying with S6.2(b) of this standard must be 100 percent of the manufacturer's production during that period.

S8.2 Vehicles manufactured in two or more stages. A final stage manufacturer or alterer may, at its option, comply with the requirements set forth in S8.2.1 and S8.2.2.

S8.2.1 Vehicles manufactured on or after September 1, 2006 and before September 1, 2009 are not required to comply with the requirements specified in S6.2(b) of this standard.

S8.2.2 Vehicles manufactured on or after September 1, 2009 must comply with the requirements specified in S6.2(b) of this standard.

S8.3 Vehicles produced by more than one manufacturer.

S8.3.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S8.1, a vehicle produced by more than one manufacturer must be attributed to a single manufacturer as follows, subject to S8.3.2:

(a) A vehicle that is imported must be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, must be attributed to the manufacturer that markets the vehicle.

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S8.3.2 A vehicle produced by more than one manufacturer must be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Admin-

istration under 49 CFR part 586, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S8.3.1.

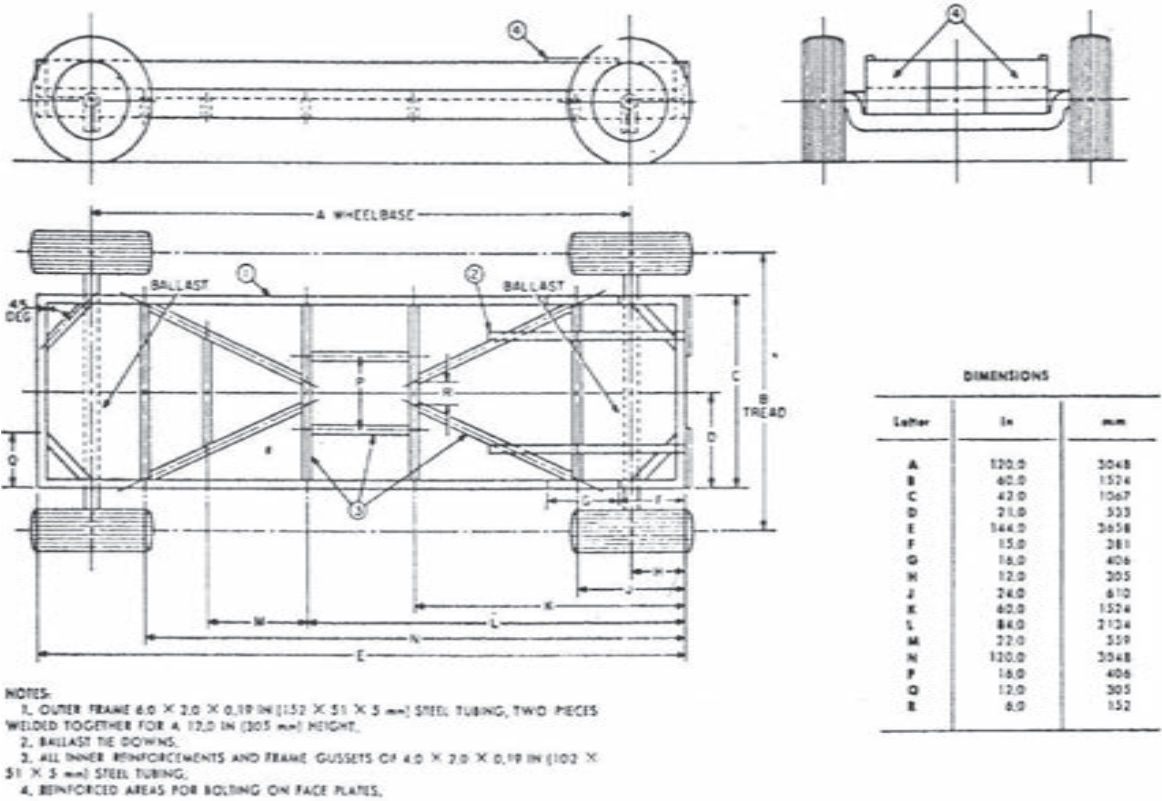
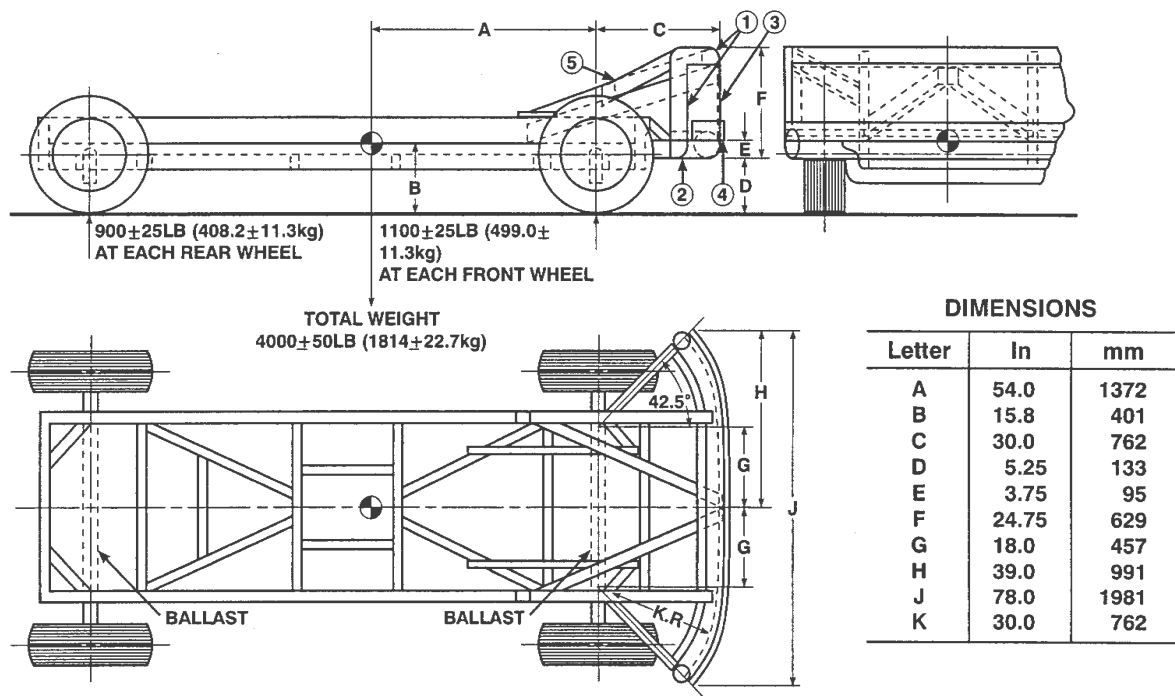


FIG. 1 – COMMON CARRIAGE FOR MOVING BARRIERS

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- NOTES:
1. UPPER FRAME 4.0 IN DIA X 0.25 IN WALL (102 mm DIA X 6 mm WALL) STEEL TUBING (THREE SIDES).
 2. LOWER FRAME 6.0 IN DIA X 0.50 IN WALL (152 mm DIA X 13 mm WALL) STEEL TUBING.
 3. FACE PLATE 0.75 IN (19 mm) THICK COLD ROLLED STEEL.
 4. LEADING EDGE 1.0 X 4.0 IN (25 X 102 mm) STEEL BAND, SHARP EDGES BROKEN.
 5. ALL INNER REINFORCEMENTS 4.0 X 2.0 X 0.19 IN (102 X 51 X 5 mm) STEEL TUBING.

Fig. 2 – Common Carriage with Contoured Impact Surface Attached

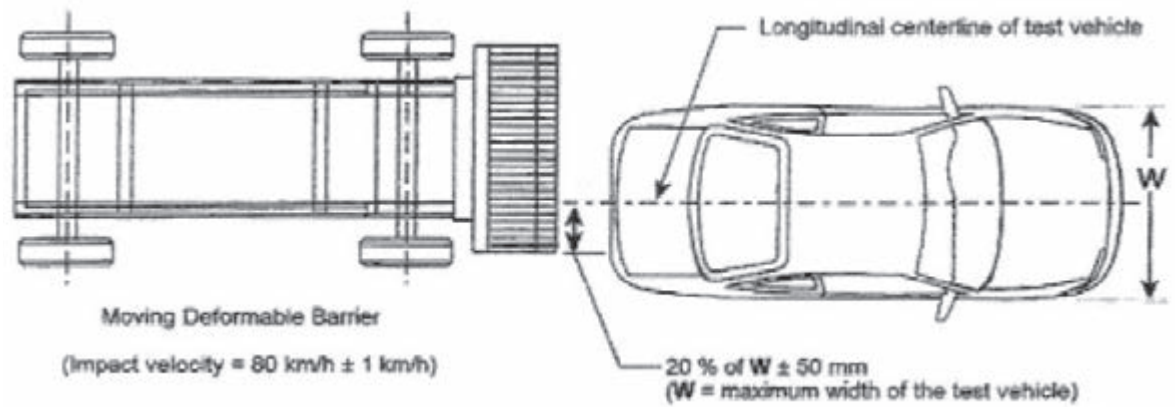


FIGURE 3 –MOVING DEFORMABLE BARRIER REAR IMPACT-70 % OVERLAP

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§571.302 Standard No. 302; Flammability of interior materials.

S1. **Scope.** This standard specifies burn resistance requirements for materials used in the occupant compartments of motor vehicles.

S2. **Purpose.** The purpose of this standard is to reduce the deaths and injuries to motor vehicle occupants caused by vehicle fires, especially those originating in the interior of the vehicle from sources such as matches or cigarettes.

S3. **Application.** This standard applies to passenger cars, multipurpose passenger vehicles, trucks, and buses.

S3A. **Definitions. Occupant compartment air space** means the space within the occupant compartment that normally contains refreshable air.

S4. Requirements.

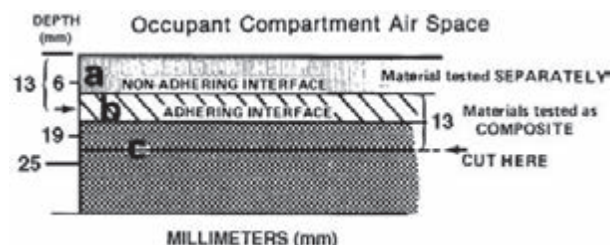
S4.1 The portions described in S4.2 of the following components of vehicle occupant compartments shall meet the requirements of S4.3: Seat cushions, seat backs, seat belts, headlining, convertible tops, arm rests, all trim panels including door, front, rear, and side panels, compartment shelves, head restraints, floor coverings, sun visors, curtains, shades, wheel housing covers, engine compartment covers, mattress covers, and any other interior materials, including padding and crash-deployed elements, that are designed to absorb energy on contact by occupants in the event of a crash.

S4.1.1 [Reserved]

S4.2 Any portion of a single or composite material which is within 13 mm of the occupant compartment air space shall meet the requirements of S4.3.

S4.2.1 Any material that does not adhere to other material(s) at every point of contact shall meet the requirements of S4.3 when tested separately.

S4.2.2 Any material that adheres to other material(s) at every point of contact shall meet the requirements of S4.3 when tested as a composite with the other material(s).



Material A has a non-adhering interface with material B and is tested separately. Part of material B is within 13 mm of the occupant compartment air space, and materials B and C adhere at every point of contact; therefore B and C are tested as a composite. The cut is in material C as shown, to make a specimen 13 mm thick.

S4.3(a) When tested in accordance with S5, material described in S4.1 and S4.2 shall not burn, nor transmit a flame front across its surface, at a rate of more than 102 mm per minute. However, the requirement concerning transmission of a flame front shall not apply to a surface created by the cutting of a test specimen for purposes of testing pursuant to S5.

(b) If a material stops burning before it has burned for 60 seconds from the start of timing, and has not burned more than 51 mm from the point where timing was started, it shall be considered to meet the burn-rate requirement of S4.3(a).

S5. Test procedure.

S5.1 Conditions.

S5.1.1 The test is conducted in a metal cabinet for protecting the test specimens from drafts. The interior of the cabinet is 381 mm long, 203 mm deep, and 356 mm high. It has a glass observation window in the front, a closable opening to permit insertion of the specimen holder, and a hole to accommodate tubing for a gas burner. For ventilation, it has a 13 mm clearance space around the top of the cabinet, ten 19 mm in diameter holes in the base of the cabinet, and legs to elevate the bottom of the cabinet by 10 mm, all located as shown in Figure 1.

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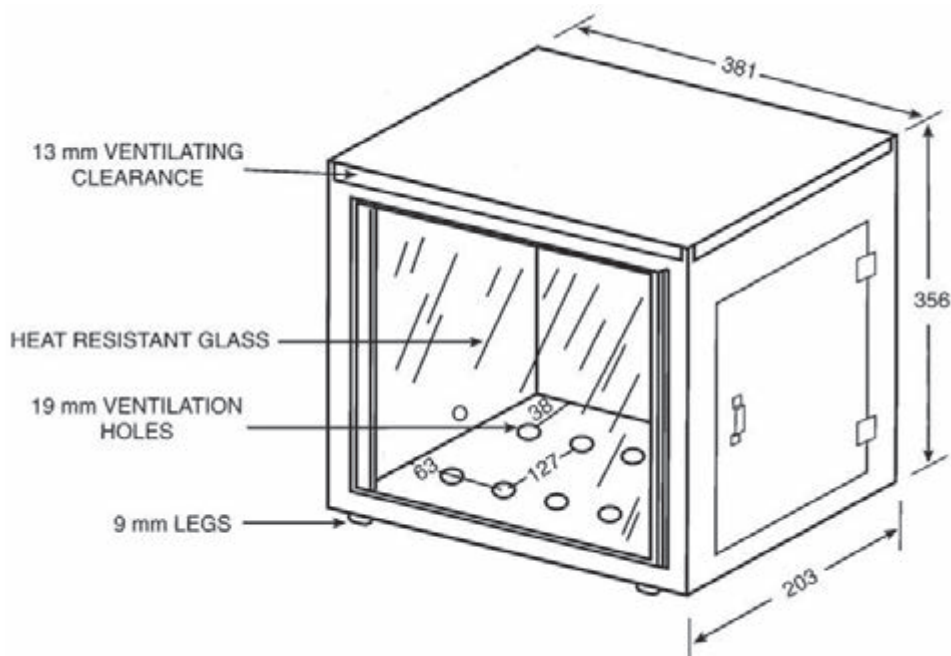


Figure 1 All dimensions in millimeters (mm)

S5.1.2 Prior to testing, each specimen is conditioned for 24 hours at a temperature of 21° C. and a relative humidity of 50 percent, and the test is conducted under those ambient conditions.

S5.1.3 The test specimen is inserted between two matching U-shaped frames of metal stock 25 mm wide and 10 mm high. The interior dimensions of the U-shaped frames are 51 mm wide by 330 mm long. A specimen that softens and bends at the flaming end so as to cause erratic burning is kept horizontal by supports consisting of thin, heat-resistant wires, spanning the width of the U-shaped frame under the specimen at 25 mm intervals. A device that may be used for supporting this type of material is an additional U-shaped frame, wider than the U-shaped frame containing the specimen, spanned by 10 -mil wires of heat-resistant composition at 25 mm intervals, inserted over the bottom U-shaped frame.

S5.1.4 A bunsen burner with a tube of 10 mm inside diameter is used. The gas adjusting valve is set to provide a flame, with the tube vertical, of 38 mm in height. The air inlet to the burner is closed.

S5.1.5 The gas supplied to the burner has a flame temperature equivalent to that of natural gas.

S5.2 Preparation of specimens.

S5.2.1 Each specimen of material to be tested shall be a rectangle 102 mm wide by 356 mm long, wherever possible. The thickness of the specimen is that of the single or composite material used in the vehicle, except that if the material's thickness exceeds 13 mm, the specimen is cut down to that thickness measured from the surface of the specimen closest to the occupant compartment air space. Where it is not possible to obtain a flat specimen because of surface curvature, the speci-

men is cut to not more than 13 mm in thickness at any point. The maximum available length or width of a specimen is used where either dimension is less than 356 mm or 102 mm, respectively, unless surrogate testing is required under S4.1.1.

S5.2.2 The specimen is produced by cutting the material in the direction that provides the most adverse test results. The specimen is oriented so that the surface closest to the occupant compartment air space faces downward on the test frame.

S5.2.3 Material with a napped or tufted surface is placed on a flat surface and combed twice against the nap with a comb having seven to eight smooth, rounded teeth per 25 mm.

S5.3 Procedure.

(a) Mount the specimen so that both sides and one end are held by the U-shaped frame, and one end is even with the open end of the frame. Where the maximum available width of a specimen is not more than 51 mm, so that the sides of the specimen cannot be held in the U-shaped frame, place the specimen in position on wire supports as described in S5.1.3, with one end held by the closed end of the U-shaped frame.

(b) Place the mounted specimen in a horizontal position, in the center of the cabinet.

(c) With the flame adjusted according to S5.1.4, position the bunsen burner and specimen so that the center of the burner tip is 19 mm below the center of the bottom edge of the open end of the specimen.

(d) Expose the specimen to the flame for 15 seconds.

(e) Begin timing (without reference to the period of application of the burner flame) when the flame from the burning specimen reaches a point 38 mm inches from the open end of the specimen.

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(f) Measure the time that it takes the flame to progress to a point 38 mm from the clamped end of the specimen. If the flame does not reach the specified end point, time its progress to the point where flaming stops.

(g) Calculate the burn rate from the formula

$$B = 60 / (D/T)$$

where

B = Burn rate in inches per minute,

D = Length the flame travels in inches, and

T = Time in seconds for the flame to travel **D** inches.

§571.303 Standard No. 303; Fuel system integrity of compressed natural gas vehicle.

S1. Scope. This standard specifies requirements for the integrity of motor vehicle fuel systems using compressed natural gas (CNG), including the CNG fuel systems of bi-fuel, dedicated, and dual fuel CNG vehicles.

S2. Purpose. The purpose of this standard is to reduce deaths and injuries occurring from fires that result from fuel leakage during and after motor vehicle crashes.

S3. Application. This standard applies to passenger cars, multipurpose passenger vehicles, trucks and buses that have a gross weight rating (GVWR) of 10,000 pounds or less and use CNG as a motor fuel. This standard also applies to school buses regardless of weight that use CNG as a motor fuel.

S4. Definitions.

Bi-fuel CNG vehicle means a vehicle equipped with two independent fuel systems, one of which is designed to supply CNG and the second to supply a fuel other than CNG.

CNG fuel container means a container designed to store CNG as motor fuel onboard a motor vehicle.

CNG fuel system means all components used to store or supply CNG to a vehicle's engine.

Dedicated CNG vehicle means a vehicle equipped with one fuel system and designed to operate on CNG.

Dual-fuel CNG vehicle means a vehicle which is fueled by two fuels simultaneously, one of which is CNG and the second is a fuel other than CNG.

High-pressure portion of a fuel system means all the components from and including each CNG fuel container up to, but not including, the first pressure regulator.

Service Pressure means the internal pressure of a CNG fuel container when filled to design capacity with CNG at 20° Celsius (68° Fahrenheit).

S5. General requirements.

S5.1 Vehicle requirements.

S5.1.1 Vehicles with GVWR of 10,000 pounds or less. Each passenger car, multipurpose passenger vehicle, truck, and bus with a GVWR of 10,000 pounds or less that uses CNG as a motor fuel and that is manu-

factured on or after September 1, 1995 shall meet the requirements S6, except S6.4.

S5.1.2 Schoolbuses with a GVWR greater than 10,000 pounds. Each schoolbus with a GVWR greater than 10,000 pounds that uses CNG as a motor fuel and is manufactured on or after September 1, 1995 shall meet the requirements of S6.4.

S5.2 Fuel system pressure drop: barrier crash.

(a) For all vehicles, the pressure drop in the high pressure portion of the fuel system, expressed in kilo Pascals (kPa), in any fixed or moving barrier crash from vehicle impact through the 60 minute period following cessation of motion shall not exceed:

(1) 1062 kPa (154 psi), or

(2) 895 (T/VFS); whichever is higher where T is the average temperature of the test gas in degrees Kelvin, stabilized to ambient temperature before testing, where average temperature (T) is calculated by measuring ambient temperature at the start of the test time and then every 15 minutes until the test time of 60 minutes is completed; the sum of the ambient temperature is then divided by five to yield the average temperature (T); and where VFS is the internal volume in liters of the fuel container and the fuel lines up to the first pressure regulator.

(b) For bi-fuel or dual fuel CNG vehicles, the test requirement in S5.2(a) shall apply to the CNG fuel system, and the test requirement of Standard No. 301 shall apply to the other fuel system, if that standard is applicable.

S5.3 Each CNG vehicle shall be permanently labeled, near the vehicle refueling connection, with the information specified in S5.3.1 and S5.3.2 of this section. The information shall be visible to a person standing next to the vehicle during refueling, in English, and in letters and numbers that are not less than 4.76 mm (3/16 inch) high.

S5.3.1 The statement: "Service pressure ____ kPa (____ psig)."

S5.3.2 The statement "See instructions on fuel container for inspection and service life."

S5.4 When a motor vehicle is delivered to the first purchaser for purposes other than resale, the manufacturer shall provide the purchaser with a written statement of the information in S5.3.1 and S5.3.2 in the owner's manual, or, if there is no owner's manual, on a one-page document. The information shall be in English and in not less than 10 point type.

S6. Test requirements: Fuel system integrity. Each vehicle with a GVWR of 10,000 pounds or less shall meet the requirements of any applicable barrier crash test. A particular vehicle need not meet further requirements after having been subjected to a single barrier crash test.

S6.1 Frontal barrier crash. When the vehicle traveling longitudinally forward at any speed up to and including 30 mph impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle, or at any angle up to 30 degrees in either direction from the perpendicular to the line of travel of the vehicle, with 50th percentile test dummies as specified in part 572 of

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this chapter at each front outboard designated seating position and at any other position whose protection system is required to be tested by a dummy under the provisions of Standard No. 208, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S6.2 Rear moving barrier crash. When the vehicle is impacted from the rear by a barrier moving at any speed up to and including 30 mph, with test dummies as specified in part 572 of this chapter at each front outboard designated seating position, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S6.3 Lateral moving barrier crash. When the vehicle is impacted laterally on either side by a barrier moving at any speed up to and including 20 mph with 50th percentile test dummies as specified in part 572 of this chapter at positions required for testing to Standard No. 208, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S6.4 Moving contoured barrier crash. When the moving contoured barrier assembly traveling longitudinally forward at any speed up to and including 30 mph impacts the test vehicle (schoolbus with a GVWR exceeding 10,000 pounds) at any point and angle, under the applicable conditions of S7, the fuel pressure drop shall not exceed the limits of S5.2.

S7. Test conditions. The requirements of S5 and S6 shall be met under the following conditions. Where a range of conditions is specified, the vehicle must be capable of meeting the requirements at all points within the range.

S7.1 General test conditions. The following conditions apply to all tests.

S7.1.1 Each fuel storage container is filled to 100 percent of service pressure with nitrogen, N₂. The gas pressure shall stabilize to ambient temperature before testing may be conducted.

S7.1.2 After each fuel storage container is filled as specified in S7.1.1, the fuel system other than each fuel storage container is filled with nitrogen, N₂, to normal operating pressures. All manual shutoff valves are to be in the open position.

S7.1.3 In meeting the requirements of S6.1 through S6.4, if the vehicle has an electrically driven fuel pump that normally runs when the vehicle's electrical system is activated, it is operating at the time of the barrier crash. If the vehicle has any high pressure electrical shutoff valve that is normally open when the electrical system is activated, it is open at the time of the barrier crash. Furthermore, if any electrical shutoff valve prevents sensing of system pressure by the pressure producer when closed, it must be open for both the initial pressure measurement and the pressure measurement 60 minutes after the vehicle ceases motion from impact. Any valve shall be open for a period of one minute to equalize the system pressure.

S7.1.4 The parking brake is disengaged and the transmission is in neutral, except that in meeting the requirements of S6.4, the parking brake is set.

S7.1.5 Tires are inflated to manufacturer's specifications.

S7.1.6 The vehicle, including test devices and instrumentation, is loaded as follows:

(a) A passenger car, with its fuel system filled as specified in S7.1.1 and S7.1.2, is loaded to its unloaded vehicle weight plus its rated cargo and luggage capacity weight, secured in the luggage area, plus the necessary test dummies as specified in S6, restrained only by means that are installed in the vehicle for protection at its seating position.

(b) A multipurpose passenger vehicle, truck, or bus with a GVWR of 10,000 pounds or less whose fuel system is filled as specified in S7.1.1 and S7.1.2, is loaded to its unloaded vehicle weight, plus the necessary test dummies as specified in S6, plus 136.1 kilograms (kg) (300 pounds (lbs.)), or its rated cargo and luggage capacity weight, whichever is less, secured to the vehicle and distributed so that the weight on each axle as measured at the tire-ground interface is in proportion to its GAWR. Each dummy shall be restrained only by means that are installed in the vehicle for protection at its seating position.

(c) A schoolbus with a GVWR greater than 10,000 pounds, whose fuel system is filled as specified in S7.1.1 and S7.1.2, is loaded to its unloaded vehicle weight, plus 54.4 kg (120 lb.) of unsecured weight at each designated seated position.

S7.1.7 The ambient temperature is not to vary more than 5.6°C (10°F) during the course of the test.

S7.1.8 The pressure drop measurement specified in S5.2 is to be made using a location on the high pressure side of the fuel system in accordance with the vehicle manufacturer's recommendation.

S7.2 Lateral moving barrier crash test conditions. The lateral moving barrier crash test conditions are those specified in S8.2 of Standard No. 208, 49 CFR 571.208.

S7.3 Rear moving barrier test conditions. The rear moving barrier test conditions are those specified in S8.2 of Standard No. 208, 49 CFR 571.208, except for the positioning of the barrier and the vehicle. The barrier and test vehicle are positioned so that at impact—

(a) The vehicle is at rest in its normal attitude;

(b) The barrier is traveling at any speed up to and including 30 mph with its face perpendicular to the longitudinal centerline of the vehicle; and

(c) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface coincides with the longitudinal centerline of the vehicle.

S7.4 Moving contoured barrier test conditions. The moving contoured barrier crash test conditions are those specified in S7.5 of Standard No. 301, 49 CFR 571.301.

Regulations

§571.304 Standard No. 304; Compressed Natural Gas Fuel Container Integrity.

S1. Scope. This standard specifies requirements for the integrity of compressed natural gas (CNG), motor vehicle fuel containers.

S2. Purpose. the purpose of this standard is to reduce deaths and injuries occurring from fires that result from fuel leakage during and after motor vehicle crashes.

S3. Application. This standard applies to each passenger car, multipurpose passenger vehicle, truck, and bus that uses CNG as a motor fuel and to each container designed to store CNG as motor fuel on-board any motor vehicle.

S4. Definitions.

Brazing means a group of welding processing wherein coalescence is produced by heating to a suitable temperature above 800 °F and by using a nonferrous filler metal, having a melting point below that to the base metals. The filler metal is distributed between the closely fitted surfaces of the joint by capillary attraction.

Burst pressure means the highest internal pressure reached in a CNG fuel container during a burst test at a temperature of 21°C (70°F).

CNG fuel container means a container designed to store CNG as motor fuel on-board a motor vehicle.

Fill pressure means the internal pressure of a CNG fuel container attained at the time of filling. Fill pressure varies according to the gas temperature in the container which is dependent on the charging parameters and the ambient conditions.

Full wrapped means applying the reinforcement of a filament or resin system over the entire liner, including the domes.

Hoop wrapped means winding of filament in a substantially circumferential pattern over the cylindrical portion of the liner so that the filament does not transmit any significant stresses in a direction parallel to the cylinder longitudinal axis.

Hydrostatic pressure means the internal pressure to which a CNG fuel container is taken during testing set forth in S5.4.1.

Liner means the inner gas tight container or gas cylinder to which the overwrap is applied.

Service pressure means the internal settled pressure of a CNG fuel container at a uniform gas temperature of 21°C (70°F) and full gas content. It is the pressure for which the container has been constructed under normal conditions.

Stress ratio means the stress in the fiber at minimum burst pressure divided by the stress in the fiber at service pressure.

S5 Container and material requirements.

S5.1 Container designations.

Container designations are as follows:

S5.1.1 Type 1—Non-composite metallic container means a metal container.

S5.1.2 Type 2—Composite metallic hoop wrapped container means a metal liner reinforced with resin impregnated continuous filament that is “hoop wrapped.”

S5.1.3 Type 3—Composite metallic full wrapped container means a metal liner reinforced with resin impregnated continuous filament that is “full wrapped.”

S5.1.4 Type 4—Composite non-metallic full wrapped container means resin impregnated continuous filament with a non-metallic liner “full wrapped.”

TABLE ONE—STEEL HEAT ANALYSIS

Grade element	Chromium-Molybdenum percent	Carbon-Boron percent	Carbon-Manganese percent
Carbon.....	0.25 to 0.38.....	0.27 to 0.37.....	0.40 max.
Manganese.....	0.40 to 1.05.....	0.80 to 1.40.....	1.65 max.
Phosphorous.....	0.015 max.....	0.015 max.....	0.025 max.
Sulfur.....	0.010 max.....	0.010 max.....	0.010 max.
Silicon.....	0.15 to 0.35.....	0.30 max.....	0.10/0.30
Chromium.....	0.80 to 1.15.....	N/A.....	N/A
Molybdenum.....	0.15 to 0.25.....	N/A.....	N/A
Boron.....	N/A.....	0.0005 to 0.003.....	N/A
Aluminum.....	0.02 to 0.07.....	0.02 to 0.07.....	0.02/0.07

¹ “N/A” means not applicable.

(b) Incidental elements shall be within the limits specified in the *Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements* for ASTM A 505 (1987).

S5.2.1.1 When carbon-boron steel is used, the test specimen is subject to a hardenability test in accordance with the *Standard Method for End-Quench Test For Hardenability of Steel*, ASTM A 255 (1989). the hardness evaluation is made 7.9 mm (⁵/₁₆ inch) from the quenched end of the Jominy quench bar.

S5.2.1.2 the test specimen’s hardness shall be at least Rc (Rockwell Hardness) 3.3 and no more than Rc 53.

S5.2.2 Aluminum containers and aluminum liners. (Type 1, Type 2 and Type 3) shall be 6010 alloy, 6061 alloy, and T6 temper. The aluminum heat analysis shall be in conformance with one of the following grades:

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TABLE TWO—ALUMINUM HEAT ANALYSIS

Grade: element	6010 alloy percent	6061 alloy percent
Magnesium	0.6 to 1.0	0.80 to 1.2.
Silicon	0.8 to 1.2	0.40 to 0.80.
Copper	0.15 to 0.6	0.15 to 0.40.
Chromium	0.10 max	0.04 to 0.35.
Iron	0.50 max	0.7 max.
Titanium	0.10 max	0.15 max.
Manganese	0.20 to 0.8	0.15 max.
Zinc	0.25 max	0.25 max.
Others, Each ¹	0.05 max	0.05 max.
Others, Total ¹²	0.15 max	0.15 max.
Aluminum min	Remainder	Remainder.

¹ “Others” includes listed elements for which no specific limit is shown as well as unlisted metallic elements. The producer may analyze samples for trace elements not specified in the registration or specification. However, such analysis is not required and may not cover all metallic “other” elements. Should any analysis by the producer or purchaser establish that an “others” element exceeds the limit of “Each” or that the aggregate of several “others” element exceeds the limit of “Total,” the material shall be considered non-conforming.

²The sum of those “Others” metallic elements 0.010 percent or more each, expressed to the second decimal before determining the sum. (Registration Record of Aluminum Association Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys, The Aluminum Association, Inc. Rev. Dec. 1993)

S6. General requirements.

S6.1 Each passenger car, multipurpose passenger vehicle, truck, and bus that uses CNG as a motor fuel shall be equipped with a CNG fuel container that meets the requirements of S7 through S7.4.

S6.2 Each CNG fuel container manufactured on or after March 27, 1995, shall meet the requirements of S7 through S7.4.

S7. Test requirements. Each CNG fuel container shall meet the applicable requirements of S7 through S7.4.

S7.1 Pressure cycling test at ambient temperature. Each CNG fuel container shall not leak when tested in accordance with S8.1.

S7.2 Hydrostatic burst test.

S7.2.2 Each Type 2, Type 3, or Type 4 CNG fuel container shall not leak when subjected to burst pressure and tested in accordance with S8.2. Burst pressure shall be not less than 2.25 times the service pressure.

TABLE 1—STRESS RATIOS

Material	Type 2	Type 3	Type 4
E-Glass	2.65	3.5	3.5
S-Glass	2.65	3.5	3.5
Aramid	2.25	3.0	3.0
Carbon	2.25	2.25	2.25

S7.3 Bonfire test. Each CNG fuel container shall be equipped with a pressure relief device. Each CNG fuel container shall completely vent its contents through a pressure relief device or shall not burst while retaining its entire contents when tested in accordance with S8.3.

S7.4 Labeling. Each CNG fuel container shall be permanently labeled with the information specified in paragraphs (a) through (h) of this section. Any label affixed to the container in compliance with this section shall remain in place and be legible for the manufactur-

er’s recommended service life of the container. The information shall be in English and in letters and numbers that are at least 6.35 mm (¼ inch) high.

(a) The statement: “If there is a question about the proper use, installation, or maintenance of this container, contact _____,” inserting the CNG fuel container manufacturer’s name, address, and telephone number.

(b) The statement: “Manufactured in _____,” inserting the month and year of manufacture of the CNG fuel container.

(c) The statement: “Service pressure _____ kPa, (____ psig).”

(d) The symbol DOT, constituting a certification by the CNG container manufacturer that the container complies with all requirements of this standard.

(e) The container designation (e.g., Type 1, 2, 3, 4).

(f) The statement: “CNG Only.”

(g) The statement: “This container should be visually inspected after a motor vehicle accident or fire and at least every 36 months or 36,000 miles, whichever comes first, for damage and deterioration.

(h) The statement: “Do Not Use After _____” inserting the month and year that mark the end of the manufacturer’s recommended service life for the container.

S8 Test conditions: fuel container integrity.

S8.1 Pressure cycling test. The requirements of S7.1 shall be met under the conditions of S8.1.1 through S8.1.4.

S8.1.1 Hydrostatically pressurize the CNG container to the service pressure, then to not more than 10 percent of the service pressure, for 13,000 cycles.

S8.1.2 After being pressurized as specified in S8.1.1, hydrostatically pressurize the CNG container to 125 percent of the service pressure, then to not more than 10 percent of the service pressure, for 5,000 cycles.

S8.1.3 The cycling rate for S8.1.1 and S8.1.2 shall be any value up to and including 10 cycles per minute.

S8.1.4 The cycling is conducted at ambient temperature.

S8.2 Hydrostatic burst test. The requirements of S7.2 shall be met under the conditions of S8.2.1 through S8.2.2.

S8.2.1 Hydrostatically pressurize the CNG fuel container, as follows: The pressure is increased up to the minimum prescribed burst pressure determined in S7.2.1 or S7.2.2, and held constant at the minimum burst pressure for 10 seconds.

S8.2.2 The pressurization rate throughout the test shall be up to and including 1,379 kPa (200 psi) per second.

S8.3 Bonfire test. Bonfire test. The requirements of S7.3 shall be met under the conditions of S8.3.1 through S8.3.7.

S8.3.1 Fill the CNG fuel container with compressed natural gas and test it at:

- (a) 100 percent of service pressure; and
- (b) 25 percent of service pressure.

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S8.3.2 Container positioning.

(a) Position the CNG fuel container in accordance with paragraphs (b) and (c) of S8.3.2.

(b) Position the CNG fuel container so that its longitudinal axis is horizontal and its bottom is 100 mm (4 inches) above the fire source.

(c)(1) Position a CNG fuel container that is 1.65 meters (65 inches) in length or less and is fitted with one pressure relief device so that the center of the container is over the center of the fire source.

(2) Position a CNG fuel container that is greater than 1.65 meters (65 inches) in length and is fitted with one pressure relief device at one end of the container so that the center of the fire source is 0.825 meters (32.5 inches) from the other end of the container, measured horizontally along a line parallel to the longitudinal axis of the container.

(3) Position a CNG fuel container that is fitted with pressure relief devices at more than one location along its length so that the portion of container over the center of the fire source is the portion midway between the two pressure relief devices that are separated by the greatest distance, measured horizontally along a line parallel to the longitudinal axis of the container.

(4) Test a CNG fuel container that is greater than 1.65 meters (65 inches) in length, is protected by thermal insulation, and does not have pressure relief devices, twice at 100 percent of service pressure. In one test, position the center of the container over the center of the

fire source. In another test, position one end of the container so that the fire source is centered 0.825 meters (32.5 inches) from one end of the container, measured horizontally along a line parallel to the longitudinal axis of the container.

S8.3.3 Number and placement of thermocouples.

To monitor flame temperature, place three thermocouples so that they are suspended 25 mm (one inch) below the bottom of the CNG fuel container. Position thermocouples so that they are equally spaced over the length of the fire source or length of the container, whichever is shorter.

S8.3.4 Shielding.

(a) Use shielding to prevent the flame from directly contacting the CNG fuel container valves, fittings, or pressure relief devices.

(b) To provide the shielding, use steel with 0.6 mm (.025 in) minimum nominal thickness.

(c) Position the shielding so that it does not directly contact the CNG fuel container valves, fittings, or pressure relief devices.

S8.3.5 Fire source. Use a uniform fire source that is 1.65 meters long (65 inches). Beginning five minutes after the fire is ignited, maintain an average flame temperature of not less than 430 degrees Celsius (800 degrees Fahrenheit) as determined by the average of the two thermocouples recording the highest temperatures over a 60 second interval:

$$\frac{1}{2} \left[\left(\frac{T_{\text{High 1}} + T_{\text{High 2}}}{2} \right)_{@ \text{ time 20 sec}} + \left(\frac{T_{\text{High 1}} + T_{\text{High 2}}}{2} \right)_{@ \text{ time 60 sec}} \right] \geq 430 \text{ } ^\circ \text{C}$$

If the pressure relief device releases before the end of the fifth minute after ignition, then the minimum temperature requirement does not apply.

S8.3.6 Recording data. Record time, temperature, and pressure readings at 30 second intervals, beginning when the fire is ignited and continuing until the pressure release device releases.

S8.3.7 Duration of exposure to fire source. The CNG fuel container is exposed to the fire source for 20 minutes after ignition or until the pressure release device releases, whichever period is shorter.

S8.3.8 Number of tests per container. A single CNG fuel container is not subjected to more than one bonfire test.

S8.3.9 Wind velocity. The average ambient wind velocity at the CNG fuel container during the period specified in S8.3.6 of this standard is not to exceed 2.24 meters/second (5 mph).

S8.3.10 The average wind velocity at the container is any velocity up to and including 2.24 meters/second (5 mph).

§571.500 Standard No. 500; Low-speed vehicles.

S1. **Scope.** This standard specifies requirements for low-speed vehicles.

S2. **Purpose.** The purpose of this standard is to ensure that low-speed vehicles operated on the public streets, roads, and highways are equipped with the minimum motor vehicle equipment appropriate for motor vehicle safety.

S3. **Applicability.** This standard applies to low-speed vehicles.

S4. [Reserved]

S5. Requirements.

(a) When tested in accordance with test conditions in S6 and test procedures in S7, the maximum speed attainable in 1.6 km (1 mile) by each low-speed vehicle shall not more than 40 kilometers per hour (25 miles per hour).

(b) Each low-speed vehicle shall be equipped with:

- (1) headlamps,
- (2) front and rear turn signal lamps,
- (3) taillamps,
- (4) stop lamps,

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(5) reflex reflectors: one red on each side as far to the rear as practicable, and one red on the rear,

(6) an exterior mirror mounted on the driver's side of the vehicle and either an exterior mirror mounted on the passenger's side of the vehicle or an interior mirror,

(7) a parking brake,

(8) a windshield that conforms to the Federal motor vehicle safety standard on glazing materials (49 CFR 571.205).

(9) a VIN that conforms to the requirements of part 565 Vehicle Identification Number of this chapter, and

(10) a Type 1 or Type 2 seat belt assembly conforming to § 571.209 of this part, Federal Motor Vehicle Safety Standard No. 209, Seat belt assemblies, installed at each designated seating position.

S6. General test conditions. Each vehicle must meet the performance limit specified in S5(a) under the following test conditions.

S6.1. Ambient conditions.

S6.1.1. Ambient temperature. The ambient temperature is any temperature between 0° C (32° F) and 40° C (104° F).

S6.1.2. Wind speed. The wind speed is not greater than 5 m/s (11.2 mph).

S6.2. Road test surface.

S6.2.1. Pavement friction. Unless otherwise specified, the road test surface produces a peak friction coefficient (PFC) of 0.9 when measured using a standard reference test tire that meets the specifications of American Society for Testing and Materials (ASTM) E1136, "Standard Specification for A Radial Standard Reference Test Tire," in accordance with ASTM Method E 1337-90, "Standard Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire, at a speed of 64.4 km/h (40.0 mph), without water delivery (incorporated by reference; see 49 CFR 571.5).

S6.2.2. Gradient. The test surface has not more than a 1 percent gradient in the direction of testing and not more than a 2 percent gradient perpendicular to the direction of testing.

S6.2.3. Lane width. The lane width is not less than 3.5 m (11.5 ft).

S6.3. Vehicle conditions.

S6.3.1. The test weight for maximum speed is unloaded vehicle weight plus a mass of 78 kg (170 pounds), including driver and instrumentation.

S6.3.2. No adjustment, repair or replacement of any component is allowed after the start of the first performance test.

S6.3.3. Tire inflation pressure. Cold inflation pressure is not more than the maximum permissible pressure molded on the tire sidewall.

S6.3.4. Break-in. The vehicle completes the manufacturer's recommended break-in agenda as a minimum condition prior to beginning the performance tests.

S6.3.5. Vehicle openings. All vehicle openings (doors, windows, hood, trunk, convertible top, cargo

doors, etc.) are closed except as required for instrumentation purposes.

S6.3.6. Battery powered vehicles. Prior to beginning the performance tests, propulsion batteries are at the state of charge recommended by the manufacturer or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. No further charging of any propulsion battery is permissible.

S7. Test procedure. Each vehicle must meet the performance limit specified in S5(a) under the following test procedure. The maximum speed performance is determined by measuring the maximum attainable vehicle speed at any point in a distance of 1.6 km (1.0 mile) from a standing start and repeated in the opposite direction within 30 minutes.

Regulations

Selected OSHA regulations

This section includes selected sections of the Occupational Safety and Health Administration (OSHA) regulations that pertain to the operation of a transportation maintenance facility. If you are interested in other OSHA regulations that are not in this section, please contact J. J. Keller & Associates, Inc. We have several other products that specialize in OSHA regulations.

Part 1904—Recording and reporting occupational injuries and illnesses

Subpart A—Purpose

§1904.0 Purpose.

The purpose of this rule (Part 1904) is to require employers to record and report work-related fatalities, injuries and illnesses.

Subpart B—Scope

Note to Subpart B: All employers covered by the Occupational Safety and Health Act (OSH Act) are covered by these Part 1904 regulations. However, most employers do not have to keep OSHA injury and illness records unless OSHA or the Bureau of Labor Statistics (BLS) informs them in writing that they must keep records. For example, employers with 10 or fewer employees and business establishments in certain industry classifications are partially exempt from keeping OSHA injury and illness records.

§1904.1 Partial exemption for employers with 10 or fewer employees.

(a) **Basic requirement.** (1) If your company had ten (10) or fewer employees at all times during the last calendar year, you do not need to keep OSHA injury and illness records unless OSHA or the BLS informs you in writing that you must keep records under §1904.41 or §1904.42. However, as required by §1904.39, all employers covered by the OSH Act must report to OSHA any workplace incident that results in a fatality or the hospitalization of three or more employees.

(2) If your company had more than ten (10) employees at any time during the last calendar year, you must keep OSHA injury and illness records unless your establishment is classified as a partially exempt industry under §1904.2.

(b) **Implementation.** (1) *Is the partial exemption for size based on the size of my entire company or on the size of an individual business establishment?* The partial exemption for size is based on the number of employees in the entire company.

(2) *How do I determine the size of my company to find out if I qualify for the partial exemption for size?* To determine if you are exempt because of size, you need to determine your company's peak employment during the last calendar year. If you had no more than 10 employees at any time in the last calendar year, your company qualifies for the partial exemption for size.

§1904.2 Partial exemption for establishments in certain industries.

(a) **Basic requirement.** (1) If your business establishment is classified in a specific low hazard retail, service, finance, insurance or real estate industry listed in Appendix A to this Subpart B, you do not need to keep OSHA injury and illness records unless the government asks you to keep the records under §1904.41 or §1904.42. However, all employers must report to OSHA any work-place incident that results in a fatality or the hospitalization of three or more employees (see §1904.39).

(2) If one or more of your company's establishments are classified in a non-exempt industry, you must keep OSHA injury and illness records for all of such establishments unless your company is partially exempted because of size under §1904.1.

(b) **Implementation.** (1) *Does the partial industry classification exemption apply only to business establishments in the retail, services, finance, insurance or real estate industries (SICs 52-89)?* Yes, business establishments classified in agriculture; mining; construction; manufacturing; transportation; communication, electric, gas and sanitary services; or wholesale trade are not eligible for the partial industry classification exemption.

(2) *Is the partial industry classification exemption based on the industry classification of my entire company or on the classification of individual business establishments operated by my company?* The partial industry classification exemption applies to individual business establishments. If a company has several business establishments engaged in different classes of business activities, some of the company's establishments may be required to keep records, while others may be exempt.

(3) *How do I determine the Standard Industrial Classification code for my company or for individual establishments?* You determine your Standard Industrial Classification (SIC) code by using the Standard Industrial Classification Manual, Executive Office of the President, Office of Management and Budget. You may contact your nearest OSHA office or State agency for help in determining your SIC.

§1904.3 Keeping records for more than one agency.

If you create records to comply with another government agency's injury and illness recordkeeping requirements, OSHA will consider those records as meeting OSHA's Part 1904 recordkeeping requirements if OSHA accepts the other agency's records under a memorandum of understanding with that agency, or if the other agency's records contain the same information as this Part 1904 requires you to record. You may contact your nearest OSHA office or State agency for help in determining whether your records meet OSHA's requirements.

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Non-Mandatory Appendix A to Subpart B—Partially Exempt Industries

Employers are not required to keep OSHA injury and illness records for any establishment classified in the following Standard Industrial Classification (SIC) codes, unless they are asked in writing to do so by OSHA, the Bureau of Labor Statistics (BLS), or

a state agency operating under the authority of OSHA or the BLS. All employers, including those partially exempted by reason of company size or industry classification, must report to OSHA any workplace incident that results in a fatality or the hospitalization of three or more employees (see §1904.39).

SIC code	Industry description	SIC code	Industry description
525	Hardware Stores	725	Shoe Repair and Shoeshine Parlors
542	Meat and Fish Markets	726	Funeral Service and Crematories
544	Candy, Nut, and Confectionery Stores	729	Miscellaneous Personal Services
545	Dairy Products Stores	731	Advertising Services
546	Retail Bakeries	732	Credit Reporting and Collection Services
549	Miscellaneous Food Stores	733	Mailing, Reproduction, and Stenographic Services
551	New and Used Car Dealers	737	Computer and Data Processing Services
552	Used Car Dealers	738	Miscellaneous Business Services
554	Gasoline Service Stations	764	Reupholstery and Furniture Repair
557	Motorcycle Dealers	78	Motion Picture
56	Apparel and Accessory Stores	791	Dance Studios, Schools, and Halls
573	Radio, Television, and Computer Stores	792	Producers, Orchestras, Entertainers
58	Eating and Drinking Places	793	Bowling Centers
591	Drug Stores and Proprietary Stores	801	Offices and Clinics of Medical Doctors
592	Liquor Stores	802	Offices and Clinics of Dentists
594	Miscellaneous Shopping Goods Stores	803	Offices of Osteopathic
599	Retail Stores, Not Elsewhere Classified	804	Offices of Other Health Practitioners
60	Depository Institutions (banks and savings institutions)	807	Medical and Dental Laboratories
61	Nondepository	809	Health and Allied Services, Not Elsewhere Classified
62	Security and Commodity Brokers	81	Legal Services
63	Insurance Carriers	82	Educational Services (schools, colleges, universities and libraries)
64	Insurance Agents, Brokers and Services	832	Individual and Family Services
653	Real Estate Agents and Managers	835	Child Day Care Services
654	Title Abstract Offices	839	Social Services, Not Elsewhere Classified
67	Holding and Other Investment Offices	841	Museums and Art Galleries
722	Photographic Studios, Portrait	86	Membership Organizations
723	Beauty Shops	87	Engineering, Accounting, Research, Management, and Related Services
724	Barber Shops	899	Services, not elsewhere classified

Subpart C—Recordkeeping forms and recording criteria

Note to Subpart C: This Subpart describes the work-related injuries and illnesses that an employer must enter into the OSHA records and explains the OSHA forms that employers must use to record work-related fatalities, injuries, and illnesses.

§1904.4 Recording criteria.

(a) **Basic requirement.** Each employer required by this Part to keep records of fatalities, injuries, and illnesses must record each fatality, injury and illness that:

- (1) Is work-related; and
- (2) Is a new case; and
- (3) Meets one or more of the general recording criteria of §1904.7 or the application to specific cases of §1904.8 through §1904.12.

(b) **Implementation.** (1) *What sections of this rule describe recording criteria for recording work-related injuries and illnesses?* The table below indicates which sections of the rule address each topic.

(i) Determination of work-relatedness. See §1904.5.

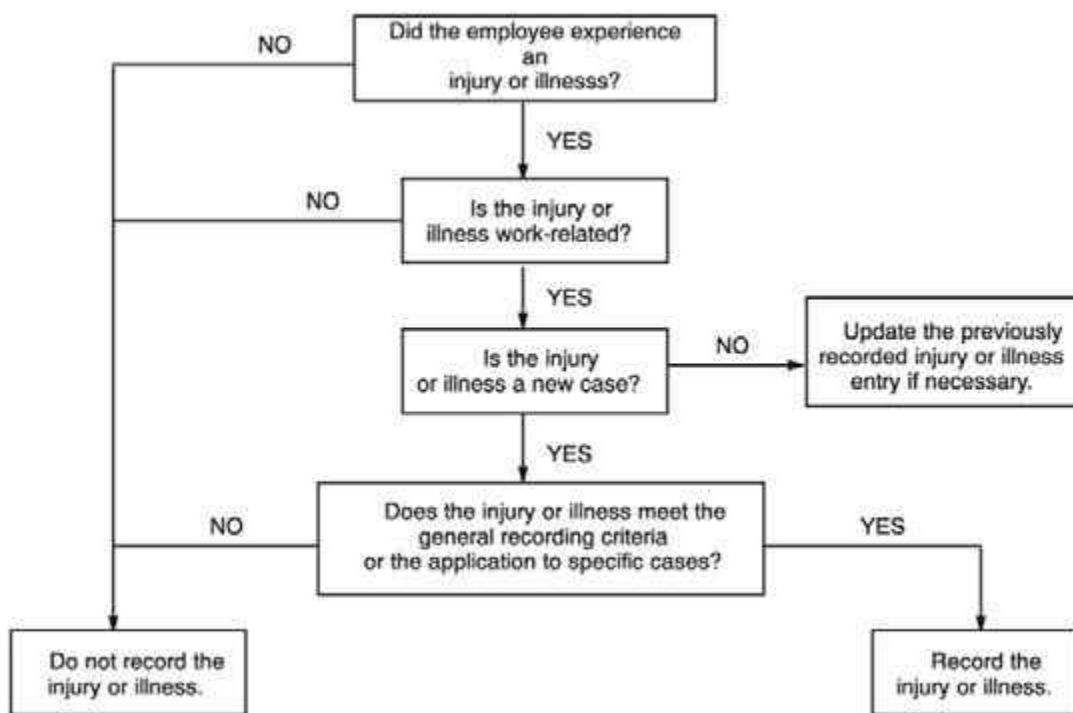
(ii) Determination of a new case. See §1904.6.

(iii) General recording criteria. See §1904.7.

(iv) Additional criteria. (Needlestick and sharps injury cases, tuberculosis cases, hearing loss cases, medical removal cases, and musculoskeletal disorder cases). See §1904.8 through §1904.12.

(2) *How do I decide whether a particular injury or illness is recordable?* The decision tree for recording work-related injuries and illnesses below shows the steps involved in making this determination.

Regulations



§1904.5 Determination of work-relatedness.

(a) **Basic requirement.** You must consider an injury or illness to be work-related if an event or exposure in the work environment either caused or contributed to the resulting condition or significantly aggravated a preexisting injury or illness. Work-relatedness is presumed for injuries and illnesses resulting from events or exposures occurring in the work environment, unless an exception in §1904.5(b)(2) specifically applies.

(b) **Implementation.** (1) *What is the “work environment”?* OSHA defines the work environment as “the establishment and other locations where one or more

employees are working or are present as a condition of their employment. The work environment includes not only physical locations, but also the equipment or materials used by the employee during the course of his or her work.”

(2) *Are there situations where an injury or illness occurs in the work environment and is not considered work-related?* Yes, an injury or illness occurring in the work environment that falls under one of the following exceptions is not work-related, and therefore is not recordable.

1904.5(b)(2)	You are not required to record injuries and illnesses if . . .
(i)	At the time of the injury or illness, the employee was present in the work environment as a member of the general public rather than as an employee.
(ii)	The injury or illness involves signs or symptoms that surface at work but result solely from a non-work-related event or exposure that occurs outside the work environment.
(iii)	The injury or illness results solely from voluntary participation in a wellness program or in a medical, fitness, or recreational activity such as blood donation, physical examination, flu shot, exercise class, racquetball, or baseball.
(iv)	The injury or illness is solely the result of an employee eating, drinking, or preparing food or drink for personal consumption (whether bought on the employer's premises or brought in). For example, if the employee is injured by choking on a sandwich while in the employer's establishment, the case would not be considered work-related. Note: If the employee is made ill by ingesting food contaminated by workplace contaminants (such as lead), or gets food poisoning from food supplied by the employer, the case would be considered work-related.
(v)	The injury or illness is solely the result of an employee doing personal tasks (unrelated to their employment) at the establishment outside of the employee's assigned working hours.
(vi)	The injury or illness is solely the result of personal grooming, self medication for a non-work-related condition, or is intentionally self-inflicted.
(vii)	The injury or illness is caused by a motor vehicle accident and occurs on a company parking lot or company access road while the employee is commuting to or from work.
(viii)	The illness is the common cold or flu (Note: contagious diseases such as tuberculosis, brucellosis, hepatitis A, or plague are considered work-related if the employee is infected at work).

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1904.5(b)(2)	You are not required to record injuries and illnesses if . . .
(ix)	The illness is a mental illness. Mental illness will not be considered work-related unless the employee voluntarily provides the employer with an opinion from a physician or other licensed healthcare professional with appropriate training and experience (psychiatrist, psychologist, psychiatric nurse practitioner, etc.) stating that the employee has a mental illness that is work-related.

(3) *How do I handle a case if it is not obvious whether the precipitating event or exposure occurred in the work environment or occurred away from work?* In these situations, you must evaluate the employee's work duties and environment to decide whether or not one or more events or exposures in the work environment either caused or contributed to the resulting condition or significantly aggravated a preexisting condition.

(4) *How do I know if an event or exposure in the work environment "significantly aggravated" a preexisting injury or illness?* A preexisting injury or illness has been significantly aggravated, for purposes of OSHA injury and illness recordkeeping, when an event or exposure in the work environment results in any of the following:

(i) Death, provided that the preexisting injury or illness would likely not have resulted in death but for the occupational event or exposure.

(ii) Loss of consciousness, provided that the preexisting injury or illness would likely not have resulted in loss of consciousness but for the occupational event or exposure.

(iii) One or more days away from work, or days of restricted work, or days of job transfer that otherwise would not have occurred but for the occupational event or exposure.

(iv) Medical treatment in a case where no medical treatment was needed for the injury or illness before the workplace event or exposure, or a change in medical treatment was necessitated by the workplace event or exposure.

(5) *Which injuries and illnesses are considered preexisting conditions?* An injury or illness is a preexisting condition if it resulted solely from a non-work-related event or exposure that occurred outside the work environment.

(6) *How do I decide whether an injury or illness is work-related if the employee is on travel status at the time the injury or illness occurs?* Injuries and illnesses that occur while an employee is on travel status are work-related if, at the time of the injury or illness, the employee was engaged in work activities "in the interest of the employer." Examples of such activities include travel to and from customer contacts, conducting job tasks, and entertaining or being entertained to transact, discuss, or promote business (work-related entertainment includes only entertainment activities being engaged in at the direction of the employer).

Injuries or illnesses that occur when the employee is on travel status do not have to be recorded if they meet one of the exceptions listed below.

1904.5(b)(6)	If the employee has . . .	You may use the following to determine if an injury or illness is work-related
(i)	Checked into a hotel or motel for one or more days.	When a traveling employee checks into a hotel, motel, or into another temporary residence, he or she establishes a "home away from home." You must evaluate the employee's activities after he or she checks into the hotel, motel, or other temporary residence for their work-relatedness in the same manner as you evaluate the activities of a non-traveling employee. When the employee checks into the temporary residence, he or she is considered to have left the work environment. When the employee begins work each day, he or she re-enters the work environment. If the employee has established a "home away from home" and is reporting to a fixed worksite each day, you also do not consider injuries or illnesses work-related if they occur while the employee is commuting between the temporary residence and the job location.
(ii)	Taken a detour for personal reasons.	Injuries or illnesses are not considered work-related if they occur while the employee is on a personal detour from a reasonably direct route of travel (e.g., has taken a side trip for personal reasons).

(7) *How do I decide if a case is work-related when the employee is working at home?* Injuries and illnesses that occur while an employee is working at home, including work in a home office, will be considered work-related if the injury or illness occurs while the employee is performing work for pay or compensation in the home, and the injury or illness is directly related to the performance of work rather than to the general home environment or setting. For example, if an employee drops a box of work documents and injures his or her foot, the case is considered work-related. If an employee's fingernail is punctured by a needle from a sewing machine used to perform garment work at home, becomes infected and requires medical treatment, the injury is considered work-related. If an employee is

injured because he or she trips on the family dog while rushing to answer a work phone call, the case is not considered work-related. If an employee working at home is electrocuted because of faulty home wiring, the injury is not considered work-related.

§1904.6 Determination of new cases.

(a) **Basic requirement.** You must consider an injury or illness to be a "new case" if:

(1) The employee has not previously experienced a recorded injury or illness of the same type that affects the same part of the body, or

(2) The employee previously experienced a recorded injury or illness of the same type that affected the same part of the body but had recovered completely (all signs

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and symptoms had disappeared) from the previous injury or illness and an event or exposure in the work environment caused the signs or symptoms to reappear.

(b) **Implementation.** (1) *When an employee experiences the signs or symptoms of a chronic work-related illness, do I need to consider each recurrence of signs or symptoms to be a new case?* No, for occupational illnesses where the signs or symptoms may recur or continue in the absence of an exposure in the workplace, the case must only be recorded once. Examples may include occupational cancer, asbestosis, byssinosis and silicosis.

(2) *When an employee experiences the signs or symptoms of an injury or illness as a result of an event or exposure in the workplace, such as an episode of occupational asthma, must I treat the episode as a new case?* Yes, because the episode or recurrence was caused by an event or exposure in the workplace, the incident must be treated as a new case.

(3) *May I rely on a physician or other licensed healthcare professional to determine whether a case is a new case or a recurrence of an old case?* You are not required to seek the advice of a physician or other licensed healthcare professional. However, if you do seek such advice, you must follow the physician or other licensed healthcare professional's recommendation about whether the case is a new case or a recurrence. If you receive recommendations from two or more physicians or other licensed healthcare professionals, you must make a decision as to which recommendation is the most authoritative (best documented, best reasoned, or most authoritative), and record the case based upon that recommendation.

§1904.7 General recording criteria.

(a) **Basic requirement.** You must consider an injury or illness to meet the general recording criteria, and therefore to be recordable, if it results in any of the following: death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness. You must also consider a case to meet the general recording criteria if it involves a significant injury or illness diagnosed by a physician or other licensed healthcare professional, even if it does not result in death, days away from work, restricted work or job transfer, medical treatment beyond first aid, or loss of consciousness.

(b) **Implementation.** (1) *How do I decide if a case meets one or more of the general recording criteria?* A work-related injury or illness must be recorded if it results in one or more of the following:

- (i) Death. See §1904.7(b)(2).
- (ii) Days away from work. See §1904.7(b)(3).
- (iii) Restricted work or transfer to another job. See §1904.7(b)(4).
- (iv) Medical treatment beyond first aid. See §1904.7(b)(5).
- (v) Loss of consciousness. See §1904.7(b)(6).

(vi) A significant injury or illness diagnosed by a physician or other licensed healthcare professional. See §1904.7(b)(7).

(2) *How do I record a work-related injury or illness that results in the employee's death?* You must record an injury or illness that results in death by entering a check mark on the OSHA 300 Log in the space for cases resulting in death. You must also report any work-related fatality to OSHA within eight (8) hours, as required by §1904.39.

(3) *How do I record a work-related injury or illness that results in days away from work?* When an injury or illness involves one or more days away from work, you must record the injury or illness on the OSHA 300 Log with a check mark in the space for cases involving days away and an entry of the number of calendar days away from work in the number of days column. If the employee is out for an extended period of time, you must enter an estimate of the days that the employee will be away, and update the day count when the actual number of days is known.

(i) *Do I count the day on which the injury occurred or the illness began?* No, you begin counting days away on the day after the injury occurred or the illness began.

(ii) *How do I record an injury or illness when a physician or other licensed healthcare professional recommends that the worker stay at home but the employee comes to work anyway?* You must record these injuries and illnesses on the OSHA 300 Log using the check box for cases with days away from work and enter the number of calendar days away recommended by the physician or other licensed healthcare professional. If a physician or other licensed healthcare professional recommends days away, you should encourage your employee to follow that recommendation. However, the days away must be recorded whether the injured or ill employee follows the physician or licensed healthcare professional's recommendation or not. If you receive recommendations from two or more physicians or other licensed healthcare professionals, you may make a decision as to which recommendation is the most authoritative, and record the case based upon that recommendation.

(iii) *How do I handle a case when a physician or other licensed healthcare professional recommends that the worker return to work but the employee stays at home anyway?* In this situation, you must end the count of days away from work on the date the physician or other licensed healthcare professional recommends that the employee return to work.

(iv) *How do I count weekends, holidays, or other days the employee would not have worked anyway?* You must count the number of calendar days the employee was unable to work as a result of the injury or illness, regardless of whether or not the employee was scheduled to work on those day(s). Weekend days, holidays, vacation days or other days off are included in the total number of days recorded if the employee would not have been able to work on those days because of a work-related injury or illness.

(v) *How do I record a case in which a worker is injured or becomes ill on a Friday and reports to work on a*

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Monday, and was not scheduled to work on the weekend? You need to record this case only if you receive information from a physician or other licensed health-care professional indicating that the employee should not have worked, or should have performed only restricted work, during the weekend. If so, you must record the injury or illness as a case with days away from work or restricted work, and enter the day counts, as appropriate.

(vi) *How do I record a case in which a worker is injured or becomes ill on the day before scheduled time off such as a holiday, a planned vacation, or a temporary plant closing?* You need to record a case of this type only if you receive information from a physician or other licensed healthcare professional indicating that the employee should not have worked, or should have performed only restricted work, during the scheduled time off. If so, you must record the injury or illness as a case with days away from work or restricted work, and enter the day counts, as appropriate.

(vii) *Is there a limit to the number of days away from work I must count?* Yes, you may “cap” the total days away at 180 calendar days. You are not required to keep track of the number of calendar days away from work if the injury or illness resulted in more than 180 calendar days away from work and/or days of job transfer or restriction. In such a case, entering 180 in the total days away column will be considered adequate.

(viii) *May I stop counting days if an employee who is away from work because of an injury or illness retires or leaves my company?* Yes, if the employee leaves your company for some reason unrelated to the injury or illness, such as retirement, a plant closing, or to take another job, you may stop counting days away from work or days of restriction/job transfer. If the employee leaves your company because of the injury or illness, you must estimate the total number of days away or days of restriction/job transfer and enter the day count on the 300 Log.

(ix) *If a case occurs in one year but results in days away during the next calendar year, do I record the case in both years?* No, you only record the injury or illness once. You must enter the number of calendar days away for the injury or illness on the OSHA 300 Log for the year in which the injury or illness occurred. If the employee is still away from work because of the injury or illness when you prepare the annual summary, estimate the total number of calendar days you expect the employee to be away from work, use this number to calculate the total for the annual summary, and then update the initial log entry later when the day count is known or reaches the 180-day cap.

(4) *How do I record a work-related injury or illness that results in restricted work or job transfer?* When an injury or illness involves restricted work or job transfer but does not involve death or days away from work, you must record the injury or illness on the OSHA 300 Log by placing a check mark in the space for job transfer or restriction and an entry of the number of restricted or transferred days in the restricted workdays column.

(i) *How do I decide if the injury or illness resulted in restricted work?* Restricted work occurs when, as the result of a work-related injury or illness:

(A) You keep the employee from performing one or more of the routine functions of his or her job, or from working the full workday that he or she would otherwise have been scheduled to work; or

(B) A physician or other licensed healthcare professional recommends that the employee not perform one or more of the routine functions of his or her job, or not work the full workday that he or she would otherwise have been scheduled to work.

(ii) *What is meant by “routine functions”?* For record-keeping purposes, an employee’s routine functions are those work activities the employee regularly performs at least once per week.

(iii) *Do I have to record restricted work or job transfer if it applies only to the day on which the injury occurred or the illness began?* No, you do not have to record restricted work or job transfers if you, or the physician or other licensed healthcare professional, impose the restriction or transfer only for the day on which the injury occurred or the illness began.

(iv) *If you or a physician or other licensed healthcare professional recommends a work restriction, is the injury or illness automatically recordable as a “restricted work” case?* No, a recommended work restriction is recordable only if it affects one or more of the employee’s routine job functions. To determine whether this is the case, you must evaluate the restriction in light of the routine functions of the injured or ill employee’s job. If the restriction from you or the physician or other licensed healthcare professional keeps the employee from performing one or more of his or her routine job functions, or from working the full workday the injured or ill employee would otherwise have worked, the employee’s work has been restricted and you must record the case.

(v) *How do I record a case where the worker works only for a partial work shift because of a work-related injury or illness?* A partial day of work is recorded as a day of job transfer or restriction for recordkeeping purposes, except for the day on which the injury occurred or the illness began.

(vi) *If the injured or ill worker produces fewer goods or services than he or she would have produced prior to the injury or illness but otherwise performs all of the routine functions of his or her work, is the case considered a restricted work case?* No, the case is considered restricted work only if the worker does not perform all of the routine functions of his or her job or does not work the full shift that he or she would otherwise have worked.

(vii) *How do I handle vague restrictions from a physician or other licensed healthcare professional, such as that the employee engage only in “light duty” or “take it easy for a week”?* If you are not clear about the physician or other licensed healthcare professional’s recommendation, you may ask that person whether the employee can do all of his or her routine job functions and work all of his or her normally assigned work shift. If the answer to both of these questions is “Yes,” then the case does not

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involve a work restriction and does not have to be recorded as such. If the answer to one or both of these questions is “No,” the case involves restricted work and must be recorded as a restricted work case. If you are unable to obtain this additional information from the physician or other licensed healthcare professional who recommended the restriction, record the injury or illness as a case involving restricted work.

(viii) *What do I do if a physician or other licensed healthcare professional recommends a job restriction meeting OSHA’s definition, but the employee does all of his or her routine job functions anyway?* You must record the injury or illness on the OSHA 300 Log as a restricted work case. If a physician or other licensed healthcare professional recommends a job restriction, you should ensure that the employee complies with that restriction. If you receive recommendations from two or more physicians or other licensed healthcare professionals, you may make a decision as to which recommendation is the most authoritative, and record the case based upon that recommendation.

(ix) *How do I decide if an injury or illness involved a transfer to another job?* If you assign an injured or ill employee to a job other than his or her regular job for part of the day, the case involves transfer to another job. **Note:** This does not include the day on which the injury or illness occurred.

(x) *Are transfers to another job recorded in the same way as restricted work cases?* Yes, both job transfer and restricted work cases are recorded in the same box on the OSHA 300 Log. For example, if you assign, or a physician or other licensed healthcare professional recommends that you assign, an injured or ill worker to his or her routine job duties for part of the day and to another job for the rest of the day, the injury or illness involves a job transfer. You must record an injury or illness that involves a job transfer by placing a check in the box for job transfer.

(xi) *How do I count days of job transfer or restriction?* You count days of job transfer or restriction in the same way you count days away from work, using §1904.7(b)(3)(i) to (viii), above. The only difference is that, if you permanently assign the injured or ill employee to a job that has been modified or permanently changed in a manner that eliminates the routine functions the employee was restricted from performing, you may stop the day count when the modification or change is made permanent. You must count at least one day of restricted work or job transfer for such cases.

(5) *How do I record an injury or illness that involves medical treatment beyond first aid?* If a work-related injury or illness results in medical treatment beyond first aid, you must record it on the OSHA 300 Log. If the injury or illness did not involve death, one or more days away from work, one or more days of restricted work, or one or more days of job transfer, you enter a check mark in the box for cases where the employee received medical treatment but remained at work and was not transferred or restricted.

(i) *What is the definition of medical treatment?* “Medical treatment” means the management and care of a

patient to combat disease or disorder. For the purposes of Part 1904, medical treatment does not include:

(A) Visits to a physician or other licensed healthcare professional solely for observation or counseling;

(B) The conduct of diagnostic procedures, such as x-rays and blood tests, including the administration of prescription medications used solely for diagnostic purposes (e.g., eye drops to dilate pupils); or

(C) “First aid” as defined in paragraph (b)(5)(ii) of this section.

(ii) *What is “first aid”?* For the purposes of Part 1904, “first aid” means the following:

(A) Using a non-prescription medication at nonprescription strength (for medications available in both prescription and non-prescription form, a recommendation by a physician or other licensed healthcare professional to use a non-prescription medication at prescription strength is considered medical treatment for recordkeeping purposes);

(B) Administering tetanus immunizations (other immunizations, such as hepatitis B vaccine or rabies vaccine, are considered medical treatment);

(C) Cleaning, flushing or soaking wounds on the surface of the skin;

(D) Using wound coverings such as bandages, Band-Aids™, gauze pads, etc.; or using butterfly bandages or Steri-Stripst (other wound closing devices such as sutures, staples, etc., are considered medical treatment);

(E) Using hot or cold therapy;

(F) Using any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc. (devices with rigid stays or other systems designed to immobilize parts of the body are considered medical treatment for recordkeeping purposes);

(G) Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.);

(H) Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;

(I) Using eye patches;

(J) Removing foreign bodies from the eye using only irrigation or a cotton swab;

(K) Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;

(L) Using finger guards;

(M) Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes); or

(N) Drinking fluids for relief of heat stress.

(iii) *Are any other procedures included in first aid?* No, this is a complete list of all treatments considered first aid for Part 1904 purposes.

(iv) *Does the professional status of the person providing the treatment have any effect on what is considered first aid or medical treatment?* No, OSHA considers the treatments listed in §1904.7(b)(5)(ii) of this Part to be

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first aid regardless of the professional status of the person providing the treatment. Even when these treatments are provided by a physician or other licensed healthcare professional, they are considered first aid for the purposes of Part 1904. Similarly, OSHA considers treatment beyond first aid to be medical treatment even when it is provided by someone other than a physician or other licensed healthcare professional.

(v) *What if a physician or other licensed healthcare professional recommends medical treatment but the employee does not follow the recommendation?* If a physician or other licensed healthcare professional recommends medical treatment, you should encourage the injured or ill employee to follow that recommendation. However, you must record the case even if the injured or ill employee does not follow the physician or other licensed healthcare professional's recommendation.

(6) *Is every work-related injury or illness case involving a loss of consciousness recordable?* Yes, you must record a work-related injury or illness if the worker becomes unconscious, regardless of the length of time the employee remains unconscious.

(7) *What is a "significant" diagnosed injury or illness that is recordable under the general criteria even if it does not result in death, days away from work, restricted work or job transfer, medical treatment beyond first aid, or loss of consciousness?* Work-related cases involving cancer, chronic irreversible disease, a fractured or cracked bone, or a punctured eardrum must always be recorded under the general criteria at the time of diagnosis by a physician or other licensed healthcare professional.

§1904.8 Recording criteria for needlestick and sharps injuries.

(a) **Basic requirement.** You must record all work-related needlestick injuries and cuts from sharp objects that are contaminated with another person's blood or other potentially infectious material (as defined by 29 CFR 1910.1030). You must enter the case on the OSHA 300 Log as an injury. To protect the employee's privacy, you may not enter the employee's name on the OSHA 300 Log (see the requirements for privacy cases in paragraphs §1904.29(b)(6) through §1904.29(b)(9)).

(b) **Implementation.** (1) *What does "other potentially infectious materials" mean?* The term "other potentially infectious materials" is defined in the OSHA Bloodborne Pathogens standard at §1910.1030(b). These materials include:

- (i) Human bodily fluids, tissues and organs, and
- (ii) Other materials infected with the HIV or hepatitis B (HBV) virus such as laboratory cultures or tissues from experimental animals.

(2) *Does this mean that I must record all cuts, lacerations, punctures, and scratches?* No, you need to record cuts, lacerations, punctures, and scratches only if they are work-related and involve contamination with another person's blood or other potentially infectious material. If the cut, laceration, or scratch involves a clean object, or a contaminant other than blood or other

potentially infectious material, you need to record the case only if it meets one or more of the recording criteria in §1904.7.

(3) *If I record an injury and the employee is later diagnosed with an infectious bloodborne disease, do I need to update the OSHA 300 Log?* Yes, you must update the classification of the case on the OSHA 300 Log if the case results in death, days away from work, restricted work, or job transfer. You must also update the description to identify the infectious disease and change the classification of the case from an injury to an illness.

(4) *What if one of my employees is splashed or exposed to blood or other potentially infectious material without being cut or scratched? Do I need to record this incident?* You need to record such an incident on the OSHA 300 Log as an illness if:

(i) It results in the diagnosis of a bloodborne illness, such as HIV, hepatitis B, or hepatitis C; or

(ii) It meets one or more of the recording criteria in §1904.7.

§1904.9 Recording criteria for cases involving medical removal under OSHA standards.

(a) **Basic requirement.** If an employee is medically removed under the medical surveillance requirements of an OSHA standard, you must record the case on the OSHA 300 Log.

(b) **Implementation.** (1) *How do I classify medical removal cases on the OSHA 300 Log?* You must enter each medical removal case on the OSHA 300 Log as either a case involving days away from work or a case involving restricted work activity, depending on how you decide to comply with the medical removal requirement. If the medical removal is the result of a chemical exposure, you must enter the case on the OSHA 300 Log by checking the "poisoning" column.

(2) *Do all of OSHA's standards have medical removal provisions?* No, some OSHA standards, such as the standards covering bloodborne pathogens and noise, do not have medical removal provisions. Many OSHA standards that cover specific chemical substances have medical removal provisions. These standards include, but are not limited to, lead, cadmium, methylene chloride, formaldehyde, and benzene.

(3) *Do I have to record a case where I voluntarily removed the employee from exposure before the medical removal criteria in an OSHA standard are met?* No, if the case involves voluntary medical removal before the medical removal levels required by an OSHA standard, you do not need to record the case on the OSHA 300 Log.

§1904.10 Recording criteria for cases involving occupational hearing loss.

(a) **Basic requirement.** If an employee's hearing test (audiogram) reveals that the employee has experienced a work-related Standard Threshold Shift (STS) in hearing in one or both ears, and the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS, you must record the case on the OSHA 300 Log.

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(b) **Implementation.** (1) *What is a Standard Threshold Shift?* A Standard Threshold Shift, or STS, is defined in the occupational noise exposure standard at 29 CFR 1910.95(g)(10)(i) as a change in hearing threshold, relative to the baseline audiogram for that employee, of an average of 10 decibels (dB) or more at 2000, 3000, and 4000 hertz (Hz) in one or both ears.

(2) *How do I evaluate the current audiogram to determine whether an employee has an STS and a 25 dB hearing level?*

(i) *STS.* If the employee has never previously experienced a recordable hearing loss, you must compare the employee's current audiogram with that employee's baseline audiogram. If the employee has previously experienced a recordable hearing loss, you must compare the employee's current audiogram with the employee's revised baseline audiogram (the audiogram reflecting the employee's previous recordable hearing loss case).

(ii) *25 dB loss.* Audiometric test results reflect the employee's overall hearing ability in comparison to audiometric zero. Therefore, using the employee's current audiogram, you must use the average hearing level at 2000, 3000, and 4000 Hz to determine whether or not the employee's total hearing level is 25 dB or more.

(3) *May I adjust the current audiogram to reflect the effects of aging on hearing?*

Yes. When you are determining whether an STS has occurred, you may age adjust the employee's current audiogram results by using Tables F-1 or F-2, as appropriate, in Appendix F of 29 CFR 1910.95. You may not use an age adjustment when determining whether the employee's total hearing level is 25 dB or more above audiometric zero.

(4) *Do I have to record the hearing loss if I am going to retest the employee's hearing?*

No, if you retest the employee's hearing within 30 days of the first test, and the retest does not confirm the recordable STS, you are not required to record the hearing loss case on the OSHA 300 Log. If the retest confirms the recordable STS, you must record the hearing loss illness within seven (7) calendar days of the retest. If subsequent audiometric testing performed under the testing requirements of the §1910.95 noise standard indicates that an STS is not persistent, you may erase or line-out the recorded entry.

(5) *Are there any special rules for determining whether a hearing loss case is work-related?*

No. You must use the rules in §1904.5 to determine if the hearing loss is work-related. If an event or exposure in the work environment either caused or contributed to the hearing loss, or significantly aggravated a pre-existing hearing loss, you must consider the case to be work-related.

(6) *If a physician or other licensed healthcare professional determines the hearing loss is not work-related, do I still need to record the case?*

If a physician or other licensed healthcare professional determines that the hearing loss is not work-related or has not been significantly aggravated by

occupational noise exposure, you are not required to consider the case work-related or to record the case on the OSHA 300 Log.

(7) *How do I complete the 300 Log for a hearing loss case?*

When you enter a recordable hearing loss case on the OSHA 300 Log, you must check the 300 Log column for hearing loss.

§1904.11 Recording criteria for work-related tuberculosis cases.

(a) **Basic requirement.** If any of your employees has been occupationally exposed to anyone with a known case of active tuberculosis (TB), and that employee subsequently develops a tuberculosis infection, as evidenced by a positive skin test or diagnosis by a physician or other licensed healthcare professional, you must record the case on the OSHA 300 Log by checking the "respiratory condition" column.

(b) **Implementation.** (1) *Do I have to record, on the Log, a positive TB skin test result obtained at a pre-employment physical?* No, you do not have to record it because the employee was not occupationally exposed to a known case of active tuberculosis in your workplace.

(2) *May I line-out or erase a recorded TB case if I obtain evidence that the case was not caused by occupational exposure?* Yes, you may line-out or erase the case from the Log under the following circumstances:

(i) The worker is living in a household with a person who has been diagnosed with active TB;

(ii) The Public Health Department has identified the worker as a contact of an individual with a case of active TB unrelated to the workplace; or

(iii) A medical investigation shows that the employee's infection was caused by exposure to TB away from work, or proves that the case was not related to the workplace TB exposure.

§1904.12–1904.28 [Reserved]

§1904.29 Forms.

(a) **Basic requirement.** You must use OSHA 300, 300A, and 301 forms, or equivalent forms, for recordable injuries and illnesses. The OSHA 300 form is called the Log of Work-Related Injuries and Illnesses, the 300A is the Summary of Work-Related Injuries and Illnesses, and the OSHA 301 form is called the Injury and Illness Incident Report.

(b) **Implementation.** (1) *What do I need to do to complete the OSHA 300 Log?* You must enter information about your business at the top of the OSHA 300 Log, enter a one or two line description for each recordable injury or illness, and summarize this information on the OSHA 300A at the end of the year.

(2) *What do I need to do to complete the OSHA 301 Incident Report?* You must complete an OSHA 301 Incident Report form, or an equivalent form, for each recordable injury or illness entered on the OSHA 300 Log.

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(3) *How quickly must each injury or illness be recorded?* You must enter each recordable injury or illness on the OSHA 300 Log and 301 Incident Report within seven (7) calendar days of receiving information that a recordable injury or illness has occurred.

(4) *What is an equivalent form?* An equivalent form is one that has the same information, is as readable and understandable, and is completed using the same instructions as the OSHA form it replaces. Many employers use an insurance form instead of the OSHA 301 Incident Report, or supplement an insurance form by adding any additional information required by OSHA.

(5) *May I keep my records on a computer?* Yes, if the computer can produce equivalent forms when they are needed, as described under §§1904.35 and 1904.40, you may keep your records using the computer system.

(6) *Are there situations where I do not put the employee's name on the forms for privacy reasons?* Yes, if you have a "privacy concern case," you may not enter the employee's name on the OSHA 300 Log. Instead, enter "privacy case" in the space normally used for the employee's name. This will protect the privacy of the injured or ill employee when another employee, a former employee, or an authorized employee representative is provided access to the OSHA 300 Log under §1904.35(b)(2). You must keep a separate, confidential list of the case numbers and employee names for your privacy concern cases so you can update the cases and provide the information to the government if asked to do so.

(7) *How do I determine if an injury or illness is a privacy concern case?* You must consider the following injuries or illnesses to be privacy concern cases:

- (i) An injury or illness to an intimate body part or the reproductive system;
- (ii) An injury or illness resulting from a sexual assault;
- (iii) Mental illnesses;
- (iv) HIV infection, hepatitis, or tuberculosis;
- (v) Needlestick injuries and cuts from sharp objects that are contaminated with another person's blood or other potentially infectious material (see §1904.8 for definitions); and
- (vi) Other illnesses, if the employee voluntarily requests that his or her name not be entered on the log.

(8) *May I classify any other types of injuries and illnesses as privacy concern cases?* No, this is a complete list of all injuries and illnesses considered privacy concern cases for Part 1904 purposes.

(9) *If I have removed the employee's name, but still believe that the employee may be identified from the information on the forms, is there anything else that I can do to further protect the employee's privacy?* Yes, if you have a reasonable basis to believe that information describing the privacy concern case may be personally identifiable even though the employee's name has been omitted, you may use discretion in describing the injury or illness on both the OSHA 300 and 301 forms. You must enter enough information to identify the cause of the incident and the general severity of the injury or

illness, but you do not need to include details of an intimate or private nature. For example, a sexual assault case could be described as "injury from assault," or an injury to a reproductive organ could be described as "lower abdominal injury."

(10) *What must I do to protect employee privacy if I wish to provide access to the OSHA Forms 300 and 301 to persons other than government representatives, employees, former employees or authorized representatives?* If you decide to voluntarily disclose the Forms to persons other than government representatives, employees, former employees or authorized representatives (as required by §§1904.35 and 1904.40), you must remove or hide the employees' names and other personally identifying information, except for the following cases. You may disclose the Forms with personally identifying information only:

- (i) To an auditor or consultant hired by the employer to evaluate the safety and health program;
- (ii) To the extent necessary for processing a claim for workers' compensation or other insurance benefits; or
- (iii) To a public health authority or law enforcement agency for uses and disclosures for which consent, an authorization, or opportunity to agree or object is not required under Department of Health and Human Services Standards for Privacy of Individually Identifiable Health Information, 45 CFR 164.512.

Subpart D—Other OSHA injury and illness recordkeeping requirements

§1904.30 Multiple business establishments.

(a) **Basic requirement.** You must keep a separate OSHA 300 Log for each establishment that is expected to be in operation for one year or longer.

(b) **Implementation.** (1) *Do I need to keep OSHA injury and illness records for short-term establishments (i.e., establishments that will exist for less than a year)?* Yes, however, you do not have to keep a separate OSHA 300 Log for each such establishment. You may keep one OSHA 300 Log that covers all of your short-term establishments. You may also include the short-term establishments' recordable injuries and illnesses on an OSHA 300 Log that covers short-term establishments for individual company divisions or geographic regions.

(2) *May I keep the records for all of my establishments at my headquarters location or at some other central location?* Yes, you may keep the records for an establishment at your headquarters or other central location if you can:

- (i) Transmit information about the injuries and illnesses from the establishment to the central location within seven (7) calendar days of receiving information that a recordable injury or illness has occurred; and
- (ii) Produce and send the records from the central location to the establishment within the time frames required by §1904.35 and §1904.40 when you are required to provide records to a government representative, employees, former employees or employee representatives.

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(3) *Some of my employees work at several different locations or do not work at any of my establishments at all. How do I record cases for these employees?* You must link each of your employees with one of your establishments, for recordkeeping purposes. You must record the injury and illness on the OSHA 300 Log of the injured or ill employee's establishment, or on an OSHA 300 Log that covers that employee's short-term establishment.

(4) *How do I record an injury or illness when an employee of one of my establishments is injured or becomes ill while visiting or working at another of my establishments, or while working away from any of my establishments?* If the injury or illness occurs at one of your establishments, you must record the injury or illness on the OSHA 300 Log of the establishment at which the injury or illness occurred. If the employee is injured or becomes ill and is not at one of your establishments, you must record the case on the OSHA 300 Log at the establishment at which the employee normally works.

§1904.31 Covered employees.

(a) **Basic requirement.** You must record on the OSHA 300 Log the recordable injuries and illnesses of all employees on your payroll, whether they are labor, executive, hourly, salary, part-time, seasonal, or migrant workers. You also must record the recordable injuries and illnesses that occur to employees who are not on your payroll if you supervise these employees on a day-to-day basis. If your business is organized as a sole proprietorship or partnership, the owner or partners are not considered employees for recordkeeping purposes.

(b) **Implementation.** (1) *If a self-employed person is injured or becomes ill while doing work at my business, do I need to record the injury or illness?* No, self-employed individuals are not covered by the OSH Act or this regulation.

(2) *If I obtain employees from a temporary help service, employee leasing service, or personnel supply service, do I have to record an injury or illness occurring to one of those employees?* You must record these injuries and illnesses if you supervise these employees on a day-to-day basis.

(3) *If an employee in my establishment is a contractor's employee, must I record an injury or illness occurring to that employee?* If the contractor's employee is under the day-to-day supervision of the contractor, the contractor is responsible for recording the injury or illness. If you supervise the contractor employee's work on a day-to-day basis, you must record the injury or illness.

(4) *Must the personnel supply service, temporary help service, employee leasing service, or contractor also record the injuries or illnesses occurring to temporary, leased or contract employees that I supervise on a day-to-day basis?* No, you and the temporary help service, employee leasing service, personnel supply service, or contractor should coordinate your efforts to make sure that each injury and illness is recorded only once: either on your OSHA 300 Log (if you provide day-to-day supervision) or on the other employer's OSHA 300 Log (if that company provides day-to-day supervision).

§1904.32 Annual summary.

(a) **Basic requirement.** At the end of each calendar year, you must:

- (1) Review the OSHA 300 Log to verify that the entries are complete and accurate, and correct any deficiencies identified;
- (2) Create an annual summary of injuries and illnesses recorded on the OSHA 300 Log;
- (3) Certify the summary; and
- (4) Post the annual summary.

(b) **Implementation.** (1) *How extensively do I have to review the OSHA 300 Log entries at the end of the year?* You must review the entries as extensively as necessary to make sure that they are complete and correct.

(2) *How do I complete the annual summary?* You must:

(i) Total the columns on the OSHA 300 Log (if you had no recordable cases, enter zeros for each column total); and

(ii) Enter the calendar year covered, the company's name, establishment name, establishment address, annual average number of employees covered by the OSHA 300 Log, and the total hours worked by all employees covered by the OSHA 300 Log.

(iii) If you are using an equivalent form other than the OSHA 300A summary form, as permitted under §1904.6(b)(4), the summary you use must also include the employee access and employer penalty statements found on the OSHA 300A Summary form.

(3) *How do I certify the annual summary?* A company executive must certify that he or she has examined the OSHA 300 Log and that he or she reasonably believes, based on his or her knowledge of the process by which the information was recorded, that the annual summary is correct and complete.

(4) *Who is considered a company executive?* The company executive who certifies the log must be one of the following persons:

- (i) An owner of the company (only if the company is a sole proprietorship or partnership);
- (ii) An officer of the corporation;
- (iii) The highest ranking company official working at the establishment; or
- (iv) The immediate supervisor of the highest ranking company official working at the establishment.

(5) *How do I post the annual summary?* You must post a copy of the annual summary in each establishment in a conspicuous place or places where notices to employees are customarily posted. You must ensure that the posted annual summary is not altered, defaced or covered by other material.

(6) *When do I have to post the annual summary?* You must post the summary no later than February 1 of the year following the year covered by the records and keep the posting in place until April 30.

§1904.33 Retention and updating.

(a) **Basic requirement.** You must save the OSHA 300 Log, the privacy case list (if one exists), the annual summary, and the OSHA 301 Incident Report forms for

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five (5) years following the end of the calendar year that these records cover.

(b) **Implementation.** (1) *Do I have to update the OSHA 300 Log during the five-year storage period?* Yes, during the storage period, you must update your stored OSHA 300 Logs to include newly discovered recordable injuries or illnesses and to show any changes that have occurred in the classification of previously recorded injuries and illnesses. If the description or outcome of a case changes, you must remove or line out the original entry and enter the new information.

(2) *Do I have to update the annual summary?* No, you are not required to update the annual summary, but you may do so if you wish.

(3) *Do I have to update the OSHA 301 Incident Reports?* No, you are not required to update the OSHA 301 Incident Reports, but you may do so if you wish.

§1904.34 Change in business ownership.

If your business changes ownership, you are responsible for recording and reporting work-related injuries and illnesses only for that period of the year during which you owned the establishment. You must transfer the Part 1904 records to the new owner. The new owner must save all records of the establishment kept by the prior owner, as required by §1904.33 of this Part, but need not update or correct the records of the prior owner.

§1904.35 Employee involvement.

(a) **Basic requirement.** Your employees and their representatives must be involved in the recordkeeping system in several ways.

(1) You must inform each employee of how he or she is to report an injury or illness to you.

(2) You must provide limited access to your injury and illness records for your employees and their representatives.

(b) **Implementation.** (1) *What must I do to make sure that employees report work-related injuries and illnesses to me?*

(i) You must set up a way for employees to report work-related injuries and illnesses promptly; and

(ii) You must tell each employee how to report work-related injuries and illnesses to you.

(2) *Do I have to give my employees and their representatives access to the OSHA injury and illness records?* Yes, your employees, former employees, their personal representatives, and their authorized employee representatives have the right to access the OSHA injury and illness records, with some limitations, as discussed below.

(i) *Who is an authorized employee representative?* An authorized employee representative is an authorized collective bargaining agent of employees.

(ii) *Who is a “personal representative” of an employee or former employee?* A personal representative is:

(A) Any person that the employee or former employee designates as such, in writing; or

(B) The legal representative of a deceased or legally incapacitated employee or former employee.

(iii) *If an employee or representative asks for access to the OSHA 300 Log, when do I have to provide it?* When an employee, former employee, personal representative, or authorized employee representative asks for copies of your current or stored OSHA 300 Log(s) for an establishment the employee or former employee has worked in, you must give the requester a copy of the relevant OSHA 300 Log(s) by the end of the next business day.

(iv) *May I remove the names of the employees or any other information from the OSHA 300 Log before I give copies to an employee, former employee, or employee representative?* No, you must leave the names on the 300 Log. However, to protect the privacy of injured and ill employees, you may not record the employee’s name on the OSHA 300 Log for certain “privacy concern cases,” as specified in paragraphs §1904.29(b)(6) through §1904.29(b)(9).

(v) *If an employee or representative asks for access to the OSHA 301 Incident Report, when do I have to provide it?*

(A) When an employee, former employee, or personal representative asks for a copy of the OSHA 301 Incident Report describing an injury or illness to that employee or former employee, you must give the requester a copy of the OSHA 301 Incident Report containing that information by the end of the next business day.

(B) When an authorized employee representative asks for a copies of the OSHA 301 Incident Reports for an establishment where the agent represents employees under a collective bargaining agreement, you must give copies of those forms to the authorized employee representative within 7 calendar days. You are only required to give the authorized employee representative information from the OSHA 301 Incident Report section titled “Tell us about the case.” You must remove all other information from the copy of the OSHA 301 Incident Report or the equivalent substitute form that you give to the authorized employee representative.

(vi) *May I charge for the copies?* No, you may not charge for these copies the first time they are provided. However, if one of the designated persons asks for additional copies, you may assess a reasonable charge for retrieving and copying the records.

§1904.36 Prohibition against discrimination.

Section 11(c) of the Act prohibits you from discriminating against an employee for reporting a work-related fatality, injury or illness. That provision of the Act also protects the employee who files a safety and health complaint, asks for access to the Part 1904 records, or otherwise exercises any rights afforded by the OSH Act.

§1904.37 State recordkeeping regulations.

(a) **Basic requirement.** Some States operate their own OSHA programs, under the authority of a State Plan approved by OSHA. States operating OSHA-approved State Plans must have occupational injury and illness recording and reporting requirements that are substantially identical to the requirements in this Part (see 29 CFR 1902.3(k), 29 CFR 1952.4 and 29 CFR

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1956.10(i)).

(b) **Implementation.** (1) State-Plan States must have the same requirements as Federal OSHA for determining which injuries and illnesses are recordable and how they are recorded.

(2) For other Part 1904 provisions (for example, industry exemptions, reporting of fatalities and hospitalizations, record retention, or employee involvement), State-Plan State requirements may be more stringent than or supplemental to the Federal requirements, but because of the unique nature of the national recordkeeping program, States must consult with and obtain approval of any such requirements.

(3) Although State and local government employees are not covered Federally, all State-Plan States must provide coverage, and must develop injury and illness statistics, for these workers. State Plan recording and reporting requirements for State and local government entities may differ from those for the private sector but must meet the requirements of paragraphs §1904.37(b)(1) and (b)(2).

(4) A State-Plan State may not issue a variance to a private sector employer and must recognize all variances issued by Federal OSHA.

(5) A State-Plan State may only grant an injury and illness recording and reporting variance to a State or local government employer within the State after obtaining approval to grant the variance from Federal OSHA.

§1904.38 Variances from the recordkeeping rule.

(a) **Basic requirement.** If you wish to keep records in a different manner from the manner prescribed by the Part 1904 regulations, you may submit a variance petition to the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, Washington, DC 20210. You can obtain a variance only if you can show that your alternative recordkeeping system:

(1) Collects the same information as this Part requires;

(2) Meets the purposes of the Act; and

(3) Does not interfere with the administration of the Act.

(b) **Implementation.** (1) *What do I need to include in my variance petition?* You must include the following items in your petition:

(i) Your name and address;

(ii) A list of the State(s) where the variance would be used;

(iii) The address(es) of the business establishment(s) involved;

(iv) A description of why you are seeking a variance;

(v) A description of the different recordkeeping procedures you propose to use;

(vi) A description of how your proposed procedures will collect the same information as would be collected by this Part and achieve the purpose of the Act; and

(vii) A statement that you have informed your employees of the petition by giving them or their authorized representative a copy of the petition and by posting a statement summarizing the petition in the same way as notices are posted under §1903.2(a).

(2) *How will the Assistant Secretary handle my variance petition?* The Assistant Secretary will take the following steps to process your variance petition.

(i) The Assistant Secretary will offer your employees and their authorized representatives an opportunity to submit written data, views, and arguments about your variance petition.

(ii) The Assistant Secretary may allow the public to comment on your variance petition by publishing the petition in the *Federal Register*. If the petition is published, the notice will establish a public comment period and may include a schedule for a public meeting on the petition.

(iii) After reviewing your variance petition and any comments from your employees and the public, the Assistant Secretary will decide whether or not your proposed re-recordkeeping procedures will meet the purposes of the Act, will not otherwise interfere with the Act, and will provide the same information as the Part 1904 regulations provide. If your procedures meet these criteria, the Assistant Secretary may grant the variance subject to such conditions as he or she finds appropriate.

(iv) If the Assistant Secretary grants your variance petition, OSHA will publish a notice in the *Federal Register* to announce the variance. The notice will include the practices the variance allows you to use, any conditions that apply, and the reasons for allowing the variance.

(3) *If I apply for a variance, may I use my proposed recordkeeping procedures while the Assistant Secretary is processing the variance petition?* No, alternative re-recordkeeping practices are only allowed after the variance is approved. You must comply with the Part 1904 regulations while the Assistant Secretary is reviewing your variance petition.

(4) *If I have already been cited by OSHA for not following the Part 1904 regulations, will my variance petition have any effect on the citation and penalty?* No, in addition, the Assistant Secretary may elect not to review your variance petition if it includes an element for which you have been cited and the citation is still under review by a court, an Administrative Law Judge (ALJ), or the OSH Review Commission.

(5) *If I receive a variance, may the Assistant Secretary revoke the variance at a later date?* Yes, the Assistant Secretary may revoke your variance if he or she has good cause. The procedures revoking a variance will follow the same process as OSHA uses for reviewing variance petitions, as outlined in paragraph §1904.38(b)(2). Except in cases of willfulness or where necessary for public safety, the Assistant Secretary will:

(i) Notify you in writing of the facts or conduct that may warrant revocation of your variance; and

(ii) Provide you, your employees, and authorized employee representatives with an opportunity to participate in the revocation procedures.

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Subpart E—Reporting fatality, injury and illness information to the government

§1904.39 Reporting fatalities and multiple hospitalization incidents to OSHA.

(a) **Basic requirement.** Within eight (8) hours after the death of any employee from a work-related incident or the in-patient hospitalization of three or more employees as a result of a work-related incident, you must orally report the fatality/multiple hospitalization by telephone or in person to the Area Office of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, that is nearest to the site of the incident. You may also use the OSHA toll-free central telephone number, 1-800-321-OSHA (1-800-321-6742).

(b) **Implementation.** (1) *If the Area Office is closed, may I report the incident by leaving a message on OSHA's answering machine, faxing the Area Office, or sending an e-mail?* No, if you can't talk to a person at the Area Office, you must report the fatality or multiple hospitalization incident using the 800 number.

(2) *What information do I need to give to OSHA about the incident?* You must give OSHA the following information for each fatality or multiple hospitalization incident:

- (i) The establishment name;
- (ii) The location of the incident;
- (iii) The time of the incident;
- (iv) The number of fatalities or hospitalized employees;
- (v) The names of any injured employees;
- (vi) Your contact person and his or her phone number; and
- (vii) A brief description of the incident.

(3) *Do I have to report every fatality or multiple hospitalization incident resulting from a motor vehicle accident?* No, you do not have to report all of these incidents. If the motor vehicle accident occurs on a public street or highway, and does not occur in a construction work zone, you do not have to report the incident to OSHA. However, these injuries must be recorded on your OSHA injury and illness records, if you are required to keep such records.

(4) *Do I have to report a fatality or multiple hospitalization incident that occurs on a commercial or public transportation system?* No, you do not have to call OSHA to report a fatality or multiple hospitalization incident if it involves a commercial airplane, train, subway or bus accident. However, these injuries must be recorded on your OSHA injury and illness records, if you are required to keep such records.

(5) *Do I have to report a fatality caused by a heart attack at work?* Yes, your local OSHA Area Office director will decide whether to investigate the incident, depending on the circumstances of the heart attack.

(6) *Do I have to report a fatality or hospitalization that occurs long after the incident?* No, you must only report

each fatality or multiple hospitalization incident that occurs within thirty (30) days of an incident.

(7) *What if I don't learn about an incident right away?* If you do not learn of a reportable incident at the time it occurs and the incident would otherwise be reportable under paragraphs (a) and (b) of this section, you must make the report within eight (8) hours of the time the incident is reported to you or to any of your agent(s) or employee(s).

§1904.40 Providing records to government representatives.

(a) **Basic requirement.** When an authorized government representative asks for the records you keep under Part 1904, you must provide copies of the records within four (4) business hours.

(b) **Implementation.** (1) *What government representatives have the right to get copies of my Part 1904 records?* The government representatives authorized to receive the records are:

- (i) A representative of the Secretary of Labor conducting an inspection or investigation under the Act;
- (ii) A representative of the Secretary of Health and Human Services (including the National Institute for Occupational Safety and Health — NIOSH) conducting an investigation under section 20(b) of the Act, or
- (iii) A representative of a State agency responsible for administering a State plan approved under section 18 of the Act.

(2) *Do I have to produce the records within four (4) hours if my records are kept at a location in a different time zone?* OSHA will consider your response to be timely if you give the records to the government representative within four (4) business hours of the request. If you maintain the records at a location in a different time zone, you may use the business hours of the establishment at which the records are located when calculating the deadline.

§1904.41 Annual OSHA injury and illness survey of ten or more employers.

(a) **Basic requirement.** If you receive OSHA's annual survey form, you must fill it out and send it to OSHA or OSHA's designee, as stated on the survey form. You must report the following information for the year described on the form:

- (1) The number of workers you employed;
- (2) The number of hours worked by your employees; and
- (3) The requested information from the records that you keep under Part 1904.

(b) **Implementation.** (1) *Does every employer have to send data to OSHA?* No, each year, OSHA sends injury and illness survey forms to employers in certain industries. In any year, some employers will receive an OSHA survey form and others will not. You do not have to send injury and illness data to OSHA unless you receive a survey form.

(2) *How quickly do I need to respond to an OSHA survey form?* You must send the survey reports to

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OSHA, or OSHA's designee, by mail or other means described in the survey form, within 30 calendar days, or by the date stated in the survey form, whichever is later.

(3) *Do I have to respond to an OSHA survey form if I am normally exempt from keeping OSHA injury and illness records?* Yes, even if you are exempt from keeping injury and illness records under §1904.1 to §1904.3, OSHA may inform you in writing that it will be collecting injury and illness information from you in the following year. If you receive such a letter, you must keep the injury and illness records required by §1904.5 to §1904.15 and make a survey report for the year covered by the survey.

(4) *Do I have to answer the OSHA survey form if I am located in a State-Plan State?* Yes, all employers who receive survey forms must respond to the survey, even those in State-Plan States.

(5) *Does this section affect OSHA's authority to inspect my workplace?* No, nothing in this section affects OSHA's statutory authority to investigate conditions related to occupational safety and health.

§1904.42 Requests from the Bureau of Labor Statistics for data.

(a) **Basic requirement.** If you receive a Survey of Occupational Injuries and Illnesses Form from the Bureau of Labor Statistics (BLS), or a BLS designee, you must promptly complete the form and return it following the instructions contained on the survey form.

(b) **Implementation.** (1) *Does every employer have to send data to the BLS?* No, each year, the BLS sends injury and illness survey forms to randomly selected employers and uses the information to create the Nation's occupational injury and illness statistics. In any year, some employers will receive a BLS survey form and others will not. You do not have to send injury and illness data to the BLS unless you receive a survey form.

(2) *If I get a survey form from the BLS, what do I have to do?* If you receive a Survey of Occupational Injuries and Illnesses Form from the Bureau of Labor Statistics (BLS), or a BLS designee, you must promptly complete the form and return it, following the instructions contained on the survey form.

(3) *Do I have to respond to a BLS survey form if I am normally exempt from keeping OSHA injury and illness records?* Yes, even if you are exempt from keeping injury and illness records under §1904.1 to §1904.3, the BLS may inform you in writing that it will be collecting injury and illness information from you in the coming year. If you receive such a letter, you must keep the injury and illness records required by §1904.5 to §1904.15 and make a survey report for the year covered by the survey.

(4) *Do I have to answer the BLS survey form if I am located in a State-Plan State?* Yes, all employers who receive a survey form must respond to the survey, even those in State-Plan States.

Subpart F—Transition from the former rule

§1904.43 Summary and posting of the 2001 data.

(a) **Basic requirement.** If you were required to keep OSHA 200 Logs in 2001, you must post a 2000 annual summary from the OSHA 200 Log of occupational injuries and illnesses for each establishment.

(b) **Implementation.** (1) *What do I have to include in the summary?*

(i) You must include a copy of the totals from the 2001 OSHA 200 Log and the following information from that form:

- (A) The calendar year covered;
- (B) Your company name;
- (C) The name and address of the establishment; and
- (D) The certification signature, title and date.

(ii) If no injuries or illnesses occurred at your establishment in 2001, you must enter zeros on the totals line and post the 2001 summary.

(2) *When am I required to summarize and post the 2001 information?*

(i) You must complete the summary by February 1, 2002; and

(ii) You must post a copy of the summary in each establishment in a conspicuous place or places where notices to employees are customarily posted. You must ensure that the summary is not altered, defaced or covered by other material.

(3) You must post the 2001 summary from February 1, 2002 to March 1, 2002.

§1904.44 Retention and updating of old forms.

You must save your copies of the OSHA 200 and 101 forms for five years following the year to which they relate and continue to provide access to the data as though these forms were the OSHA 300 and 301 forms. You are not required to update your old 200 and 101 forms.

§1904.45 OMB control numbers under the Paperwork Reduction Act.

The following sections each contain a collection of information requirement which has been approved by the Office of Management and Budget under the control number listed.

29 CFR citation	OMB Control No.
1904.4-35	1218-0176
1904.39-41	1218-0176
1904.42	1220-0045
1904.43-44	1218-0176

Subpart G—Definitions

§1904.46 Definitions.

The Act. The Act means the Occupational Safety and Health Act of 1970 (29 U.S.C. 651 *et seq.*). The definitions contained in section 3 of the Act (29 U.S.C. 652)

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and related interpretations apply to such terms when used in this Part 1904.

Establishment. An establishment is a single physical location where business is conducted or where services or industrial operations are performed. For activities where employees do not work at a single physical location, such as construction; transportation; communications, electric, gas and sanitary services; and similar operations, the establishment is represented by main or branch offices, terminals, stations, etc. that either supervise such activities or are the base from which personnel carry out these activities.

(1) *Can one business location include two or more establishments?* Normally, one business location has only one establishment. Under limited conditions, the employer may consider two or more separate businesses that share a single location to be separate establishments. An employer may divide one location into two or more establishments only when:

- (i) Each of the establishments represents a distinctly separate business;
- (ii) Each business is engaged in a different economic activity;
- (iii) No one industry description in the Standard Industrial Classification Manual (1987) applies to the joint activities of the establishments; and
- (iv) Separate reports are routinely prepared for each establishment on the number of employees, their wages and salaries, sales or receipts, and other business information. For example, if an employer operates a construction company at the same location as a lumber yard, the employer may consider each business to be a separate establishment.

(2) *Can an establishment include more than one physical location?* Yes, but only under certain conditions. An employer may combine two or more physical locations into a single establishment only when:

(i) The employer operates the locations as a single business operation under common management;

(ii) The locations are all located in close proximity to each other; and

(iii) The employer keeps one set of business records for the locations, such as records on the number of employees, their wages and salaries, sales or receipts, and other kinds of business information. For example, one manufacturing establishment might include the main plant, a warehouse a few blocks away, and an administrative services building across the street.

(3) *If an employee telecommutes from home, is his or her home considered a separate establishment?* No, for employees who telecommute from home, the employee's home is not a business establishment and a separate 300 Log is not required. Employees who telecommute must be linked to one of your establishments under §1904.30(b)(3).

Injury or illness. An injury or illness is an abnormal condition or disorder. Injuries include cases such as, but not limited to, a cut, fracture, sprain, or amputation. Illnesses include both acute and chronic illnesses, such as, but not limited to, a skin disease, respiratory disorder, or poisoning. (Note: Injuries and illnesses are recordable only if they are new, work-related cases that meet one or more of the Part 1904 recording criteria.)

Physician or other licensed healthcare professional. A physician or other licensed healthcare professional is an individual whose legally permitted scope of practice (*i.e.*, license, registration, or certification) allows him or her to independently perform, or be delegated the responsibility to perform, the activities described by this regulation.

You. "You" means an employer as defined in Section 3 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 652).

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OSHA's Form 301
Injury and Illness Incident Report

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary*, these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by _____

Title _____

Phone (____) _____ Date ____/____/____

Information about the employee

- 1) Full name _____
- 2) Street _____
City _____ State _____ ZIP _____
- 3) Date of birth ____/____/____
4) Date hired ____/____/____
- 5) ☐ Male ☐ Female

Information about the physician or other health care professional

- 6) Name of physician or other health care professional _____
- 7) If treatment was given away from the worksite, where was it given?
Facility _____
Street _____
City _____ State _____ ZIP _____
- 8) Was employee treated in an emergency room?
☐ Yes ☐ No
- 9) Was employee hospitalized overnight as an in-patient?
☐ Yes ☐ No

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

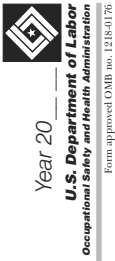


Information about the case

- 10) Case number from the Log _____
(Transfer the case number from the Log after you record the case.)
- 11) Date of injury or illness ____/____/____
- 12) Time employee began work ____ AM / PM
- 13) Time of event ____ AM / PM ☐ Check if time cannot be determined
- 14) **What was the employee doing just before the incident occurred?** Describe the activity, as well as the tools, equipment, or material the employee was using. *Examples:* "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."
- 15) **What happened?** Tell us how the injury occurred. *Examples:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."
- 16) **What was the injury or illness?** Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or "sore." *Examples:* "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."
- 17) **What object or substance directly harmed the employee?** *Examples:* "concrete floor"; "chlorine"; "radial arm saw." If this question does not apply to the incident, leave it blank.
- 18) **If the employee died, when did death occur?** Date of death ____/____/____

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Persons are not required to respond to the collection of information unless it displays a current valid OMB control number. If you have any comments about this estimate or any other aspects of this data collection, including suggestions for reducing this burden, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

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OSHA's Form 300A (Rev. 01/2004)
Summary of Work-Related Injuries and Illnesses

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.
Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."
Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35, in OSHA's recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases			
Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
(G)	(H)	(I)	(J)
Number of Days			
Total number of days away from work	Total number of days of job transfer or restriction		
(K)	(L)		
Injury and Illness Types			
Total number of . . .			
(1) Injuries	(2) Skin disorders	(3) Respiratory conditions	(4) Poisonings
(5) Hearing loss	(6) All other illnesses		

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Public reporting burden for this collection of information is estimated to average 30 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any other aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

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Selections from the Environmental Protection Agency regulations

This section includes selected sections of the Environmental Protection Agency (EPA) regulations that pertain to the operation of a transportation maintenance facility. If you are interested in other EPA regulations that are not in this section, please contact J. J. Keller & Associates, Inc. We have several other products that specialize in EPA regulations.

Part 82—Protection of stratospheric ozone

Subpart A—Production and Consumption Controls

- §82.1 Purpose and scope.
- §82.2 [Reserved]
- §82.3 Definitions for class I and class II controlled substances.
- §82.4 Prohibitions for class I controlled substances.
- §82.5 Apportionment of baseline production allowances for class I controlled substances. §82.6 Apportionment of baseline consumption allowances for class I controlled substances.
- §82.7 Grant and phase reduction of baseline production and consumption allowances for class I
- §82.8 Grant of essential use allowances and critical use allowances.
- §82.9 Availability of production allowances in addition to baseline production allowances for class I controlled substances.
- §82.10 Availability of consumption allowances in addition to baseline consumption allowances for class I controlled substances.
- §82.11 Exports of class I controlled substances to Article 5 Parties.
- §82.12 Transfers of allowances for class I controlled substances.
- §82.13 Recordkeeping and reporting requirements for class I controlled substances.
- §82.15 Prohibitions for class II controlled substances.
- §82.16 Phaseout schedule of class II controlled substances.
- §82.17 Apportionment of baseline production allowances for class II controlled substances.
- §82.18 Availability of production in addition to baseline production allowances for class II controlled substances.
- §82.19 Apportionment of baseline consumption allowances for class II controlled substances.
- §82.20 Availability of consumption allowances in addition to baseline consumption allowances for class II controlled substances.
- §§82.21-82.22 [Reserved]
- §82.23 Transfers of allowances of class II controlled substances.
- §82.24 Recordkeeping and reporting requirements for class II controlled substances.
- Appendix A to Subpart A of Part 82—Class I Controlled Substances

- Appendix B to Subpart A of Part 82—Class II Controlled Substances^a
- Appendix C to Subpart A of Part 82—Parties to the Montreal Protocol, and Nations Complying With, But Not Parties To, The Protocol
- Appendix D to Subpart A of Part 82—Harmonized Tariff Schedule Description of Products That May Contain Controlled Substances in Appendix A, Class I, Groups I and II
- Appendix E to Subpart A of Part 82—Article 5 Parties
- Appendix F to Subpart A of Part 82—Listing of Ozone-Depleting Chemicals
- Appendix G to Subpart A of Part 82—UNEP Recommendations for Conditions Applied to Exemption for Essential Laboratory and Analytical Uses
- Appendix H to Subpart A of Part 82—Clean Air Act Amendments of 1990 Phaseout Schedule for Production of Ozone-Depleting Substances
- Appendix I to Subpart A of Part 82—Global Warming Potentials (Mass Basis), Referenced to the Absolute GWP for the Adopted Carbon Cycle Model CO2 Decay Response and Future CO2 Atmospheric Concentrations Held Constant at Current Levels. (Only Direct Effects are Considered.)
- Appendix J to Subpart A of Part 82—Parties to the Montreal Protocol Classified Under Article 5(1) That Have Banned the Import of Controlled Products That Rely on Class I Controlled Substances for Their Continuing Functioning [Reserved]
- Appendix K to Subpart A of Part 82—Commodity Codes From the Harmonized Tariff Schedule for Controlled Substances and Used Controlled Substances
- Appendix L to Part 82 Subpart A—Approved Critical Uses and Limiting Critical Conditions for Those Uses for the 2008 Control Period

Subpart B—Servicing of Motor Vehicle Air Conditioners

- §82.30 Purpose and scope.
- §82.32 Definitions.
- §82.34 Prohibitions and required practices.
- §82.36 Approved refrigerant handling equipment.
- §82.38 Approved independent standards testing organizations.
- §82.40 Technician training and certification.
- §82.42 Certification, recordkeeping and public notification requirements.
- Appendix A to Subpart B of Part 82—Standard for Recycle/Recover Equipment
- Appendix B to Subpart B of Part 82—Standard for Recover Equipment
- Appendix C to Subpart B of Part 82—SAE J2788 Standard for Recovery/Recycle and Recovery/Recycle/Recharging Equipment for HFC-134a Refrigerant
- Appendix D to Subpart B of Part 82—Standard for HFC-134a Recover-Only Equipment
- Appendix E to Subpart B of Part 82—The Standard for Automotive Refrigerant Recycling Equipment Intended for Use With Both CFC-12 and HFC-134a
- Appendix F to Subpart B of Part 82—Standard for Recover-Only Equipment That Extracts a Single, Specific Refrigerant Other Than CFC-12 or HFC-134a

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- §82.64 Prohibitions.
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- §82.66 Nonessential Class I products and exceptions.
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Subpart E—The Labeling of Products Using Ozone-Depleting Substances

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- §82.104 Definitions.
- §82.106 Warning statement requirements.
- §82.108 Placement of warning statement.
- §82.110 Form of label bearing warning statement.
- §82.112 Removal of label bearing warning statement.
- §82.114 Compliance by manufacturers and importers with requirements for labeling of containers of controlled substances, or products containing controlled substances.
- §82.116 Compliance by manufacturers or importers incorporating products manufactured with controlled substances.
- §82.118 Compliance by wholesalers, distributors and retailers.
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- §82.154 Prohibitions.
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- Appendix A to Subpart F of Part 82—Specifications for Fluorocarbon and Other Refrigerants
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- §82.170 Purpose and scope.
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- Appendix A to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes

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- Appendix C to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes Listed in the May 22, 1996 Final Rule, Effective June 21, 1996
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- Appendix F to Subpart G of Part 82—Unacceptable Substitutes Listed in the January 26, 1999 Final Rule, Effective January 26, 1999
- Appendix G to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes Listed in the March 3, 1999, Final rule, Effective April 2, 1999.
- Appendix H to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes, Effective May 28, 1999
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- Appendix J to Subpart G of Part 82—Substitutes listed in the January 29, 2002 Final Rule, effective April 1, 2002
- Appendix K to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes Listed in the July 22, 2002, Final Rule, Effective August 21, 2002
- Appendix L to Subpart G of Part 82—Substitutes Listed in the January 27, 2003, Final Rule, Effective March 28, 2003
- Appendix M to Subpart G—Unacceptable Substitutes Listed in the September 30, 2004 Final Rule, Effective November 29, 2004

Subpart H—Halon Emissions Reduction

- §82.250 Purpose and scope.
- §82.260 Definitions.
- §82.270 Prohibitions.

Subpart I—Ban on Refrigeration and Air-Conditioning Appliances Containing HCFCs

- §82.300 Purpose.
- §82.302 Definitions.
- §82.304 Prohibitions.
- §82.306 Prohibited products.

Authority: 42 U.S.C. 7414, 7601, 7671–7671q.

Source: 57 FR 33787, July 30, 1992, unless otherwise noted. **Source:** 60 FR 24986, May 10, 1995, unless otherwise noted.

Subpart A—Production and Consumption Controls

§82.1 Purpose and scope.

(a) The purpose of the regulations in this subpart is to implement the Montreal Protocol on Substances that Deplete the Ozone Layer and sections 602, 603, 604, 605, 606, 607, 614 and 616 of the Clean Air Act Amendments of 1990, Public Law 101–549. The Protocol and section 604 impose limits on the production and consumption (defined as production plus imports minus exports, excluding transshipments and used controlled substances) of certain ozone-depleting substances, according to specified schedules. The Protocol also requires each nation that becomes a Party to the agreement to impose certain

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restrictions on trade in ozone-depleting substances with non-Parties.

(b) This subpart applies to any person that produces, transforms, destroys, imports or exports a controlled substance or imports or exports a controlled product.

§82.2 [Reserved]

§82.3 Definitions for class I and class II controlled substances.

As used in this subpart, the term:

Administrator means the Administrator of the United States Environmental Protection Agency or his authorized representative. For purposes of reports and petitions, the Administrator must be written at the following mailing address: EPA (6205J), Global Programs Division, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

Appliance means any device which contains and uses a refrigerant and which is used for household or commercial purposes, including any air conditioner, refrigerator, chiller, or freezer.

Applicator means the person who applies methyl bromide.

Approved critical use(s) means those uses of methyl bromide listed in Column A of appendix L to this subpart as further clarified in Columns B and C of that appendix.

Approved critical user(s) means a person who:

(1) For the applicable control period, applied to EPA for a critical use exemption or is a member of a consortium that applied to EPA for a critical use exemption for a use and location of use that was included in the U.S. nomination, authorized by a Decision of the Parties to the Montreal Protocol, and then finally determined by EPA in a notice-and-comment rulemaking to be an approved critical use; and

(2) Has an area in the applicable location of use that requires methyl bromide fumigation because the person reasonably expects that the area will be subject to a limiting critical condition during the applicable control period.

Article 5 allowances means the allowances apportioned under §82.9(a), §82.11(a)(2), and §82.18(a).

Baseline consumption allowances means the consumption allowances apportioned under §82.6 and §82.19.

Baseline production allowances means the production allowances apportioned under §82.5 and §82.17.

Beijing Amendments means the Montreal Protocol, as amended at the Eleventh Meeting of the Parties to the Montreal Protocol in Beijing in 1999.

Calculated level means the weighted amount of a controlled substance determined by multiplying the amount (in kilograms) of the controlled substance by that substance's ozone depletion potential (ODP) weight listed in appendix A or appendix B to this subpart.

Class I refers to the controlled substances listed in appendix A to this subpart.

Class II refers to the controlled substances listed in appendix B to this subpart.

Commodity Owner, Shipper or their Agent means the person requesting that an applicator use methyl bromide for quarantine or preshipment applications.

Completely destroy means to cause the expiration of a controlled substance at a destruction efficiency of 98 percent or greater, using one of the destruction technologies approved by the Parties.

Complying with the Protocol, when referring to a foreign state not Party to the 1987 Montreal Protocol, the London Amendments, or the Copenhagen Amendments, means that the non-Party has been determined as complying with the Protocol, as indicated in appendix C to this subpart, by a meeting of the Parties as noted in the records of the directorate of the United Nations Secretariat.

Confer means to shift the essential-use allowances obtained under §82.8 from the holder of the unexpended essential-use allowances to a person for the production of a specified controlled substance, or to shift the HCFC-141b exemption allowances granted under §82.16(h) from the holder of the unexpended HCFC-141b exemption allowances to a person for the production or import of the controlled substance.

Consortium means an organization representing a group of methyl bromide users that has collectively submitted an application for a critical use exemption on behalf of all members of the group. The members of a consortium shall be determined on the basis of the rules established by the organization. Members may either be required to formally join the consortium (e.g., by submitting an application or paying dues) or may automatically become members upon meeting particular criteria (e.g., a grower of a specific crop in a particular region).

Consumption means the production plus imports minus exports of a controlled substance (other than transshipments, or used controlled substances).

Consumption allowances means the privileges granted by this subpart to produce and import controlled substances; however, consumption allowances may be used to produce controlled substances only in conjunction with production allowances. A person's consumption allowances for class I substances are the total of the allowances obtained under §§82.6 and 82.7 and 82.10, as may be modified under §82.12 (transfer of allowances). A person's consumption allowances for class II controlled substances are the total of the allowances obtained under §§82.19 and 82.20, as may be modified under §82.23.

Control period means the period from January 1, 1992 through December 31, 1992, and each twelve-month period from January 1 through December 31, thereafter.

Controlled product means a product that contains a controlled substance listed as a Class I, Group I or II substance in appendix A to this subpart. Controlled products include, but are not limited to, those products listed in appendix D to this subpart.

Controlled products belong to one or more of the following six categories of products:

(1) Automobile and truck air conditioning units (whether incorporated in vehicles or not);

(2) Domestic and commercial refrigeration and air-conditioning/heat pump equipment (whether containing controlled substances as a refrigerant and/or in insulating material of the product), e.g. Refrigerators, Freezers,

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Dehumidifiers, Water coolers, Ice machines, Air-conditioning and heat pump units;

- (3) Aerosol products, except medical aerosols;
- (4) Portable fire extinguishers;
- (5) Insulation boards, panels and pipe covers;
- (6) Pre-polymers.

Controlled substance means any substance listed in appendix A or appendix B to this subpart, whether existing alone or in a mixture, but excluding any such substance or mixture that is in a manufactured product other than a container used for the transportation or storage of the substance or mixture. Thus, any amount of a listed substance in appendix A or appendix B to this subpart that is not part of a use system containing the substance is a controlled substance. If a listed substance or mixture must first be transferred from a bulk container to another container, vessel, or piece of equipment in order to realize its intended use, the listed substance or mixture is a “controlled substance.” The inadvertent or coincidental creation of insignificant quantities of a listed substance in appendix A or appendix B to this subpart; during a chemical manufacturing process, resulting from unreacted feedstock, from the listed substance’s use as a process agent present as a trace quantity in the chemical substance being manufactured, or as an unintended byproduct of research and development applications, is not deemed a controlled substance. Controlled substances are divided into two classes, Class I in appendix A to this subpart, and Class II listed in appendix B to this subpart. Class I substances are further divided into eight groups, Group I, Group II, Group III, Group IV, Group V, Group VI, Group VII, and Group VIII, as set forth in appendix A to this subpart.

Copenhagen Amendments means the Montreal Protocol on Substances That Deplete the Ozone Layer, as amended at the Fourth Meeting of the Parties to the Montreal Protocol in Copenhagen in 1992.

Critical stock allowance (CSA) means the right granted by this subpart to sell one (1) kilogram of class I, Group VI controlled substances from inventory produced or imported prior to the January 1, 2005 phaseout date for an approved critical use during the specified control period to the extent permitted by federal and state pesticide statutes and regulations other than the Clean Air Act and regulations in this part. A person’s critical stock allowances are the total of the allowances obtained under §82.8(c) as may be modified under §82.12 (transfer of allowances).

Critical stock allowance (CSA) holder means an entity to which EPA allocates a quantity of critical stock allowances as reflected under §82.8(c), or who receives a quantity of critical stock allowances through a transfer under §82.12.

Critical use means a circumstance in which the following two conditions are satisfied:

- (1) There are no technically and economically feasible alternatives or substitutes for methyl bromide available that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances involved, and

- (2) The lack of availability of methyl bromide for a particular use would result in significant market disruption.

Critical use allowance (CUA) means the privilege granted by this subpart to produce or import one (1) kilogram of methyl bromide for an approved critical use during the specified control period. A person’s critical use allowances are the total of the allowances obtained under §82.8(c) as may be modified under §82.12 (transfer of allowances).

Critical use allowance for pre-plant uses means the privilege granted by this subpart to produce or import one (1) kilogram of methyl bromide solely for an approved critical use in pre-plant categories specified in Appendix L to this subpart during the specified control period. A person’s critical use allowances for pre-plant uses are the total of the allowances obtained under §82.8(c) as may be modified under §82.12 (transfer of allowances).

Critical use allowance for post-harvest uses means the privilege granted by this subpart to produce or import one (1) kilogram of methyl bromide solely for an approved critical use in post-harvest categories specified in appendix L to this subpart during the specified control period. A person’s critical use allowances for post-harvest uses are the total of the allowances obtained under §82.8(c) as may be modified under §82.12 (transfer of allowances).

Critical use allowance (CUA) holder means an entity to which EPA allocates a quantity of critical use allowances as reflected in §82.8(c) or who receives a quantity of critical use allowances through a transfer under §82.12.

Critical use methyl bromide means the class I, Group VI controlled substance produced or imported through expending a critical use allowance or that portion of inventory produced or imported prior to the January 1, 2005 phaseout date that is sold only for approved critical uses through expending a critical stock allowance.

Destruction means the expiration of a controlled substance to the destruction efficiency actually achieved, unless considered completely destroyed as defined in this section. Such destruction does not result in a commercially useful end product and uses one of the following controlled processes approved by the Parties to the Protocol:

- (1) Liquid injection incineration;
- (2) Reactor cracking;
- (3) Gaseous/fume oxidation;
- (4) Rotary kiln incineration;
- (5) Cement kiln;
- (6) Radio frequency plasma; or
- (7) Municipal waste incinerators only for the destruction of foams.

Distributor of methyl bromide means the person directly selling a class I, Group VI controlled substance to an applicator.

Essential Metered Dose Inhaler (Essential MDI) means metered dose inhalers for the treatment of asthma and chronic obstructive pulmonary disease, approved by the Food and Drug Administration or by another Party’s

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analogous health authority before December 31, 2000, and considered to be essential by the Party where the MDI product will eventually be sold. In addition, if the MDI product is to be sold in the U.S., the active moiety contained in the MDI must be listed as essential at 21 CFR 2.125(e).

Essential-Use Allowances means the privileges granted by §82.4(n) to produce class I substances, as determined by allocation decisions made by the Parties to the Montreal Protocol and in accordance with the restrictions delineated in the Clean Air Act Amendments of 1990.

Essential-Use Chlorofluorocarbons (Essential-use CFCs) are the CFCs (CFC-11, CFC-12, or CFC-114) produced under the authority of essential-use allowances and not the allowances themselves. Essential-use CFCs include CFCs imported or produced by U.S. entities under the authority of essential-use allowances for use in essential metered dose inhalers, as well as CFCs imported or produced by non-U.S. entities under the authority of privileges granted by the Parties and the national authority of another country for use in essential metered dose inhalers.

Essential-Uses means those uses of controlled substances designated by the Parties to the Protocol to be necessary for the health and safety of, or critical for the functioning of, society; and for which there are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health. Beginning January 1, 2000 (January 1, 2002 for methyl chloroform) the essential use designations for class I substances must be made in accordance with the provisions of the Clean Air Act Amendments of 1990.

Export means the transport of virgin or used controlled substances from inside the United States or its territories to persons outside the United States or its territories, excluding United States military bases and ships for on-board use.

Export production allowances means the privileges granted by §82.18(b) to produce HCFC-141b for export following the phaseout of HCFC-141b on January 1, 2003.

Exporter means the person who contracts to sell controlled substances for export or transfers controlled substances to his affiliate in another country.

Facility means any process equipment (e.g., reactor, distillation column) used to convert raw materials or feed-stock chemicals into controlled substances or consume controlled substances in the production of other chemicals.

Foreign state means an entity which is recognized as a sovereign nation or country other than the United States of America.¹

Foreign state not Party to or Non-Party means a foreign state that has not deposited instruments of ratification, acceptance, or other form of approval with the Directorate of the United Nations Secretariat, evidencing the foreign state's ratification of the provisions of the 1987 Montreal Protocol, the London Amendments, or of the Copenhagen Amendments, as specified.

¹Taiwan is not considered a foreign state.

Formulator means an entity that distributes a class II controlled substance(s) or blends of a class II controlled substance(s) to persons who use the controlled substance(s) for a specific application identified in the formulator's petition for HCFC-141b exemption allowances.

HCFC-141b exemption allowances means the privileges granted to a HCFC-141b formulator; an agency, department, or instrumentality of the U.S.; or a non-governmental space vehicle entity by this subpart to order production of or to import HCFC-141b, as determined in accordance with §82.16(h).

Heel means the amount of a controlled substance that remains in a container after it is discharged or off-loaded (that is no more than ten percent of the volume of the container) and that the person owning or operating the container certifies the residual amount will remain in the container and be included in a future shipment, or be recovered for transformation, destruction or a non-emissive purpose.

Import means to land on, bring into, or introduce into, or attempt to land on, bring into, or introduce into any place subject to the jurisdiction of the United States whether or not such landing, bringing, or introduction constitutes an importation within the meaning of the customs laws of the United States, with the following exemptions:

- (1) Off-loading used or excess controlled substances or controlled products from a ship during servicing,
- (2) Bringing controlled substances into the U.S. from Mexico where the controlled substance had been admitted into Mexico in bond and was of U.S. origin, and
- (3) Bringing a controlled product into the U.S. when transported in a consignment of personal or household effects or in a similar non-commercial situation normally exempted from U.S. Customs attention.

Importer means the importer of record listed on U.S. Customs Service forms for imported controlled substances, used controlled substances or controlled products.

Individual shipment means the kilograms of a used controlled substance for which a person may make one (1) U.S. Customs entry as, as identified in the non-objection letter from the Administrator under §§82.13(g) and 82.24(c)(4).

Interstate commerce means the distribution or transportation of any controlled substance between one state, territory, possession or the District of Columbia, and another state, territory, possession or the District of Columbia, or the sale, use or manufacture of any controlled substance in more than one state, territory, possession or District of Columbia. The entry points for which a controlled substance is introduced into interstate commerce are the release of a controlled substance from the facility in which the controlled substance was manufactured, the entry into a warehouse from which the domestic manufacturer releases the controlled substance for sale or distribution, and at the site of United States customs clearance.

Limiting critical condition means the regulatory, technical, and economic circumstances listed in Column C of Appendix L to this subpart that establish conditions of critical use for methyl bromide in a fumigation area.

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Location of use means the geographic area (such as a state, region, or the entire United States) covered by an application for a critical use exemption in which the limiting critical condition may occur.

London Amendments means the Montreal Protocol, as amended at the Second Meeting of the Parties to the Montreal Protocol in London in 1990.

Manufactured, for an appliance, means the date upon which the appliance's refrigerant circuit is complete, the appliance can function, the appliance holds a full refrigerant charge, and the appliance is ready for use for its intended purposes; and for a pre-charged appliance component, means the date that such component is completely produced by the original equipment manufacture, charged with refrigerant, and is ready for initial sale or distribution in interstate commerce.

Montreal Anniversary amendments means the Montreal Protocol, as amended at the Ninth Meeting of the Parties to the Montreal Protocol in Montreal in 1997.

Montreal Protocol means the Montreal Protocol on Substances that Deplete the Ozone Layer, a protocol to the Vienna Convention for the Protection of the Ozone Layer, including adjustments adopted by the Parties thereto and amendments that have entered into force.

1987 Montreal Protocol means the Montreal Protocol, as originally adopted by the Parties in 1987.

Nations complying with, but not joining, the Protocol means any nation listed in Appendix C, Annex 2, to this subpart.

Non-Objection notice means the privilege granted by the Administrator to import a specific individual shipment of used controlled substance in accordance with §§82.13(g) and 82.24(c)(3) and (4).

Party means any foreign state that is listed in Appendix C to this subpart (pursuant to instruments of ratification, acceptance, or approval deposited with the Depositary of the United Nations Secretariat), as having ratified the specified control measure in effect under the Montreal Protocol. Thus, for purposes of the trade bans specified in §82.4(l)(2) pursuant to the London Amendments, only those foreign states that are listed in Appendix C to this subpart as having ratified both the 1987 Montreal Protocol and the London Amendments shall be deemed to be Parties.

Person means any individual or legal entity, including an individual, corporation, partnership, association, state, municipality, political subdivision of a state, Indian tribe; any agency, department, or instrumentality of the United States; and any officer, agent, or employee thereof.

Plant means one or more facilities at the same location owned by or under common control of the same person.

Preshipment applications, with respect to class I, Group VI controlled substances, are those non-quarantine applications applied within 21 days prior to export to meet the official requirements of the importing country or existing official requirements of the exporting country. Official requirements are those which are performed by, or authorized by, a national plant, animal, environmental, health or stored product authority.

Production means the manufacture of a controlled substance from any raw material or feedstock chemical, but does not include:

(1) The manufacture of a controlled substance that is subsequently transformed;

(2) The reuse or recycling of a controlled substance;

(3) Amounts that are destroyed by the approved technologies; or

(4) Amounts that are spilled or vented unintentionally.

Production allowances means the privileges granted by this subpart to produce controlled substances; however, production allowances may be used to produce controlled substances only in conjunction with consumption allowances. A person's production allowances for class I substances are the total of the allowances obtained under §§82.5, 82.7 and 82.9, and as may be modified under §82.12 (transfer of allowances). A person's production allowances for class II controlled substances are the total of the allowances obtained under §82.17 and as may be modified under §§82.18 and 82.23.

Quarantine applications, with respect to class I, Group VI controlled substances, are treatments to prevent the introduction, establishment and/or spread of quarantine pests (including diseases), or to ensure their official control, where: (1) Official control is that performed by, or authorized by, a national (including state, tribal or local) plant, animal or environmental protection or health authority; (2) quarantine pests are pests of potential importance to the areas endangered thereby and not yet present there, or present but not widely distributed and being officially controlled. This definition excludes treatments of commodities not entering or leaving the United States or any State (or political subdivision thereof).

Source facility means the location at which a used controlled substance was recovered from a piece of equipment, including the name of the company responsible for, or owning the piece of equipment, a contact person at the location, the mailing address for that specific location, and a phone number and a fax number for the contact person at the location.

Space vehicle means a man-made device, either manned or unmanned, designed for operation beyond earth's atmosphere. This definition includes integral equipment such as models, mock-ups, prototypes, molds, jigs, tooling, hardware jackets, and test coupons. Also included is auxiliary equipment associated with tests, transport, and storage, which through contamination can compromise the space vehicle performance.

Third party applicator means an applicator of critical use methyl bromide who fumigates or treats commodities, structures, crops, or land on behalf of an approved critical user.

Transform means to use and entirely consume (except for trace quantities) a controlled substance in the manufacture of other chemicals for commercial purposes.

Transshipment means the continuous shipment of a controlled substance, from a foreign state of origin through the United States or its territories, to a second foreign state of final destination, as long as the shipment does not enter into United States jurisdiction. A transshipment, as it moves through the United States or its territories, cannot be re-packaged, sorted or otherwise changed in condition.

Unexpended Article 5 allowances means Article 5 allowances that have not been used. At any time in any

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control period a person's unexpended Article 5 allowances are the total of the level of Article 5 allowances the person has authorization under this subpart to hold at that time for that control period, minus the level of controlled substances that the person has produced in that control period until that time.

Unexpended consumption allowances means consumption allowances that have not been used. At any time in any control period a person's unexpended consumption allowances are the total of the level of consumption allowances the person has authorization under this subpart to hold at that time for that control period, minus the level of controlled substances that the person has produced or imported (not including transshipments and used controlled substances) in that control period until that time.

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Unexpended critical stock allowance (CSA) means critical stock allowances against which methyl bromide has not yet been sold for an approved critical use.

Unexpended critical use allowances (CUA) means critical use allowances against which methyl bromide has not yet been produced or imported. At any time in any control period a person's unexpended critical use allowances are the total of the level of critical use allowances the person holds at that time for that control period, minus the level of class I, Group VI controlled substances that the person has produced or has imported solely for approved critical uses in that control period.

Unexpended destruction and transformation credits means destruction and transformation credits that have not been used. At any time in any control period a person's unexpended destruction and transformation credits are the total of the level of destruction and transformation credits the person has authorization under this subpart to hold at that time for that control period, minus the level of controlled substances that the person has produced or imported (not including transshipments and used controlled substances) in that control period until that time.

Unexpended essential-use allowances means essential-use allowances that have not been used. At any time in any control period a person's unexpended essential-use allowances are the total of the level of essential-use allowances the person has authorization under this subpart to hold at that time for that control period, minus the level of controlled substances that the person has imported or had produced in that control period until that time.

Unexpended export production allowances means export production allowances that have not been used. A person's unexpended export production allowances are the total of the quantity of the export production allowances the person has authorization under §82.18(h) to hold for that control period, minus the quantity of class II controlled substances that the person has produced at that time during the same control period.

Unexpended HCFC-141b exemption allowances means HCFC-141b exemption allowances that have not been used. A person's unexpended HCFC-141b exemption allowances are the total of the quantity of the HCFC-141b exemption allowances the person has authorization under §82.16(h) to hold for that control period, minus the quantity of HCFC-141b that the person has had produced or has had imported at that time during the same control period.

Unexpended production allowances means production allowances that have not been used. At any time in any control period a person's unexpended production allowances are the total of the level of production allowances he has authorization under this subpart to hold at that time for that control period, minus the level of controlled substances that the person has produced in that control period until that time.

Used controlled substances means controlled substances that have been recovered from their intended

use systems (may include controlled substances that have been, or may be subsequently, recycled or reclaimed).

§82.4 Prohibitions for class I controlled substances.

(a)(1) Prior to January 1, 1996, for all Groups of class I controlled substances, and prior to January 1, 2005, for class I, Group VI controlled substances, no person may produce, at any time in any control period, (except that are transformed or destroyed domestically or by a person of another Party) in excess of the amount of unexpended production allowances or unexpended Article 5 allowances for that substance held by that person under the authority of this subpart at that time for that control period. Every kilogram of excess production constitutes a separate violation of this subpart.

(2) Effective January 1, 2003, production of class I, Group VI controlled substances is not subject to the prohibitions in paragraph (a)(1) of this section if it is solely for quarantine or preshipment applications as defined in this subpart.

(b)(1) Effective January 1, 1996, for any Class I, Group I, Group II, Group III, Group IV, Group V or Group VII controlled substances, and effective January 1, 2005 for any Class I, Group VI controlled substances, and effective August 18, 2003, for any Class I, Group VIII controlled substance, no person may produce, at any time in any control period (except that are transformed or destroyed domestically or by a person of another Party) in excess of the amount of conferred unexpended essential use allowances or exemptions, or in excess of the amount of unexpended critical use allowances, or in excess of the amount of unexpended Article 5 allowances as allocated under §82.9 and §82.11, as may be modified under §82.12 (transfer of allowances) for that substance held by that person under the authority of this subpart at that time for that control period. Every kilogram of excess production constitutes a separate violation of this subpart.

(2) Effective January 1, 2005, production of class I, Group VI controlled substances is not subject to the prohibitions in paragraph (b)(1) of this section if it is solely for quarantine or preshipment applications as defined in this subpart, or it is solely for export to satisfy critical uses authorized by the Parties for that control period.

(c)(1) Prior to January 1, 1996, for all Groups of class I controlled substances, and prior to January 1, 2005, for class I, Group VI controlled substances, no person may produce or (except for transshipments, heels or used controlled substances) import, at any time in any control period, (except for controlled substances that are transformed or destroyed) in excess of the amount of unexpended consumption allowances held by that person under the authority of this subpart at that time for that control period. Every kilogram of excess production or importation (other than transshipments, heels or used controlled substances) constitutes a separate violation of this subpart.

(2) Effective January 1, 2003, production and import of class I, Group VI controlled substances is not subject to the prohibitions in paragraph(c)(1) of this section if it

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is solely for quarantine or preshipment applications as defined in this subpart.

(d) Effective January 1, 1996, for any class I, Group I, Group II, Group III, Group IV, Group V, or Group VII controlled substances, and effective January 1, 2005, for any class I, Group VI controlled substance, and effective August 18, 2003, for any class I, Group VIII controlled substance, no person may import (except for transshipments or heels), at any time in any control period, (except for controlled substances that are transformed or destroyed) in excess of the amount of unexpended essential use allowances or exemptions, or in excess of unexpended critical use allowances, for that substance held by that person under the authority of this subpart at that time for that control period. Every kilogram of excess importation (other than transshipments or heels) constitutes a separate violation of this subpart. It is a violation of this subpart to obtain unused class I controlled substances under the general laboratory exemption in excess of actual need and to recycle that material for sale into other markets.

(e) Effective January 1, 1996, no person may place an order by conferring essential-use allowances for the production of the class I controlled substance, at any time in any control period, in excess of the amount of unexpended essential-use allowances, held by that person under the authority of this subpart at that time for that control period. Effective January 1, 1996, no person may import a class I controlled substance with essential-use allowances, at any time in any control period, in excess of the amount of unexpended essential-use allowances, held by that person under the authority of this subpart at that time for that control period. No person may import or place an order for the production of a class I controlled substance with essential-use allowances, at any time in any control period, other than for the class I controlled substance(s) for which they received essential-use allowances under paragraph (u) of this section. Every kilogram of excess production ordered in excess of the unexpended essential-use allowances conferred to the producer constitutes a separate violation of this subpart. Every kilogram of excess import in excess of the unexpended essential-use allowances held at that time constitutes a separate violation of this subpart.

(f) Effective January 1, 1996, no person may place an order by conferring transformation and destruction credits for the production of the class I controlled substance, at any time in any control period, in excess of the amount of transformation and destruction credits, held by that person under the authority of this subpart at that time for that control period. Effective January 1, 1996, no person may import class I controlled substance, at any time in any control period, in excess of the amount of transformation and destruction credits, held by that person under the authority of this subpart at that time for that control period. No person may import or place an order for the production of a class I controlled substance with transformation and destruction credits, at any time in any control period, other than for the class I controlled substance(s) for which they received transformation and destruction credits as

under §82.9(f). Every kilogram of excess production ordered in excess of the unexpended transformation and destruction credits conferred to the producer constitutes a separate violation of this subpart. Every kilogram of excess import in excess of the unexpended transformation and destruction credits held at that time constitutes a separate violation of this subpart.

(g) Effective January 1, 1996, the U.S. total production and importation of a class I controlled substance (except Group VI) as allocated under this section for essential-use allowances and exemptions, and as obtained under §82.9 for destruction and transformation credits, may not, at any time, in any control period until January 1, 2000, exceed the percent limitation of baseline production in appendix H of this subpart, as set forth in the Clean Air Act Amendments of 1990. No person shall cause or contribute to the U.S. exceedance of the national limit for that control period.

(h) No person may sell in the U.S. any Class I controlled substance produced explicitly for export to an Article 5 country.

(i) Effective January 1, 1995, no person may import, at any time in any control period, a heel of any class I controlled substance that is greater than 10 percent of the volume of the container in excess of the amount of unexpended consumption allowances, or unexpended destruction and transformation credits held by that person under the authority of this subpart at that time for that control period. Every kilogram of excess importation constitutes a separate violation of this subpart.

(j) Effective January 1, 1995, no person may import, at any time in any control period, a used class I controlled substance, without having received a non-objection notice from the Administrator in accordance with §82.13(g)(2) and (3). A person who receives a non-objection notice for the import of an individual shipment of used controlled substances may not transfer or confer the right to import, and may not import any more than the exact quantity, in kilograms, of the used controlled substance cited in the non-objection notice. Every kilogram of importation of used controlled substance in excess of the quantity cited in the non-objection notice issued by the Administrator in accordance with §82.13(g)(2) and (3) constitutes a separate violation.

(k)(1) Prior to January 1, 1996, for all Groups of class I controlled substances, and prior to January 1, 2005, for class I, Group VI controlled substances, a person may not use production allowances to produce a quantity of a class I controlled substance unless that person holds under the authority of this subpart at the same time consumption allowances sufficient to cover that quantity of class I controlled substances nor may a person use consumption allowances to produce a quantity of class I controlled substances unless the person holds under authority of this subpart at the same time production allowances sufficient to cover that quantity of class I controlled substances. However, prior to January 1, 1996, for all class I controlled substances, and prior to January 1, 2005, for class I, Group VI controlled substances, only consumption allowances are required to import, with the exception of transshipments, heels, and used controlled substances. Effective January 1, 1996,

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for all Groups of class I controlled substances, except Group VI, only essential use allowances or exemptions are required to import class I controlled substances, with the exception of transshipments, heels, used controlled substances, and essential use CFCs.

(2) Notwithstanding paragraph (k)(1) of this section, effective January 1, 2003, for class I, Group VI controlled substances, consumption allowances are not required to import quantities solely for quarantine or preshipment applications as defined in this subpart.

(l) Every kilogram of a controlled substance, and every controlled product, imported or exported in contravention of this subpart constitutes a separate violation of this subpart, thus no person may:

(1) Import or export any quantity of a controlled substance listed in Class I, Group I or Group II, in appendix A to this subpart from or to any foreign state not listed as a Party to the 1987 Montreal Protocol unless that foreign state is complying with the 1987 Montreal Protocol (See appendix C, Annex 2 of this subpart);

(2) Import or export any quantity of a controlled substance listed in Class I, Group III, Group IV or Group V, in appendix A to this subpart, from or to any foreign state not Party to the London Amendments (as noted in appendix C, Annex 1, to this subpart), unless that foreign state is complying with the London Amendments (as noted in appendix C, Annex 2, to this subpart); or

(3) Import a controlled product, as noted in appendix D, Annex 1 to this subpart, from any foreign state not Party to the 1987 Montreal Protocol (as noted in appendix C, Annex 1, to this subpart), unless that foreign state is complying with the Protocol (as noted in appendix C, Annex 2, to this subpart).

(4) Import or export any quantity of a controlled substance listed in Class I, Group VII, in Appendix A to this subpart, from or to any foreign state not Party to the Copenhagen Amendments (as noted in Appendix C, Annex 1, to this subpart), unless that foreign state is complying with the Copenhagen Amendments (as noted in Appendix C, Annex 2, to this subpart).

(5) Import or export any quantity of a controlled substance listed in Class I, Group VI, in Appendix A to this subpart, from or to any foreign state not Party to the Copenhagen Amendments (as noted in Appendix C, Annex 1, to this subpart), unless that foreign state is complying with the Copenhagen Amendments (as noted in Appendix C, Annex 2, to this subpart).

(6) Import or export any quantity of a controlled substance listed in Class I, Group VIII, in appendix A to this subpart, from or to any foreign state not Party to the Beijing Amendments (as noted in appendix C, Annex 1, to this subpart), unless that foreign state is complying with the Beijing Amendments (as noted in appendix C, Annex 2, to this subpart).

(m) Effective October 5, 1998, no person may export a controlled product to a Party listed in Appendix J of this subpart in any control period after the control period in which EPA publishes a notice in the Federal Register listing that Party in Appendix J of this subpart. EPA will publish a notice in the Federal Register that lists a Party in Appendix J if the Party formally presents to the

U.S. a government document through its embassy in the United States stating that it has established a ban on the import of controlled products and a ban on the manufacture of those same controlled products.

(n) No person may use class I controlled substances produced or imported under the essential use exemption for any purpose other than those set forth in this paragraph. Effective January 1, 1996, essential-use allowances are apportioned to a person under §82.8(a) and (b) for the exempted production or importation of specified class I controlled substances solely for the purposes listed in paragraphs (n)(1)(i) through (iii) of this section.

(1) Essential-uses for the production or importation of controlled substances as agreed to by the Parties to the Protocol and subject to the periodic revision of the Parties are:

(i) Metered dose inhalers (MDIs) for the treatment of asthma and chronic obstructive pulmonary disease that were approved by the Food and Drug Administration before December 31, 2000.

(ii) Space Shuttle—solvents.

(iii) Essential laboratory and analytical uses (defined in Appendix G of this subpart).

(2) Any person acquiring unused class I controlled substances produced or imported under the authority of essential-use allowances or the essential-use exemption granted in §82.8 to this subpart for use in anything other than an essential-use (i.e., for uses other than those specifically listed in paragraph (n)(1) of this section) is in violation of this subpart. Each kilogram of unused class I controlled substance produced or imported under the authority of essential-use allowances or the essential-use exemption and used for a non-essential use is a separate violation of this subpart. Any person selling unused class I controlled substances produced or imported under authority of essential-use allowances or the essential-use exemption for uses other than an essential-use is in violation of this subpart. Each kilogram of unused class I controlled substances produced or imported under authority of essential-use allowances or the essential-use exemption and sold for a use other than an essential-use is a separate violation of this subpart. It is a violation of this subpart to obtain unused class I controlled substances under the exemption for laboratory and analytical uses in excess of actual need and to recycle that material for sale into other markets.

(o) [Reserved]

(p) Critical Use Exemption: With respect to class I, Group VI substances (methyl bromide):

(1) For critical use allowance holders and critical stock allowance holders:

(i) No person shall sell critical use methyl bromide without first receiving a certification from the purchaser that the quantity purchased will be sold or used solely for an approved critical use. Every kilogram of critical use methyl bromide sold without first obtaining such certification constitutes a separate violation of this subpart.

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(ii) No person shall sell a portion of inventory produced or imported prior to the January 1, 2005 phaseout date as critical use methyl bromide in excess of the number of unexpended critical stock allowances held by that person.

(iii) A person who sells methyl bromide produced or imported before the phaseout date of January 1, 2005 for a use identified by the user as a critical use must hold sufficient critical stock allowances (CSA) for the transaction and shall expend one allowance for each kilogram of methyl bromide sold. Every kilogram of critical use methyl bromide produced or imported before the phaseout date of January 1, 2005 that is sold without expending an allowance constitutes a separate violation of this subpart.

(2) For approved critical users, each action associated with each 200 kilograms of critical use methyl bromide for the following subparagraphs constitutes a separate violation of this subpart.

(i) No person shall take possession of quantities of critical use methyl bromide or acquire fumigation services using quantities of critical use methyl bromide without first completing the appropriate certification in accordance with the requirements in §82.13.

(ii) No person who purchases critical use methyl bromide may use such quantities for a use other than the specified critical use listed in Column A and the specified location of use in Column B of Appendix L to this subpart.

(iii) No person who purchases critical use methyl bromide produced or imported with expended critical use allowances for pre-plant uses, may use such quantities for other than the pre-plant uses as specified in Column A and Column B of appendix L to this subpart.

(iv) No person who purchases critical use methyl bromide produced or imported with expended critical use allowances for post-harvest uses, may use such quantities for other than the post-harvest uses as specified in Column A and Column B of appendix L to this subpart.

(v) No person who uses critical use methyl bromide on a specific field or structure may concurrently or subsequently use non-critical use methyl bromide on the same field or structure for the same use (as defined in Column A and Column B of appendix L) in the same control period, excepting methyl bromide used under the quarantine and pre-shipment exemption.

(vi) No person who purchases critical use methyl bromide during the control period shall use that methyl bromide on a field or structure for which that person has used non-critical use methyl bromide for the same use (as defined in Columns A and B of Appendix L) in the same control period, excepting methyl bromide used under the quarantine and pre-shipment exemption, unless, subsequent to that person's use of the non-critical use methyl bromide, that person becomes subject to a prohibition on the use of methyl bromide alternatives due to the reaching of a local township limit described in Appendix L of this part, or becomes an approved critical user as a result of rulemaking.

(q) Emergency use exemption. [Reserved]

§82.5 Apportionment of baseline production allowances for class I controlled substances.

Persons who produced controlled substances in Group I or Group II in 1986 are apportioned baseline production allowances as set forth in paragraphs (a) and (b) of this section. Persons who produced controlled substances in Group III, IV, or V in 1989 are apportioned baseline production allowances as set forth in paragraphs (c), (d), and (e) of this section. Persons who produced controlled substances in Group VI and VII in 1991 are apportioned baseline allowances as set forth in paragraphs (f) and (g) of this section.

Controlled substance	Person	Allowances (kg)
(a) For Group I controlled substances:		
CFC-11	Allied-Signal, Inc.	23,082,358
	E.I. DuPont de Nemours & Co.	33,830,000
	Elf Atochem, N.A.	21,821,500
CFC-12	Laroche Chemicals	12,856,364
	Allied-Signal, Inc.	35,699,776
	E.I. DuPont de Nemours & Co.	64,849,000
CFC-113	Elf Atochem, N.A.	31,089,807
	Laroche Chemicals	15,330,909
CFC-114	Allied-Signal, Inc.	21,788,896
	E.I. DuPont de Nemours & Co.	58,553,000
CFC-115	Allied-Signal, Inc.	1,488,569
	E.I. DuPont de Nemours & Co.	4,194,000
(b) For Group II controlled substances:		
Halon-1211 ..	E.I. DuPont de Nemours & Co.	4,176,000
	E.I. DuPont de Nemours & Co.	4,176,000
Halon-1301 ..	Great Lakes Chemical Corp.	826,487
	ICI Americas, Inc.	2,135,484
Halon-2402 ..	E.I. DuPont de Nemours & Co.	3,220,000
	Great Lakes Chemical Corp.	1,766,850
(c) For Group III controlled substances:		
CFC-13	Allied-Signal, Inc.	127,125
	E.I. DuPont de Nemours & Co.	187,831
	Elf Atochem, N.A.	3,992
	Great Lakes Chemical Corp.	56,381
	Laroche Chemicals	29,025
CFC-111		
CFC-112		
CFC-211	E.I. DuPont de Nemours & Co.	11
CFC-212	E.I. DuPont de Nemours & Co.	11
CFC-213	E.I. DuPont de Nemours & Co.	11
CFC-214	E.I. DuPont de Nemours & Co.	11
CFC-215	E.I. DuPont de Nemours & Co.	511
	Halocarbon Products Corp.	1,270
CFC-216	E.I. DuPont de Nemours & Co.	170,574
CFC-217	E.I. DuPont de Nemours & Co.	511
(d) For Group IV controlled substances:		
CCl4	Akzo Chemicals, Inc.	7,873,615
	Degussa Corporation	26,546
	Dow Chemical Company, USA.	18,987,747
	E.I. DuPont de Nemours & Co.	9,099
	Hanlin Chemicals-WV, Inc.	219,616
	ICI Americas, Inc.	853,714
	Occidental Chemical Corp.	1,059,358
	Vulcan Chemicals	21,931,987
(e) For Group V controlled substances:		
Methyl Chloroform....	Dow Chemical Company, USA.....	168,030,117

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Controlled substance	Person	Allowances (kg)
	E.I. DuPont de Nemours & Co.....	2
	PPG Industries, Inc.	7,450,719
	Vulcan Chemicals	89,689,064
(f) For Group VI controlled substances:		
Methyl Bromide	Great Lakes Chemical Corporation	19,945,788
	Ethyl Corporation	8,233,894
(g) For Group VII controlled substances:		
HBFC 22B1-1	Great Lakes Chemical Corporation	46,211

§82.6 Apportionment of baseline consumption allowances for Class I controlled substances.

Persons who produced, imported, or produced and imported controlled substances in Group I or Group II in 1986 are apportioned chemical-specific baseline consumption allowances as set forth in paragraphs (a) and (b) of this section. Persons who produced, imported, or produced and imported controlled substances in Group III, Group IV, or Group V in 1989 are apportioned chemical-specific baseline consumption allowances as set forth in paragraphs (c), (d) and (e) of this section. Persons who produced, imported, or produced and imported controlled substances in Group VI or Group VII in 1991 are apportioned chemical specific baseline consumption allowances as set forth in paragraphs (f) and (g) of this section.

Controlled substance	Person	Allowances (kg)
(a) For Group I controlled substances:		
CFC-11	Allied-Signal, Inc.	22,683,833
	E.I. DuPont de Nemours & Co.....	32,054,283
	Elf Atochem, N.A.....	21,740,194
	Hoechst Celanese Corporation.	185,396
	ICI Americas, Inc.....	1,673,436
	Kali-Chemie Corporation.....	82,500
	Laroche Chemicals	12,695,726
	National Refrigerants, Inc.	693,707
	Refricentro, Inc.....	160,697
	Sumitomo Corporation of America.....	5,800
CFC-12	Allied-Signal, Inc.	35,236,397
	E.I. DuPont de Nemours & Co.....	61,098,726
	Elf Atochem, N.A.....	32,403,869
	Hoechst Celanese Corporation	138,865
	ICI Americas, Inc.....	1,264,980
	Kali-Chemie Corporation.....	355,440
	Laroche Chemicals	15,281,553
	National Refrigerants, Inc.	2,375,384
	Refricentro, Inc.....	242,526
	Sumitomo Corp. of America	280,163
CFC-113	Allied-Signal, Inc.	18,241,928
	E.I. DuPont de Nemours & Co.....	49,602,858
	Elf Atochem, N.A.....	244,908
	Holchem	265,199
	ICI Americas, Inc.....	2,399,700
	Refricentro, Inc.....	37,385
	Sumitomo Corp. of America	280,163
	Allied-Signal, Inc.	1,429,582
	E.I. DuPont de Nemours & Co.....	3,686,103

Controlled substance	Person	Allowances (kg)
CFC-115	Elf Atochem, N.A.....	22,880
	ICI Americas, Inc.....	32,930
	E.I. DuPont de Nemours & Co.....	2,764,109
	Elf Atochem, N.A.....	633,007
	Hoechst Celanese Corporation	8,893
	ICI Americas, Inc.....	2,366,351
	Laroche Chemicals	135,520
	Refricentro, Inc.....	27,337
(b) For Group II controlled substances:		
Halon-1211 ..	Elf Atochem, N.A.....	411,292
	Great Lakes Chemical Corp.	772,775
	ICI Americas, Inc.....	2,116,641
	Kali-Chemie Corporation.....	330,000
Halon-1301 ..	E.I. DuPont de Nemours & Co.....	2,772,917
	Elf Atochem, N.A.....	89,255
	Great Lakes Chemical Corp.	1,744,132
	Kali-Chemie Corporation.....	54,380
Halon-2402 ..	Ausimont	34,400
	Great Lakes Chemical Corp.	15,900
(c) For Group III controlled substances:		
CFC-13	Allied-Signal, Inc.	127,124
	E.I. DuPont de Nemours & Co.....	158,508
	Elf Atochem, N.A.....	3,992
	Great Lakes Chemical Corp.	56,239
	ICI Americas, Inc.....	5,855
	Laroche Chemicals	29,025
CFC-111	National Refrigerants, Inc.	16,665
CFC-112	Sumitomo Corp of America	5,912
	TG (USA) Corporation	9,253
CFC-211	E.I. DuPont de Nemours & Co.....	11
CFC-212	E.I. DuPont de Nemours & Co.....	11
CFC-213	E.I. DuPont de Nemours & Co.....	11
CFC-214	E.I. DuPont de Nemours & Co.....	11
CFC-215	E.I. DuPont de Nemours & Co.....	511
	Halocarbon Products Corp.....	1,270
CFC-216	E.I. DuPont de Nemours & Co.....	170,574
CFC-217	E.I. DuPont de Nemours & Co.....	511
(d) For Group IV controlled substances:		
CCl4	Crescent Chemical Co.	56
	Degussa Corporation	12,466
	Dow Chemical Company, USA	8,170,561
	E.I. DuPont de Nemours & Co.....	26,537
	Elf Atochem, N.A.....	41
	Hanlin Chemicals-WV, Inc.	103,133
	Hoechst Celanese Corporation	3
	ICC Chemical Corp.	1,173,723
	ICI Americas, Inc.....	855,466
	Occidental Chemical Corp.	497,478
	Sumitomo Corporation of America	9
(e) For Group V controlled substances:		
Methyl Chloroform	3V Chemical Corp.	3,528
	Actex, Inc.	50,171
	Atochem North America	74,355
	Dow Chemical Company, USA	125,200,200
	E.I. DuPont de Nemours & Co.....	2
	IBM	2,026
	ICI Americas, Inc.....	14,179,850
	Laidlaw	420,207
	PPG Industries	45,254,115
	Sumitomo	1,954

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Controlled substance	Person	Allowances (kg)
(f) For Group VI controlled substances:	TG (USA) Corporation.....	7,073
	Unitor Ships Service, Inc.	14,746
	Vulcan Chemicals	70,765,072
	Great Lakes Chemical Corporation	15,514,746
	Ethyl Corporation	6,379,906
(g) For Group VII controlled substances:	AmeriBrom, Inc.	3,524,393
	TriCal, Inc.	109,225
	Great Lakes Chemical Corporation	40,110
	HBFC	
	22B1-1	

§82.7 Grant and phase reduction of baseline production and consumption allowances for class I controlled substances.

For each control period specified in the following table, each person is granted the specified percentage of the baseline production and consumption allowances apportioned to him under §82.5 and 82.6 of this subpart.

Control period	Class I substances in groups I and III (percent)	Class I substances in group II (percent)	Class I substances in group IV (percent)	Class I substances in group V (percent)	Class I substances in group IV (percent)	Class I substances in group VII (percent)
1994	25	0	50	50	100	100
1995	25	0	15	30	100	100
1996	0	0	0	0	100	0
1997	0	0	0	0	100	0
1998	0	0	0	0	100	0
1999	0	0	0	0	75	0
2000	0	0	0	0	75	0
2001 .....	.....	.....	.....	.....	50	.....
2002 .....	.....	.....	.....	.....	50	.....
2003 .....	.....	.....	.....	.....	30	.....
2004 .....	.....	.....	.....	.....	30	.....
2005 .....	.....	.....	.....	.....	0	.....

§82.8 Grants of essential use allowances and critical use allowances.

(a) Effective January 1, 1996, persons in the following list are allocated essential-use allowances or exemptions for quantities of a specific class I controlled substance for a specific essential-use (the Administrator reserves the right to revise the allocations based on future decisions of the Parties).

TABLE I—ESSENTIAL USE ALLOWANCES FOR CALENDAR YEAR 2010

(i) Metered Dose Inhalers (for oral inhalation) for Treatment of Asthma and Chronic Obstructive Pulmonary Disease		
Company	Chemical	2010 Quantity (metric tons)
Armstrong.....	CFC-11 or CFC-12 or CFC-114.	30.0

(b) A global exemption for class I controlled substances for essential laboratory and analytical uses shall be in effect through December 31, 2011, subject to the restrictions in appendix G of this subpart, and subject to the record-keeping and reporting requirements at §82.13(u) through (x). There is no amount specified for this exemption.

(c) Effective January 1, 2005, critical use allowances are apportioned as set forth in paragraph (c)(1) of this section for the exempted production and import of class I, Group VI controlled substances specifically for those approved critical uses listed in appendix L to this subpart for the applicable control period. Every kilogram of production and import in excess of the total number and type of unexpended critical use allowances held for a particular type of use constitutes a separate violation of this subpart.

(1) Allocated critical use allowances granted for specified control period.

Company	2014 Critical use allowances for pre-plant uses* (kilograms)	2014 Critical use allowances for post-harvest uses* (kilograms)	2015 Critical use allowances for pre-plant uses* (kilograms)	2015 Critical use allowances for post-harvest uses* (kilograms)
Great Lakes Chemical Corp. A Chemtura Company.....	252,236	16,572	227,073	1,969
Albemarle Corp	103,725	6,815	93,378	810
ICL-IP America	57,321	3,766	51,602	447
TriCal, Inc.	1,785	117	1,607	14
Total	415,067	27,270	373,660	3,240

* For production or import of Class I, Group VI controlled substance exclusively for the Pre-Plant or Post-Harvest uses specified in appendix L to this subpart for the appropriate control period.

(2) [Reserved]

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§82.9 Availability of production allowances in addition to baseline production allowances for class I controlled substances.

(a) Every person apportioned baseline production allowances for class I controlled substances under §82.5 (a) through (f) of this subpart is also granted Article 5 allowances equal to:

(1) 10 percent of their baseline production allowances listed for class I, Group I, Group III, Group IV, and Group V controlled substances listed under §82.5 of this subpart for each control period ending before January 1, 1996;

(2) 15 percent of their baseline production allowances for class I, Group VI controlled substances listed under §82.5 of this subpart for each control period ending before January 1, 2005;

(3) 15 percent of their baseline production allowances for class I, Group II controlled substances listed under §82.5 of this subpart for each control period beginning January 1, 1994, until January 1, 2003;

(4) 15 percent of their baseline production allowances for Class I, Group IV and Group V controlled substances listed under §82.5 of this subpart for each control period beginning January 1, 1996 until January 1, 2010;

(b) Effective January 1, 1995, a person allocated Article 5 allowances may produce class I controlled substances for export to Article 5 countries as under §82.11 and transfer Article 5 allowances as under §82.12.

(c) A company may increase or decrease its production allowances, its Article 5 allowances by trading with another Party to the Protocol according to the provision under this paragraph (c). A company may increase or decrease its essential-use allowances for CFCs for use in essential MDIs according to the provisions under this paragraph (c). A nation listed in appendix C to this subpart (Parties to the Montreal Protocol) must agree either to transfer to the person for the current control period some amount of production or import that the nation is permitted under the Montreal Protocol or to receive from the person for the current control period some amount of production or import that the person is permitted under this subpart. If the controlled substance is produced under the authority of production allowances and is to be returned to the Party from whom production allowances are received, the request for production allowances shall also be considered a request for consumption allowances under §82.10(c). If the controlled substance is produced under the authority of production allowances and is to be sold in the United States or to another Party (not the Party from whom the allowances are received), the U.S. company must expend its consumption allowances allocated under §82.6 and §82.7 in order to produce with the additional production allowances.

(1) For trades from a Party, the person must obtain from the principal diplomatic representative in that nation's embassy in the United States a signed document stating that the appropriate authority within that nation has established or revised production limits or essential-use allowance limits for the nation to equal the lesser of the maximum production that the nation is allowed under the Protocol minus the amount transferred,

the maximum production or essential-use allowances that are allowed under the nation's applicable domestic law minus the amount transferred, or the average of the nation's actual national production level for the three years prior to the transfer minus the production transferred. The person must submit to the Administrator a transfer request that includes a true copy of this document and that sets forth the following:

- (i) The identity and address of the person;
- (ii) The identity of the Party;
- (iii) The names and telephone numbers of contact persons for the person and for the Party;
- (iv) The chemical type, type of allowance being transferred, and the level of allowances being transferred;
- (v) The control period(s) to which the transfer applies; and

(vi) For increased production intended for export to the Party from whom the allowances would be received, a signed statement of intent to export to the Party.

(vii) In the case of transferring essential-use allowances, the transferor must include a signed document from the transferee identifying the CFC MDI products that will be produced using the essential-use allowances.

(2) For trades to a Party, a person must submit a transfer request that sets forth the following:

- (i) The identity and address of the person;
- (ii) The identity of the Party;
- (iii) The names and telephone numbers of contact persons for the person and for the Party;
- (iv) The chemical type, type of allowance being transferred, and the level of allowances being transferred; and
- (v) The control period(s) to which the transfer applies.

(3) After receiving a transfer request that meets the requirements of paragraph (c)(2) of this section, the Administrator may, at his discretion, consider the following factors in deciding whether to approve such a transfer:

- (i) Possible creation of economic hardship;
- (ii) Possible effects on trade;
- (iii) Potential environmental implications; and
- (iv) The total amount of unexpended production or essential-use allowances held by a U.S. entity.

(v) In the case of transfer of essential-use allowances the Administrator may consider whether the CFCs will be used for production of essential MDIs.

(4) The Administrator will issue the person a notice either granting or deducting production allowances, Article 5 allowances, or essential-use allowances, and specifying the control period to which the transfer applies, provided that the request meets the requirement of paragraph (c)(1) of this sections for trades from Parties and paragraph (c)(2) of this section for trades to Parties, unless the Administrator has decided to disapprove the trade under paragraph (c)(3) of this section. For a trade from a Party, the Administrator will issue a notice that revises the allowances held by the person to equal the unexpended production, Article 5, or essential-use allowances held by the person under this subpart plus the level of allowable production transferred from the Party.

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For a trade to a Party, the Administrator will issue a notice that revises the production limit for the person to equal the lesser of:

(i) The unexpended production allowances, essential-use allowances, or Article 5 allowances held by the person under this subpart minus the amount transferred; or

(ii) The unexpended production allowances, essential-use allowances, or Article 5 allowances held by the person under this subpart minus the amount by which the United States average annual production of the controlled substance being traded for the three years prior to the transfer is less than the total production allowable for that substance under this subpart minus the amount transferred. The change in allowances will be effective on the date that the notice is issued.

(5) If after one person obtains approval for a trade of allowable production of a controlled substance to a Party, one or more other persons obtain approval for trades involving the same controlled substance and the same control period, the Administrator will issue notices revising the production limits for each of the other persons trading that controlled substance in that control period to equal the lesser of:

(i) The unexpended production allowances or Article 5 allowances held by the person under this subpart minus the amount transferred; or

(ii) The unexpended production allowances or Article 5 allowances held by the person under this subpart minus the amount by which the United States average annual production of the controlled substance being traded for the three years prior to the transfer is less than the total allowable production for that substance under this subpart multiplied by the amount transferred divided by the total amount transferred by all the other persons trading the same controlled substance in the same control period minus the amount transferred by that person.

(iii) The Administrator will also issue a notice revising the production limit for each person who previously obtained approval of a trade of that substance in that control period to equal the unexpended production allowances or unexpended Article 5 allowances held by the person under this subpart plus the amount by which the United States average annual production of the controlled substance being traded for the three years prior to the transfer is less than the total allowable production under this subpart multiplied by the amount transferred by that person divided by the amount transferred by all of the persons who have traded that controlled substance in that control period. The change in production allowances or Article 5 allowances will be effective on the date that the notice is issued.

(d) Effective January 1, 1996, there will be no trade in production or consumption allowances with other Parties to the Protocol for class I controlled substances, except for class I, Group VI, methyl bromide.

(e) Until January 1, 1996 for all class I controlled substances, except Group VI, and until January 1, 2005 for class I, Group VI, a person may obtain production allowances for that controlled substance equal to the amount of that controlled substance produced in the United States that was transformed or destroyed within the United

States, or transformed or destroyed by a person of another Party, in the cases where production allowances were expended to produce such substance in the U.S. in accordance with the provisions of this paragraph. A request for production allowances under this section will be considered a request for consumption allowances under §82.10(b).

(1) Until January 1, 1996, for all class I controlled substances, except Group VI, and until January 1, 2005, for class I, Group VI, a person must submit a request for production allowances that includes the following:

(i) The name, address, and telephone number of the person requesting the allowances, and the Employer Identification Number if the controlled substance is being exported;

(ii) The name, quantity, and level of controlled substance transformed or the name, quantity and volume destroyed, and the commodity code if the substance was exported;

(iii) A copy of the invoice or receipt documenting the sale of the controlled substance, including the name, address, contact person and telephone number of the transformer or destroyer;

(iv) A certification that production allowances were expended for the production of the controlled substance, and the date of purchase, if applicable;

(v) If the controlled substance is transformed, the name, quantity, and verification of the commercial use of the resulting chemical and a copy of the IRS certificate of intent to use the controlled substance as a feedstock; and,

(vi) If the controlled substance is destroyed, the verification of the destruction efficiency.

(2) Until January 1, 1996 for all class I controlled substances, except Group VI, and until January 1, 2005, for class I, Group VI, the Administrator will review the information and documentation submitted under paragraph (e)(1) of this section and will assess the quantity of class I controlled substance that the documentation and information verifies was transformed or destroyed. The Administrator will issue the person production allowances equivalent to the controlled substances that the Administrator determines were transformed or destroyed. For controlled substances completely destroyed under this rule, the Agency will grant allowances equal to 100 percent of volume intended for destruction. For those controlled substances destroyed at less than a 98 percent destruction efficiency, the

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Agency will grant allowances commensurate with that percentage of destruction efficiency that is actually achieved. The grant of allowances will be effective on the date that the notice is issued.

(3) Until January 1, 1996 for all class I controlled substances, except Group VI, and until January 1, 2005, for class I, Group VI, if the Administrator determines that the request for production allowances does not satisfactorily substantiate that the person transformed or destroyed controlled substances as claimed, or that modified allowances were not expended, the Administrator will issue a notice disallowing the request for additional production allowances. Within ten working days after receipt of notification, the person may file a notice of appeal, with supporting reasons, with the Administrator. The Administrator may affirm the disallowance or grant an allowance, as she/he finds appropriate in light of the available evidence. If no appeal is taken by the tenth day after notification, the disallowance will be final on that day.

(f) Effective January 1, 1996, and until January 1, 2000, a person who was nominated by the United States to the Secretariat of the Montreal Protocol for an essential use exemption may obtain destruction and transformation credits for a class I controlled substance (except class I, Group VI) equal to the amount of that controlled substance produced in the United States that was destroyed or transformed within the United States in cases where the controlled substance was produced for other than destruction or transformation in accordance with the provisions of this subpart, subtracting an offset of 15 percent.

(1) Effective January 1, 1996, and until January 1, 2000, a person must submit a request for destruction and transformation credits that includes the following:

(i) The identity and address of the person and the essential-use exemption and years for which the person was nominated to the Secretariat of the Montreal Protocol;

(ii) The name, quantity and volume of controlled substance destroyed or transformed;

(iii) A copy of the invoice or receipt documenting the sale or transfer of the controlled substance to the person;

(iv) A certification of the previous use of the controlled substance;

(v) For destruction credits, a certification that the controlled substance was destroyed and a certification of the efficiency of the destruction process; and

(vi) For transformation credits, an IRS certificate of feedstock use or transformation of the controlled substance.

(2) Effective January 1, 1996, and until January 1, 2000, the Administrator will issue the person destruction and transformation credits equivalent to the class I controlled substance (except class I, Group VI) recovered from a use system in the United States, that the Administrator determines were destroyed or transformed, subtracting the offset of 15 percent. For controlled substances completely destroyed under this rule, the Agency will grant destruction credits equal to

100 percent of volume destroyed minus the offset. For those controlled substances destroyed at less than a 98 percent destruction efficiency, the Agency will grant destruction credits commensurate with that percentage of destruction efficiency that is actually achieved minus the offset. The grant of credits will be effective on the date that the notice is issued.

(3) Effective January 1, 1996, and until January 1, 2000, if the Administrator determines that the request for destruction and transformation credits does not satisfactorily substantiate that the person was nominated for an essential-use exemption by the United States to the Secretariat for the Montreal Protocol for the control period, or that the person destroyed or transformed a class I controlled substance as claimed, or that the controlled substance was not recovered from a U.S. use system the Administrator will issue a notice disallowing the request for additional destruction and transformation credits. Within ten working days after receipt of notification, the person may file a notice of appeal, with supporting reasons, with the Administrator. The Administrator may affirm the disallowance or grant an allowance, as she/he finds appropriate in light of the available evidence. If no appeal is taken by the tenth day after notification, the disallowance will be final on that day.

(g) *International transfer of essential-use CFCs.* (1) For trades of essential-use CFCs where the transferee or the transferor is a person in another nation (Party), the persons involved in the transfer must submit the information requested in §82.12(d)(2) and (d)(3), along with a signed document from the principal diplomatic representative in the Party's embassy in the United States stating that the appropriate authority within that nation has approved the transfer of the essential-use CFCs.

(2) If the transfer claim is complete, and EPA does not object to the transfer, then EPA will issue letters to the transferor and the transferee indicating that the transfer may proceed. EPA reserves the right to disallow a transfer if the transfer request is incomplete, or if it has reason to believe that the transferee plans to produce MDIs that are not essential MDIs. If EPA objects to the transfer, EPA will issue letters to the transferor and transferee stating the basis for disallowing the transfer. The burden of proof is placed on the transferee to retain sufficient records to prove that the transferred essential-use CFCs are used only for production of essential MDIs. If EPA ultimately finds that the transferee did not use the essential-use CFCs for production of essential MDIs then the transferee is in violation of this subpart.

§82.10 Availability of consumption allowances in addition to baseline consumption allowances for class I controlled substances.

(a) Until January 1, 1996 for all class I controlled substances, except Group VI, and until January 1, 2005, for class I, Group VI, any person may obtain, in accordance with the provisions of this subsection, consumption allowances equivalent to the level of class I controlled substances (other than used controlled substances or transshipments) that the person has exported

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from the United States and its territories to a Party (as listed in appendix C to this subpart).

(1) Until January 1, 1996 for all class I controlled substances, except Group VI, and until January 1, 2005, for class I, Group VI, to receive consumption allowances in addition to baseline consumption allowances, the exporter of the class I controlled substances must submit to the Administrator a request for consumption allowances setting forth the following:

- (i) The identities and addresses of the exporter and the recipient of the exports;
- (ii) The exporter's Employer Identification Number;
- (iii) The names and telephone numbers of contact persons for the exporter and the recipient;
- (iv) The quantity and type of controlled substances exported;
- (v) The source of the controlled substance and the date purchased;
- (vi) The date on which, and the port from which, the controlled substances were exported from the United States or its territories;
- (vii) The country to which the controlled substances were exported;
- (viii) A copy of the bill of lading and the invoice indicating the net quantity of controlled substances shipped and documenting the sale of the controlled substances to the purchaser.
- (ix) The commodity code of the controlled substance exported; and
- (x) Written statement from the producer that the controlled substance was produced with expended allowances.

(2) The Administrator will review the information and documentation submitted under paragraph (a)(1) of this section and will assess the quantity of controlled substances that the documentation verifies was exported. The Administrator will issue the exporter consumption allowances equivalent to the level of controlled substances that the Administrator determined were exported. The grant of the consumption allowances will be effective on the date the notice is issued. If the Administrator determines that the information and documentation does not satisfactorily substantiate that the person exported controlled substances as claimed the Administrator will issue a notice that the consumption allowances are not granted.

(b) Until January 1, 1996, a person may obtain consumption allowances for a class I controlled substance (and until January 1, 2005 for class I, Group VI) equal to the amount of a controlled substance either produced in, or imported into, the United States that was transformed or destroyed in the case where consumption allowances were expended to produce or import such substance in accordance with the provisions of this paragraph. However, a person producing or importing a controlled substance (except class I, Group VI) that was transformed or destroyed must submit to the Administrator the information described under §82.13 (f)(3) (i) and (ii).

(c) A company may also increase its consumption allowances by receiving production from another Party to the Protocol for class I, Group I through Group V and Group VII controlled substances until January 1, 1996 and for class I, Group VI controlled substances until January 1, 2005. A nation listed in appendix C to this subpart (Parties to the Montreal Protocol) must agree to transfer to the person for the current control period some amount of production that the nation is permitted under the Montreal Protocol. If the controlled substance is to be returned to the Party from whom allowances are received, the request for consumption allowances shall also be considered a request for production allowances under §82.9(c). For trades from a Party, the person must obtain from the principal diplomatic representative in that nation's embassy in the United States a signed document stating that the appropriate authority within that nation has established or revised production limits for the nation to equal the lesser of the maximum production that the nation is allowed under the Protocol minus the amount transferred, the maximum production that is allowed under the nation's applicable domestic law minus the amount transferred, or the average of the nation's actual national production level for the three years prior to the transfer minus the production allowances transferred. The person must submit to the Administrator a transfer request that includes a true copy of this document and that sets forth the following:

- (1) The identity and address of the person;
 - (2) The identity of the Party;
 - (3) The names and telephone numbers of contact persons for the person and for the Party;
 - (4) The chemical type and level of production being transferred;
 - (5) The control period(s) to which the transfer applies; and
 - (6) For increased production intended for export to the Party from whom allowances would be received, a signed statement of intent to export to this Party.
- (d) On the first day of each control period, until January 1, 1996, the Agency will grant consumption allowances to any person that produced and exported a Group IV controlled substance in the baseline year and that was not granted baseline consumption allowances under §82.5.

(1) The number of consumption allowances any such person will be granted for each control period will be equal to the number of production allowances granted to that person under §82.7 for that control period.

(2) Any person granted allowances under this paragraph must hold the same number of unexpended consumption allowances for the control period for which the allowances were granted by February 15 of the following control period. Every kilogram by which the person's unexpended consumption allowances fall short of the amount the person was granted under this paragraph constitutes a separate violation.

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§82.11 Exports of class I controlled substances to Article 5 Parties.

(a) If apportioned Article 5 allowances under §82.9(a) or §82.11(a)(2), a person may produce Class I controlled substances, in accordance with the prohibitions in §82.4 and the reduction schedule in §82.11(a)(3), to be exported (not including exports resulting in transformation or destruction, or exports of used controlled substances) to foreign states listed in appendix E to this subpart (Article 5 countries).

(1) A person must submit a notice to the Administrator of exports to Article 5 countries (except exports resulting in transformation or destruction, or used controlled substances) at the end of the quarter that includes the following:

(i) The identities and addresses of the exporter and the Article 5 country recipient of the exports;

(ii) The exporter's Employee Identification Number;

(iii) The names and telephone numbers of contact persons for the exporter and for the recipient;

(iv) The quantity and the type of controlled substances exported, its source and date purchased;

(v) The date on which, and the port from which, the controlled substances were exported from the United States or its territories;

(vi) The Article 5 country to which the controlled substances were exported;

(vii) A copy of the bill of lading and invoice indicating the net quantity shipped and documenting the sale of the controlled substances to the Article 5 purchaser;

(viii) The commodity code of the controlled substance exported; and

(ix) A copy of the invoice or sales agreement covering the sale of the controlled substances to the recipient Article 5 country that contains provisions forbidding the reexport of the controlled substance in bulk form and subjecting the recipient or any transferee of the recipient to liquidated damages equal to the resale price of the controlled substances if they are reexported in bulk form.

(2) Persons who reported exports of Class I, Group I controlled substances to Article 5 countries in 2000–2003 are apportioned baseline Article 5 allowances as set forth in §82.11(a)(2)(i). Persons who reported exports of Class I, Group VI controlled substances to Article 5 countries in 1995–1998 are apportioned baseline Article 5 allowances as set forth in §82.11(a)(2)(ii).

(i) For Group I Controlled Substances

Controlled Substance	Person	Allowances (kg)
CFC-11.....	Honeywell.....	7,150
	Sigma Aldrich.....	1
CFC-113.....	Fisher Scientific.....	5
	Honeywell.....	313,686
	Sigma Aldrich.....	48
CFC-114.....	Honeywell.....	24,798
	Sigma Aldrich.....	1

(ii) For Group VI Controlled Substances

Controlled Substance	Person	Allowances (kg)
Methyl Bromide	Albemarle	1,152,714
	Ameribrom	176,903
	Great Lakes Chemical Corporation	3,825,846

(3) Phased Reduction Schedule for Article 5 Allowances allocated in §82.11. For each control period specified in the following table, each person is granted the specified percentage of the baseline Article 5 allowances apportioned under §82.11.

Control Period	Class I substances in group I (In percent)	Class I substances in group VI (In percent)
2006	50	80
2007	15	80
2008	15	80
2009	15	80
2010	0	80
2011	0	80
2012	0	80
2013	0	80
2014	0	80
2015 0	0	0

(2) [Reserved]

(b) [Reserved]

§82.12 Transfers of allowances for class I controlled substances.

(a) *Inter-company transfers.* (1) Until January 1, 1996, for all class I controlled substances, except for Group VI, and until January 1, 2005, for Group VI, any person ("transferor") may transfer to any other person ("transferee") any amount of the transferor's consumption allowances or production allowances, and effective January 1, 1995, for all class I controlled substances any person ("transferor") may transfer to any other person ("transferee") any amount of the transferor's Article 5 allowances. After January 1, 2002, any essential-use allowance holder (including those persons that hold essential-use allowances issued by a Party other than the United States) ("transferor") may transfer essential-use allowances for CFCs to a metered dose inhaler company solely for the manufacture of essential MDIs. After January 1, 2005, any critical use allowance holder ("transferor") may transfer critical use allowances to any other person ("transferee"). After January 1, 2005, any critical stock allowance holder ("transferor") may transfer critical stock allowances to any critical stock allowance holder or any methyl bromide producer, importer, distributor or third party applicator ("transferee").

(i) The transferor must submit to the Administrator a transfer claim setting forth the following:

(A) The identities and addresses of the transferor and the transferee;

(B) The name and telephone numbers of contact persons for the transferor and the transferee;

(C) The type of allowances being transferred, including the names of the controlled substances for which allowances are to be transferred;

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(D) The group of controlled substances to which the allowances being transferred pertains;

(E) The amount of allowances being transferred;

(F) The control period(s) for which the allowances are being transferred;

(G) The amount of unexpended allowances of the type and for the control period being transferred that the transferor holds under authority of this subpart as of the date the claim is submitted to EPA; and

(H) The one percent offset applied to the unweighted amount traded will be deducted from the transferor's production or consumption allowance balance (except for trades from transformers and destroyers to producers or importers for the purpose of allowance reimbursement). In the case of transferring essential use allowances, the amount of one tenth of one percent of the amount traded will be deducted from the transferor's allowance balance. In the case of transferring critical use allowances, the amount of one tenth of one percent of the amount traded will be deducted from the transferor's critical use allowance balance.

(I) The transferor must include a signed document from the transferee identifying the CFC MDI products that will be produced using the essential-use allowances.

(ii) The Administrator will determine whether the records maintained by EPA, taking into account any previous transfers and any production, allowable imports and exports of controlled substances reported by the transferor, indicate that the transferor possesses, as of the date the transfer claim is processed, unexpended allowances sufficient to cover the transfer claim (i.e., the amount to be transferred plus, in the case of transferors of essential use allowances and critical use allowances, one tenth of one percent of the transferred amount). Within three working days of receiving a complete transfer claim, the Administrator will take action to notify the transferor and transferee as follows:

(A) If EPA's records show that the transferor has sufficient unexpended allowances to cover the transfer claim, the Administrator will issue a notice indicating that EPA does not object to the transfer and will reduce the transferor's balance of unexpended allowances by the amount to be transferred plus, in the case of transfers of production or consumption allowances, one percent of that amount, or in the case of transfers of essential use allowances, one tenth of one percent of that amount. When EPA issues a no objection notice, the transferor and the transferee may proceed with the transfer. However, if EPA ultimately finds that the transferor did not have sufficient unexpended allowances to cover the claim, the transferor and transferee will be held liable for any violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer.

(B) If EPA's records show that the transferor has insufficient unexpended allowances to cover the transfer claim, or that the transferor has failed to respond to one or more Agency requests to supply information needed to make a determination, the Administrator will issue a notice disallowing the transfer. Within 10 working days

after receipt of notification, either party may file a notice of appeal, with supporting reasons, with the Administrator. The Administrator may affirm or vacate the disallowance. If no appeal is taken by the tenth working day after notification, the disallowance shall be final on that day.

(iii) In the event that the Administrator does not respond to a transfer claim within the three working days specified in paragraph (a)(1)(ii) of this section the transferor and transferee may proceed with the transfer. EPA will reduce the transferor's balance of unexpended allowances by the amount to be transferred plus, in the case of transfers of production or consumption allowances, one percent of that amount, and in the case of essential use allowances and critical use allowances, one tenth of one percent of that amount. However if EPA ultimately finds that the transferor did not have sufficient unexpended allowances to cover the claim, the transferor and transferee will be held liable for any violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer.

(2) Effective January 1, 1996, any person ("transferor") may transfer to an eligible person ("transferee") as defined in §82.9 any amount of the transferor's destruction and transformation credits. The transfer proceeds as follows:

(i) The transferor must submit to the Administrator a transfer claim setting forth the following:

(A) The identities and addresses of the transferor and the transferee;

(B) The name and telephone numbers of contact persons for the transferor and the transferee;

(C) The type of credits being transferred, including the names of the controlled substances for which credits are to be transferred;

(D) The group of controlled substances to which the credits being transferred pertains;

(E) The amount of destruction and transformation credits being transferred;

(F) The control period(s) for which the destruction and transformation credits are being transferred;

(G) The amount of unexpended destruction and transformation credits for the control period being transferred that the transferor holds under authority of this subpart as of the date the claim is submitted to EPA; and

(H) The amount of the one-percent offset applied to the unweighted amount traded that will be deducted from the transferor's balance.

(ii) The Administrator will determine whether the records maintained by EPA, taking into account any previous transfers and any production of controlled substances reported by the transferor, indicate that the transferor possesses, as of the date the transfer claim is processed, unexpended destruction and transformation credits sufficient to cover the transfer claim (i.e., the amount to be transferred plus one percent of that amount). Within three working days of receiving a complete transfer claim, the Administrator will take action to notify the transferor and transferee as follows:

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(A) If EPA's records show that the transferor has sufficient unexpended destruction and transformation credits to cover the transfer claim, the Administrator will issue a notice indicating that EPA does not object to the transfer and will reduce the transferor's balance of unexpended or credits by the amount to be transferred plus one percent of that amount. When EPA issues a no objection notice, the transferor and the transferee may proceed with the transfer. However, if EPA ultimately finds that the transferor did not have sufficient unexpended credits to cover the claim, the transferor and transferee will be held liable for any violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer.

(B) If EPA's records show that the transferor has insufficient unexpended destruction and transformation credits to cover the transfer claim, or that the transferor has failed to respond to one or more Agency requests to supply information needed to make a determination, the Administrator will issue a notice disallowing the transfer. Within 10 working days after receipt of notification, either party may file a notice of appeal, with supporting reasons, with the Administrator. The Administrator may affirm or vacate the disallowance. If no appeal is taken by the tenth working day after notification, the disallowance shall be final on that day.

(iii) In the event that the Administrator does not respond to a transfer claim within the three working days specified in paragraph (a)(2)(ii) of this section, the transferor and transferee may proceed with the transfer. EPA will reduce the transferor's balance of unexpended destruction and transformation credits by the amount to be transferred plus one percent of that amount. However, if EPA ultimately finds that the transferor did not have sufficient unexpended credits to cover the claim, the transferor and transferee will be held liable for any violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer.

(b) Inter-pollutant conversions.

(1) Until January 1, 1996, for all class I controlled substances, except Group VI, and until January 1, 2005 for Group VI, any person ("convertor") may convert consumption allowances or production allowances for one class I controlled substance to the same type of allowance for another class I controlled substance within the same Group as the first as listed in appendix A of this subpart, following the procedures described in paragraph (b)(4) of this section.

(2) Effective January 1, 1995, any person ("convertor") may convert Article 5 allowances for one class I controlled substance to the same type of allowance for another class I controlled substance within the same Group of controlled substances as the first as listed in appendix A of this subpart, following the procedures described in paragraph (b)(4) of this section.

(3) Effective January 1, 1996, any person ("convertor") may convert destruction and/or transformation credits for one class I controlled substance to the same type of credits for another class I controlled substance within the same Group of controlled substances as the first as

listed in appendix A of this subpart, following the procedures in paragraph (b)(4) of this section.

(4) The convertor must submit to the Administrator a conversion claim.

(i) The conversion claim would include the following:

(A) The identity and address of the convertor;

(B) The name and telephone number of a contact person for the convertor;

(C) The type of allowances or credits being converted, including the names of the controlled substances for which allowances or credits are to be converted;

(D) The group of controlled substances to which the allowances or credits being converted pertains;

(E) The amount and type of allowances or credits to be converted;

(F) The amount of allowances or credits to be subtracted from the convertor's unexpended allowances or credits for the first controlled substance, to be equal to 101 percent of the amount of allowances or credits converted;

(G) The amount of allowances or credits to be added to the convertor's unexpended allowances or credits for the second controlled substance, to be equal to the amount of allowances or credits for the first controlled substance being converted multiplied by the quotient of the ozone depletion factor of the first controlled substance divided by the ozone depletion factor of the second controlled substance, as listed in appendix A to this subpart;

(H) The control period(s) for which the allowances or credits are being converted; and

(I) The amount of unexpended allowances or credits of the type and for the control period being converted that the convertor holds under authority of this subpart as of the date the claim is submitted to EPA.

(ii) The Administrator will determine whether the records maintained by EPA, taking into account any previous conversions, any transfers, any credits, and any production, imports (not including transshipments or used controlled substances), or exports (not including transshipments or used controlled substances) of controlled substances reported by the convertor, indicate that the convertor possesses, as of the date the conversion claim is processed, unexpended allowances or credits sufficient to cover the conversion claim (i.e., the amount to be converted plus one percent of that amount). Within three working days of receiving a complete conversion claim, the Administrator will take action to notify the convertor as follows:

(A) If EPA's records show that the convertor has sufficient unexpended allowances or credits to cover the conversion claim, the Administrator will issue a notice indicating that EPA does not object to the conversion and will reduce the convertor's balance of unexpended allowances or credits by the amount to be converted plus one percent of that amount. When EPA issues a no objection notice, the convertor may proceed with the conversion. However, if EPA ultimately finds that the convertor did not have sufficient unexpended allowances or credits to cover the claim, the convertor will be held liable for any violations of the regulations of this

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subpart that occur as a result of, or in conjunction with, the improper conversion.

(B) If EPA's records show that the convertor has insufficient unexpended allowances or credits to cover the conversion claim, or that the convertor has failed to respond to one or more Agency requests to supply information needed to make a determination, the Administrator will issue a notice disallowing the conversion. Within 10 working days after receipt of notification, the convertor may file a notice of appeal, with supporting reasons, with the Administrator. The Administrator may affirm or vacate the disallowance. If no appeal is taken by the tenth working day after notification, the disallowance shall be final on that day.

(iii) In the event that the Administrator does not respond to a conversion claim within the three working days specified in paragraph (b)(4)(ii) of this section, the convertor may proceed with the conversion. EPA will reduce the convertor's balance of unexpended allowances or credits by the amount to be converted plus one percent of that amount. However, if EPA ultimately finds that the convertor did not have sufficient unexpended allowances or credits to cover the claims, the convertor will be held liable for any violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper conversion.

(5) Effective January 1, 1995, and for every control period thereafter, inter-pollutant trades will be permitted during the 45 days after the end of a control period.

(c) Inter-company transfers and Inter-pollutant conversions.

(1) Until January 1, 1996, for production and consumption allowances; effective January 1, 1995, for Article 5 allowances; and effective January 1, 1996, for destruction and/or transformation credits; if a person requests an inter-company transfer and an inter-pollutant conversion simultaneously, the amount subtracted from the convertor-transferor's unexpended allowances or unexpended credits for the first controlled substance will be equal to 101 percent of the amount of allowances or credits that are being converted and transferred.

(2) [Reserved]

(d) *Transfers of essential-use CFCs.* (1) Effective January 1, 2002, any metered dose inhaler company (transferor) may transfer essential-use CFCs to another metered dose inhaler company (transferee) provided that the Administrator approves the transfer.

(2) The transferee must submit a transfer claim to the Administrator for approval before the transfer can take place. The transfer claim must set forth the following:

(i) The identities and addresses of the transferor and the transferee; and

(ii) The name and telephone numbers of contact persons for the transferor and the transferee; and

(iii) The amount of each controlled substance (CFC-11, CFC-12, or CFC-114) being transferred; and

(iv) The specific metered dose inhaler products (i.e. the MDI drug product or active moiety) that the transferee plans to produce with the transferred CFCs; and

(v) The country(ies) where the CFC metered dose inhalers produced with the transferred essential-use CFCs will be sold if other than in the United States; and

(vi) Certification that the essential-use CFCs will be used in the production of essential MDIs. If the MDIs are to be sold in the United States, the certification must state that MDIs produced with the transferred essential-use CFCs are listed as essential at 21 CFR 2.125, and were approved by the Food and Drug Administration before December 31, 2000. If the MDIs produced with the essential-use CFCs are to be sold outside the United States, the transferee must certify that the metered dose inhalers produced with the essential-use CFCs are considered essential by the importing country.

(3) The transferor must submit a letter stating that it concurs with the terms of the transfer as requested by the transferee.

(4) Once the transfer claim is complete, and if EPA does not object to the transfer, then EPA will issue letters to the transferor and the transferee within 10 business days indicating that the transfer may proceed. EPA reserves the right to disallow a transfer if the transfer request is incomplete, or if it has reason to believe that the transferee plans use the essential-use CFCs in anything other than essential MDIs. If EPA objects to the transfer, within EPA will issue letters to the transferor and transferee stating the basis for disallowing the transfer. The burden of proof is placed on the transferee to retain sufficient records to prove that the transferred essential-use CFCs are used only for production of essential MDIs. If EPA ultimately finds that the transferee did not use the essential-use CFCs for production of essential MDIs then the transferee is in violation of this subpart.

(e) *Exchange of Critical Use Allowances for Critical Stock Allowances.* (1) Critical use allowance holders may petition the Administrator to exchange a quantity of their unexpended critical use allowances for an equivalent amount of critical stock allowances. A person allocated critical stock allowances may not petition to exchange unexpended critical stock allowances for critical use allowances.

(2) [Reserved]

§82.13 Recordkeeping and reporting requirements for class I controlled substances.

(a) Unless otherwise specified, the recordkeeping and reporting requirements set forth in this section take effect on January 1, 1995. For class I, Group VIII controlled substances, the recordkeeping and reporting requirements set forth in this section take effect on August 18, 2003. For class I, Group VI critical use methyl bromide, the recordkeeping and reporting requirements set forth in this section take effect January 1, 2005.

(b) Reports and records required by this section may be used for purposes of compliance determinations. These requirements are not intended as a limitation on the use of other evidence admissible under the Federal Rules of Evidence. Failure to provide the reports, petitions and records required by this section, and to certify

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the accuracy of the information in the reports, petitions and records required by this section, will be considered a violation of this subpart. False statements made in reports, petitions and records will be considered violations of Section 113 of the Clean Air Act.

(c) Unless otherwise specified, reports required by this section must be mailed to the Administrator within 45 days of the end of the applicable reporting period.

(d) Records and copies of reports required by this section must be retained for three years.

(e) In reports required by this section, quantities of controlled substances must be stated in terms of kilograms.

(f) Every person ("producer") who produces class I controlled substances during a control period must comply with the following recordkeeping and reporting requirements:

(1) Within 120 days of May 10, 1995, or within 120 days of the date that a producer first produces a class I controlled substance, whichever is later, and within 120 days of July 18, 2003 for class I, Group VIII controlled substances, every producer who has not already done so must submit to the Administrator a report describing:

(i) The method by which the producer in practice measures daily quantities of controlled substances produced;

(ii) Conversion factors by which the daily records as currently maintained can be converted into kilograms of controlled substances produced, including any constants or assumptions used in making those calculations (e.g., tank specifications, ambient temperature or pressure, density of the controlled substance);

(iii) Internal accounting procedures for determining plant-wide production;

(iv) The quantity of any fugitive losses accounted for in the production figures; and

(v) The estimated percent efficiency of the production process for the controlled substance. Within 60 days of any change in the measurement procedures or the information specified in the above report, the producer must submit a report specifying the revised data or procedures to the Administrator.

(2) Every producer of a class I or class II controlled substance during a control period must maintain the following records:

(i) Dated records of the quantity of each controlled substance produced at each facility;

(ii) Dated records of the quantity of controlled substances produced for use in processes that result in their transformation or for use in processes that result in their destruction and quantity sold for use in processes that result in their transformation or for use in processes that result in their destruction;

(iii) Dated records of the quantity of controlled substances produced for an essential-use and quantity sold for use in an essential-use process;

(iv) Dated records of the quantity of controlled substances produced with expended destruction and/or transformation credits;

(v) Dated records of the quantity of controlled substances produced with Article 5 allowances;

(vi) Copies of invoices or receipts documenting sale of controlled substance for use in processes resulting in their transformation or for use in processes resulting in destruction;

(vii) Dated records of the quantity of each controlled substance used at each facility as feedstocks or destroyed in the manufacture of a controlled substance or in the manufacture of any other substance, and any controlled substance introduced into the production process of the same controlled substance at each facility;

(viii) Dated records identifying the quantity of each chemical not a controlled substance produced within each facility also producing one or more controlled substances;

(ix) Dated records of the quantity of raw materials and feedstock chemicals used at each facility for the production of controlled substances;

(x) Dated records of the shipments of each controlled substance produced at each plant;

(xi) The quantity of controlled substances, the date received, and names and addresses of the source of used materials containing controlled substances which are recycled or reclaimed at each plant;

(xii) Records of the date, the controlled substance, and the estimated quantity of any spill or release of a controlled substance that equals or exceeds 100 pounds;

(xiii) Internal Revenue Service Certificates in the case of transformation, or the destruction verification in the case of destruction (as in §82.13(k)), showing that the purchaser or recipient of a controlled substance, in the United States or in another country that is a Party, certifies the intent to either transform or destroy the controlled substance, or sell the controlled substance for transformation or destruction in cases when production and consumption allowances were not expended;

(xiv) Written verifications that essential-use allowances were conveyed to the producer for the production of specified quantities of a specific controlled substance that will only be used for the named essential-use and not resold or used in any other manufacturing process.

(xv) Written certifications that quantities of controlled substances, meeting the purity criteria in appendix G of this subpart, were purchased by distributors of laboratory supplies or by laboratory customers to be used only in essential laboratory and analytical uses as defined by appendix G, and not to be resold or used in manufacturing.

(xvi) Written verifications from a U.S. purchaser that the controlled substance was exported to an Article 5 country in cases when Article 5 allowances were expended during production; and

(xvii) For class I, Group VI controlled substances, dated records of the quantity of controlled substances produced for quarantine and preshipment applications and quantity sold for quarantine and preshipment applications;

(xviii) Written certifications that quantities of class I, Group VI controlled substances produced solely for

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quarantine and preshipment applications were purchased by distributors or applicators to be used only for quarantine and preshipment applications in accordance with the definitions in this subpart; and

(xix) Written verifications from a U.S. purchaser that class I, Group VI controlled substances produced solely for quarantine and preshipment applications, if exported, will be exported solely for quarantine and preshipment applications upon receipt of a certification in accordance with the definitions of this subpart and requirements in paragraph (h) of this section.

(xx) For class I, Group VI controlled substances, dated records such as invoices and order forms, and a log of the quantity of controlled substances produced for critical use, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, and the quantity sold for critical use, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use;

(xxi) Written certifications that quantities of class I, Group VI controlled substances produced for critical use were purchased by distributors, applicators, or approved critical users to be used or sold only for critical use in accordance with the definitions and prohibitions in this subpart. Certifications must be maintained by the producer for a minimum of three years and;

(xxii) For class I, Group VI controlled substances, dated records such as invoices and order forms, and a log of the quantity of controlled substances produced solely for export to satisfy critical uses authorized by the Parties for that control period, and the quantity sold solely for export to satisfy critical uses authorized by the Parties for that control period.

(3) Reporting Requirements—Producers. For each quarter, except as specified below, each producer of a class I controlled substance must provide the Administrator with a report containing the following information:

(i) The production by company in that quarter of each controlled substance, specifying the quantity of any controlled substance used in processing, resulting in its transformation by the producer;

(ii) The amount of production for use in processes resulting in destruction of controlled substances by the producer;

(iii) The levels of production (expended allowances and credits) for each controlled substance;

(iv) The producer's total of expended and unexpended production allowances, consumption allowances, Article 5 allowances, critical use allowances (pre-plant), critical use allowances (post-harvest), critical stock allowances, and amount of essential-use allowances and destruction and transformation credits conferred at the end of that quarter;

(v) The amount of controlled substance sold or transferred during the quarter to a person other than the producer for use in processes resulting in its transformation or eventual destruction;

(vi) A list of the quantities and names of controlled substances exported, by the producer and or by other U.S. companies, to a Party to the Protocol that will be

transformed or destroyed and therefore were not produced expending production or consumption allowances;

(vii) For transformation in the United States or by a person of another Party, one copy of an IRS certification of intent to transform the same controlled substance for a particular transformer and a list of additional quantities shipped to that same transformer for the quarter;

(viii) For destruction in the United States or by a person of another Party, one copy of a destruction verification (as under §82.13(k)) for a particular destroyer, destroying the same controlled substance, and a list of additional quantities shipped to that same destroyer for the quarter;

(ix) A list of U.S. purchasers of controlled substances that exported to an Article 5 country in cases when Article 5 allowances were expended during production;

(x) A list of the essential-use allowance holders, distributors of laboratory supplies and laboratory customers from whom orders were placed and the quantity of specific essential-use controlled substances requested and produced;

(xi) The certifications from essential-use allowance holders stating that the controlled substances were purchased solely for specified essential uses and will not be resold or used in any other manufacturing process;

(xii) In the case of laboratory essential-uses, certifications from distributors of laboratory supplies that controlled substances were purchased for sale to laboratory customers who certify that the substances will only be used for essential laboratory and analytical uses as defined by appendix G of this subpart, and will not be resold or used in manufacturing; or, if sales are made directly to laboratories, certification from laboratories that the controlled substances will only be used for essential laboratory and analytical uses (defined at appendix G of this subpart) and will not be resold or used in manufacturing.

(xiii) The amount of class I, Group VI controlled substances sold or transferred during the quarter to a person other than the producer solely for quarantine and preshipment applications;

(xiv) A list of the quantities of class I, Group VI controlled substances produced by the producer and exported by the producer and/or by other U.S. companies, to a Party to the Protocol that will be used solely for quarantine and preshipment applications and therefore were not produced expending production or consumption allowances; and

(xv) For quarantine and preshipment applications of class I, Group VI controlled substances in the United States or by a person of another Party, one copy of a certification that the material will be used only for quarantine and preshipment applications in accordance with the definitions in this subpart from each recipient of the material and a list of additional quantities shipped to that same person for the quarter.

(xvi) For critical uses of class I, Group VI controlled substances, producers shall report annually the amount of critical use methyl bromide owned by the reporting entity, specifying quantities dedicated for pre-plant use

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and quantities dedicated for post-harvest use, as well as quantities held by the reporting entity on behalf of another entity, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use along with the name of the entity on whose behalf the material is held; and

(xvii) A list of the quantities of class I, Group VI controlled substances produced by the producer and exported by the producer and/or by other U.S. companies in that control period, solely to satisfy the critical uses authorized by the Parties for that control period; and

(xviii) On an annual basis, the amount of methyl bromide produced or imported prior to the January 1, 2005, phaseout date owned by the reporting entity, as well as quantities held by the reporting entity on behalf of another entity, specifying the name of the entity on whose behalf the material is held.

(4) For any person who fails to maintain the records required by this paragraph, or to submit the report required by this paragraph, the Administrator may assume that the person has produced at full capacity during the period for which records were not kept, for purposes of determining whether the person has violated the prohibitions at §82.4.

(g) Importers of class I controlled substances during a control period must comply with record-keeping and reporting requirements specified in this paragraph (g).

(1) Recordkeeping—Importers. Any importer of a class I controlled substance (including used, recycled and reclaimed controlled substances) must maintain the following records:

(i) The quantity of each controlled substance imported, either alone or in mixtures, including the percentage of each mixture which consists of a controlled substance;

(ii) The quantity of those controlled substances imported that are used (including recycled or reclaimed) and the information provided with the petition as under §82.13(g)(2);

(iii) The quantity of controlled substances other than transshipments or used, recycled or reclaimed substances imported for use in processes resulting in their transformation or destruction and quantity sold for use in processes that result in their destruction or transformation;

(iv) The date on which the controlled substances were imported;

(v) The port of entry through which the controlled substances passed;

(vi) The country from which the imported controlled substances were imported;

(vii) The commodity code for the controlled substances shipped, which must be one of those listed in Appendix K to this subpart;

(viii) The importer number for the shipment;

(ix) A copy of the bill of lading for the import;

(x) The invoice for the import;

(xi) The quantity of imports of used, recycled or reclaimed class I controlled substances and class II controlled substances;

(xii) The U.S. Customs entry form;

(xiii) Dated records documenting the sale or transfer of controlled substances for use in processes resulting in transformation or destruction;

(xiv) Copies of IRS certifications that the controlled substance will be transformed or destruction verifications that it will be destroyed (as in §82.13(k));

(xv) Dated records of the quantity of controlled substances imported for an essential-use or imported with destruction and transformation credits; and

(xvi) Copies of certifications that imported controlled substances are being purchased for essential laboratory and analytical uses (defined at appendix G of this subpart) or being purchased for eventual sale to laboratories that certify that controlled substances are for essential laboratory and analytical uses (defined at appendix G of this subpart).

(xvii) For class I, Group VI controlled substances, dated records of the quantity of controlled substances imported for quarantine and preshipment applications and quantity sold for quarantine and preshipment applications;

(xviii) Written certifications that quantities of class I, Group VI controlled substances imported solely for quarantine and preshipment applications were purchased by distributors or applicators to be used only for quarantine and preshipment applications in accordance with the definitions in this subpart; and

(xix) Written verifications from a U.S. purchaser that class I, Group VI controlled substances imported solely for quarantine and preshipment applications, if exported, will be exported solely for quarantine and preshipment applications upon receipt of a certification in accordance with the definitions of this Subpart and requirements in paragraph (h) of this section.

(xx) For class I, Group VI controlled substances, dated records such as invoices and order forms, of the quantity of controlled substances imported for critical use, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, and the quantity sold for critical use, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, and;

(xxi) Written certifications that quantities of class I, Group VI controlled substances imported for critical use were purchased by distributors, applicators, or approved critical users to be used or sold only for critical use in accordance with the definitions and prohibitions in this subpart. Certifications must be maintained by an importer for a minimum of three years.

(2) Petitioning—Importers of Used, Recycled or Reclaimed Controlled Substances. For each individual shipment over 5 pounds of a used controlled substance as defined in §82.3, an importer must submit directly to the Administrator, at least 40 working days before the shipment is to leave the foreign port of export, the following information in a petition:

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(i) Name and quantity in kilograms of the used controlled substance to be imported;

(ii) Name and address of the importer, the importer ID number, the contact person, and the phone and fax numbers;

(iii) Name, address, contact person, phone number and fax number of all previous source facilities from which the used controlled substance was recovered;

(iv) A detailed description of the previous use of the controlled substance at each source facility and a best estimate of when the specific controlled substance was put into the equipment at each source facility, and, when possible, documents indicating the date the material was put into the equipment;

(v) A list of the name, make and model number of the equipment from which the material was recovered at each source facility;

(vi) Name, address, contact person, phone number and fax number of the exporter and of all persons to whom the material was transferred or sold after it was recovered from the source facility;

(vii) The U.S. port of entry for the import, the expected date of shipment and the vessel transporting the chemical. If at the time of submitting a petition the importer does not know the U.S. port of entry, the expected date of shipment and the vessel transporting the chemical, and the importer receives a non-objection notice for the individual shipment in the petition, the importer is required to notify the Administrator of this information prior to the actual U.S. Customs entry of the individual shipment;

(viii) A description of the intended use of the used controlled substance, and, when possible, the name, address, contact person, phone number and fax number of the ultimate purchaser in the United States;

(ix) Name, address, contact person, phone number and fax number of the U.S. reclamation facility, where applicable;

(x) If someone at the source facility recovered the controlled substance from the equipment, the name and phone and fax numbers of that person;

(xi) If the imported controlled substance was reclaimed in a foreign Party, the name, address, contact person, phone number and fax number of any or all foreign reclamation facility(ies) responsible for reclaiming the cited shipment;

(xii) An export license from the appropriate government agency in the country of export and, if recovered in another country, the export license from the appropriate government agency in that country;

(xiii) If the imported used controlled substance is intended to be sold as a refrigerant in the U.S., the name and address of the U.S. reclaimer who will bring the material to the standard required under section 608 (§82.152(g)) of the CAA, if not already reclaimed to those specifications; and

(xiv) A certification of accuracy of the information submitted in the petition.

(3) Starting on the first working day following receipt by the Administrator of a petition to import a used class

I controlled substance, the Administrator will initiate a review of the information submitted under paragraph (g)(2) of this section and take action within 40 working days to issue either an objection-notice or a non-objection notice for the individual shipment to the person who submitted the petition to import the used class I controlled substance.

(i) For the following reasons, the Administrator may issue an objection notice to a petition:

(A) If the Administrator determines that the information is insufficient, that is, if the petition lacks or appears to lack any of the information required under §82.13(g)(2);

(B) If the Administrator determines that any portion of the petition contains false or misleading information, or the Administrator has information from other U.S. or foreign government agencies indicating that the petition contains false or misleading information;

(C) If the importer wishes to import a used class I controlled substance from a country which is, for that particular controlled substance, out of compliance regarding its phaseout obligations under the Protocol or the transaction in the petition is contrary to other provisions in the Vienna Convention or the Montreal Protocol;

(D) If the appropriate government agency in the exporting country has not agreed to issue an export license for the cited individual shipment of used controlled substance;

(E) If allowing the import of the used class I controlled substance would run counter to government restrictions from either the country of recovery or export regarding controlled ozone-depleting substances;

(F) If reclamation capacity is installed or is being installed for that specific controlled substance in the country of recovery or country of export and the capacity is funded in full or in part through the Multilateral Fund.

(ii) Within ten (10) working days after receipt of the objection notice, the importer may re-petition the Administrator, only if the Administrator indicated “insufficient information” as the basis for the objection notice. If no appeal is taken by the tenth working day after the date on the objection notice, the objection shall become final. Only one appeal of re-petition will be accepted for any petition received by EPA.

(iii) Any information contained in the re-petition which is inconsistent with the original petition must be identified and a description of the reason for the inconsistency must accompany the re-petition.

(iv) In cases where the Administrator does not object to the petition based on the criteria listed in paragraph (g)(3)(i) of this section, the Administrator will issue a non-objection notice.

(v) To pass the approved used class I controlled substances through U.S. Customs, the petition and the non-objection notice issued by EPA must accompany the shipment through U.S. Customs.

(vi) If for some reason, following EPA’s issuance of a non-objection notice, new information is brought to EPA’s attention which shows that the non-objection

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notice was issued based on false information, then EPA has the right to:

- (A) Revoke the non-objection notice;
 - (B) Pursue all means to ensure that the controlled substance is not imported into the United States; and
 - (C) Take appropriate enforcement actions.
- (vii) Once the Administrator issues a non-objection notice, the person receiving the non-objection notice is required to import the individual shipment of used class I controlled substance within the same control period as the date stamped on the non-objection notice.
- (viii) A person receiving a non-objection notice from the Administrator for a petition to import used class I controlled substances must maintain the following records:
- (A) a copy of the petition;
 - (B) the EPA non-objection notice;
 - (C) the bill of lading for the import; and
 - (D) U.S. Customs entry documents for the import that must include one of the commodity codes from Appendix K to this subpart.
- (4) **Reporting Requirements—Importers.** For each quarter, except as specified below, every importer of a class I controlled substance (including importers of used, recycled or reclaimed controlled substances) must submit to the Administrator a report containing the following information:
- (i) Summaries of the records required in paragraphs (g)(1) (i) through (xvi) of this section for the previous quarter;
 - (ii) The total quantity imported in kilograms of each controlled substance for that quarter;
 - (iii) The quantity of those controlled substances imported that are used controlled substances.
 - (iv) The levels of import (expended consumption allowances before January 1, 1996) of controlled substances for that quarter and totaled by chemical for the control-period-to-date;
 - (vii) The importer's total sum of expended and unexpended consumption allowances by chemical as of the end of that quarter and the total sum of expended and unexpended critical use allowances (pre-plant) and unexpended critical use allowances (post-harvest) and critical stock allowances;
 - (viii) The amount of controlled substances imported for use in processes resulting in their transformation or destruction;
 - (ix) The amount of controlled substances sold or transferred during the quarter to each person for use in processes resulting in their transformation or eventual destruction;
 - (x) The amount of controlled substances sold or transferred during the quarter to each person for an essential use;
 - (xi) The amount of controlled substances imported with destruction and transformation credits;
 - (xii) Internal Revenue Service Certificates showing that the purchaser or recipient of imported controlled substances intends to transform those substances or

destruction verifications (as in §82.13(k)) showing that purchaser or recipient intends to destroy the controlled substances; and

(xiii) The certifications from essential-use allowance holders stating that the controlled substances were purchased solely for specified essential-uses and will not be resold or used in manufacturing; and the certifications from distributors of laboratory supplies that the controlled substances were purchased solely for eventual sale to laboratories that certify the controlled substances are for essential laboratory and analytical uses (defined at appendix G of this subpart), or if sales are made directly to laboratories, certifications from laboratories that the controlled substances will only be used for essential laboratory and analytical uses (defined at appendix G of this subpart) and will not be resold or used in manufacturing.

(xiv) In the case of laboratory essential uses, a certification from distributors of laboratory supplies that controlled substances were purchased for sale to laboratory customers who certify that the substances will only be used for laboratory applications and will not be resold or used in manufacturing; and

(xv) The amount of class I, Group VI controlled substance sold or transferred during the quarter to a person other than the importer solely for quarantine and preshipment applications;

(xvi) A list of the quantities of class I, Group VI controlled substances exported by the importer and or by other U.S. companies, to a Party to the Protocol that will be used solely for quarantine and preshipment applications and therefore were not imported expending consumption allowances; and

(xvii) For quarantine and preshipment applications of class I, Group VI controlled substances in the United States or by a person of another Party, one copy of a certification that the material will be used only for quarantine and preshipment applications in accordance with the definitions in this subpart from each recipient of the material and a list of additional quantities shipped to that same person for the quarter.

(xviii) For critical uses of class I, Group VI controlled substances, importers shall report annually the amount of critical use methyl bromide owned by the reporting entity, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, as well as quantities held by the reporting entity on behalf of another entity, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use along with the name of the entity on whose behalf the material is held.

(xix) Importers shall report annually the amount of methyl bromide produced or imported prior to the January 1, 2005, phaseout date owned by the reporting entity, as well as quantities held by the reporting entity on behalf of another entity, specifying the name of the entity on whose behalf the material is held.

(h) **Reporting Requirements—Exporters.** (1) For any exports of class I controlled substances (except Group VI) not reported under §82.10 of this subpart (additional consumption allowances), or under paragraph (f)(3) of

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this section (reporting for producers of controlled substances), the exporter who exported a class I controlled substance (except Group VI) must submit to the Administrator the following information within 45 days after the end of the control period in which the unreported exports left the United States:

- (i) The names and addresses of the exporter and the recipient of the exports;
- (ii) The exporter's Employee Identification Number;
- (iii) The type and quantity of each controlled substance exported and what percentage, if any, of the controlled substance is used, recycled or reclaimed;
- (iv) The date on which, and the port from which, the controlled substances were exported from the United States or its territories;
- (v) The country to which the controlled substances were exported;
- (vi) The amount exported to each Article 5 country;
- (vii) The commodity code of the controlled substance shipped; and
- (viii) The invoice or sales agreement containing language similar to the Internal Revenue Service Certificate that the purchaser or recipient of imported controlled substances intends to transform those substances, or destruction verifications (as in paragraph(k) of this section) showing that the purchaser or recipient intends to destroy the controlled substances.

(2) For any exports of class I, Group VI controlled substances not reported under §82.10 of this subpart (additional consumption allowances), or under paragraph (f)(3) of this section (reporting for producers of controlled substances), the exporter who exported a class I, Group VI controlled substance must submit to the Administrator the following information within 45 days after the end of each quarter in which the unreported exports left the United States:

- (i) The names and addresses of the exporter and the recipient of the exports;
- (ii) The exporter's Employee Identification Number;
- (iii) The type and quantity of each controlled substance exported and what percentage, if any, of the controlled substance is used, recycled or reclaimed;
- (iv) The date on which, and the port from which, the controlled substances were exported from the United States or its territories;
- (v) The country to which the controlled substances were exported;
- (vi) The amount exported to each Article 5 country;
- (vii) The commodity code of the controlled substance shipped; and
- (viii) The invoice or sales agreement containing language similar to the Internal Revenue Service Certificate that the purchaser or recipient of imported controlled substances intends to transform those substances, the destruction verifications (as in paragraph (k) of this section) showing that the purchaser or recipient intends to destroy the controlled substances, or the certification that the purchaser or recipient and the eventual applicator will only use the material for quar-

antine and preshipment applications in accordance with the definitions in this subpart.

(i) Every person who has requested additional production allowances under §82.9(e) of this subpart or destruction and transformation credits under §82.9(f) of this subpart or consumption allowances under §82.10(b) of this subpart or who transforms or destroys class I controlled substances not produced or imported by that person must maintain the following:

- (1) Dated records of the quantity and level of each controlled substance transformed or destroyed;
- (2) Copies of the invoices or receipts documenting the sale or transfer of the controlled substance to the person;
- (3) In the case where those controlled substances are transformed, dated records of the names, commercial use, and quantities of the resulting chemical(s);
- (4) In the case where those controlled substances are transformed, dated records of shipments to purchasers of the resulting chemical(s);
- (5) Dated records of all shipments of controlled substances received by the person, and the identity of the producer or importer of the controlled substances;
- (6) Dated records of inventories of controlled substances at each plant on the first day of each quarter; and

(7) A copy of the person's IRS certification of intent to transform or the purchaser's or recipient's destruction verification of intent to destroy (as under §82.13(k)), in the case where substances were purchased or transferred for transformation or destruction purposes.

(j) Persons who destroy class I controlled substances shall, following promulgation of this rule, provide EPA with a one-time report stating the destruction unit's destruction efficiency and the methods used to record the volume destroyed and those used to determine destruction efficiency and the name of other relevant federal or state regulations that may apply to the destruction process. Any changes to the unit's destruction efficiency or methods used to record volume destroyed and to determine destruction efficiency must be reflected in a revision to this report to be submitted to EPA within 60 days of the change.

(k) Persons who purchase or receive and subsequently destroy controlled class I substances that were originally produced without expending allowances shall provide the producer or importer from whom they purchased or received the controlled substances with a verification that controlled substances will be used in processes that result in their destruction.

(1) The destruction verification shall include the following:

- (i) Identity and address of the person intending to destroy controlled substances;
- (ii) Indication of whether those controlled substances will be completely destroyed, as defined in §82.3 of this rule, or less than completely destroyed, in which case the destruction efficiency at which such substances will be destroyed must be included;

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(iii) Period of time over which the person intends to destroy controlled substances; and

(iv) Signature of the verifying person.

(2) If, at any time, any aspects of this verification change, the person must submit a revised verification reflecting such changes to the producer from whom that person purchases controlled substances intended for destruction.

(l) Persons who purchase class I controlled substances and who subsequently transform such controlled substances shall provide the producer or importer with the IRS certification that the controlled substances are to be used in processes resulting in their transformation.

(m) Any person who transforms or destroys class I controlled substances who has submitted an IRS certificate of intent to transform or a destruction verification (as under paragraph (k) of this section) to the producer or importer of the controlled substance, must report the names and quantities of class I controlled substances transformed and destroyed for each control period within 45 days of the end of such control period.

(n) Persons who import or export used controlled substances (including recycled or reclaimed) must label their bill of lading or invoice indicating that the controlled substance is used, recycled or reclaimed.

(o) Persons who import heels of controlled substances must label their bill of lading or invoice indicating that the controlled substance in the container is a heel.

(p) Every person who brings back a container with a heel to the United States, as defined in §82.3, must report quarterly the amount brought into the United States certifying that the residual amount in each shipment is less than 10 percent of the volume of the container and will either:

(1) Remain in the container and be included in a future shipment;

(2) Be recovered and transformed;

(3) Be recovered and destroyed; or

(4) Be recovered for a non-emissive use.

(q) Every person who brings a container with a heel into the United States must report on the final disposition of each shipment within 45 days of the end of the control period.

(r) Every person who transships a controlled substance must maintain records that indicate that the controlled substance shipment originated in a foreign country destined for another foreign country, and does not enter interstate commerce with the United States.

(s) Any person allocated essential-use allowances who submits an order to a producer or importer for a controlled substance must report the quarterly quantity received from each producer or importer.

(t) Any distributor of laboratory supplies receiving controlled substances under the global laboratory essential-use exemption for sale to laboratory customers must report quarterly the quantity received of each controlled substance from each producer or importer.

(u) Holders of Essential-Use Allowances—Reporting.

(1) Within 30 days of the end of every quarter, any person allocated essential-use allowances must submit

to the Administrator a report containing the quantity of each controlled substance, in kilograms, purchased and received from each producer and each importer during that quarter as well as from which country the controlled substance was imported.

(2) Any person allocated essential-use allowances must submit to the Administrator a report containing the following information within 30 days of the end of the control period, and, if possible, within 20 days of the end of the control period:

(i) The gross quantity of each controlled substance, in kilograms, that was used for the essential use during the control period; and

(ii) The quantity of each controlled substance, in kilograms, contained in exported products during the control period; and

(iii) The quantity of each controlled substance, in kilograms, that was destroyed or recycled during the control period; and

(iv) The quantity of each controlled substance, in kilograms, held in inventory as of the last day of the control period, that was acquired with essential use allowances in all control periods (*i.e.* quantity on hand at the end of the year); and

(v) The quantity of each controlled substance, in kilograms, in a stockpile that is owned by the company or is being held on behalf of the company under contract, and was produced or imported through the use of production allowances and consumption allowances prior to the phaseout (*i.e.* class I ODSs produced before their phase-out dates); and

(vi) For essential use allowances for metered-dose inhalers only, the allowance holder must report the total number of marketable units of each specific metered-dose inhaler product manufactured in the control period.

(v) Any distributor of laboratory supplies who purchased controlled substances under the global essential laboratory and analytical use exemption must submit quarterly (except distributors following procedures in paragraph (x) of this section) the quantity of each controlled substance purchased by each laboratory customer whose certification was previously provided to the distributor pursuant to paragraph (w) of this section.

(w) A laboratory customer purchasing a controlled substance under the global essential laboratory and analytical use exemption must provide the producer, importer or distributor with a one-time per-year certification for each controlled substance that the substance will only be used for essential laboratory and analytical uses (defined at appendix G of this subpart) and not be resold or used in manufacturing.

(1) The identity and address of the laboratory customer;

(2) The name and phone number of a contact person for the laboratory customer;

(3) The name and quantity of each controlled substance purchased, and the estimated percent of the controlled substance that will be used for each listed type of laboratory application.

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(x) Any distributor of laboratory supplies who purchased class I controlled substances under the global essential laboratory and analytical use exemption, and who only sells the class I controlled substances as reference standards for calibrating laboratory analytical equipment, may write a letter to the Administrator requesting permission to submit the reports required under paragraph (v) of this section annually rather than quarterly. The Administrator will review the request and issue a notification of permission to file annual reports if, in the Administrator's judgment, the distributor meets the requirements of this paragraph. Upon receipt of a notification of extension from the Administrator, the distributor must submit annually the quantity of each controlled substance purchased by each laboratory customer whose certification was previously provided to the distributor pursuant to paragraph (w) of this section.

(y) Every distributor of methyl bromide (class I, Group VI controlled substances) who purchases or receives a quantity produced or imported solely for quarantine and preshipment applications under the exemptions in this subpart must comply with recordkeeping and reporting requirements specified in this paragraph (aa) of this section.

(1) Every distributor of methyl bromide must certify to the producer or importer that quantities received that were produced or imported solely for quarantine and preshipment applications under the exemptions in this subpart will be used only for quarantine applications or preshipment applications in accordance with the definitions in this subpart.

(2) Every distributor of a quantity of methyl bromide that was produced or imported solely for quarantine or preshipment applications under the exemptions in this subpart must receive from an applicator a certification of the quantity of class I, Group VI controlled substances ordered, prior to delivery of the quantity, stating that the quantity will be used solely for quarantine or preshipment applications in accordance with definitions in this subpart.

(3) Every distributor of methyl bromide who receives a certification from an applicator that the quantity ordered and delivered will be used solely for quarantine and preshipment applications in accordance with definitions in this subpart must maintain the certifications as records for 3 years.

(4) Every distributor of methyl bromide who receives a certification from an applicator that the quantity ordered and delivered will be used solely for quarantine and preshipment applications in accordance with definitions in this subpart must report to the Administrator within 45 days after the end of each quarter, the total quantity delivered for which certifications were received that stated the class I, Group VI controlled substance would be used solely for quarantine and preshipment applications in accordance with definitions in this Subpart.

(z) Every applicator of class I, Group VI controlled substances who purchases or receives a quantity produced or imported solely for quarantine and preshipment applications under the exemptions in this

subpart must comply with recordkeeping and reporting requirements specified in this paragraph (bb) of this section.

(1) Recordkeeping—Applicators. Every applicator of class I, Group VI controlled substances produced or imported solely for quarantine and preshipment applications under the exemptions of this subpart must maintain, for every application, a document from the commodity owner, shipper or their agent requesting the use of class I, Group VI controlled substances citing the regulatory requirement that justifies its use in accordance with definitions in this subpart. These documents shall be retained for 3 years.

(2) Reporting—Applicators. Every applicator of class I, Group VI controlled substances who purchases or receives a quantity of class I, Group VI controlled substance that was produced or imported solely for quarantine and preshipment applications under the exemptions in this subpart shall provide the distributor of the methyl bromide, prior to shipment of the class I, Group VI controlled substance, with a certification that the quantity of controlled substances will be used only for quarantine and preshipment applications as defined in this subpart.

(aa) Every commodity owner, shipper or their agent requesting an applicator to use a quantity of class I, Group VI controlled substance that was produced or imported solely for quarantine and preshipment applications under the exemptions of this subpart must maintain a record for 3 years, for each request, certifying knowledge of the requirements associated with the exemption for quarantine and preshipment applications in this subpart and citing the regulatory requirement that justifies the use of the class I, Group VI controlled substance in accordance with definitions in this subpart. The record must include the following statement: "I certify knowledge of the requirements associated with the exempted quarantine and preshipment applications published in 40 CFR part 82, including the requirement that this letter cite the treatments or official controls for quarantine applications or the official requirements for preshipment requirements."

(bb) Every distributor of methyl bromide (class I, Group VI controlled substances) who purchases or receives a quantity of critical use methyl bromide must comply with recordkeeping and reporting requirements specified in this paragraph (bb).

(1) Recordkeeping—Every distributor of critical use methyl bromide must certify to the producer or importer or other entity from which they are acquiring quantities of critical use methyl bromide that such quantities received will be sold or used only for approved critical use(s) in accordance with the definitions and prohibitions in this subpart.

(i) Every distributor of a quantity of critical use methyl bromide must receive from an applicator, or any other entity to whom they sell critical use methyl bromide, a certification of the quantity of critical use methyl bromide ordered, prior to delivery of the quantity, stating that the quantity will be sold or used only for approved critical uses in accordance with definitions and prohibitions in this subpart.

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(ii) Every distributor of methyl bromide who receives a certification from an applicator or any other entity to which they sell critical use methyl bromide must maintain the certifications as records for 3 years.

(iii) Every distributor of a quantity of critical use methyl bromide must maintain invoice and order records related to the sale of such material for 3 years.

(2) Reporting—Every distributor of critical use methyl bromide must report to the Administrator annually, the following items:

(i) For critical uses of class I, Group VI controlled substances, an annual list of the amount of critical use methyl bromide bought;

(ii) For critical uses of class I, Group VI controlled substances, an annual list of the amount of critical use methyl bromide sold for each specified critical use in Appendix L of this subpart;

(iii) For critical uses of class I, Group VI controlled substances, report the amount of critical use methyl bromide owned by the reporting entity, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, as well as quantities held by the reporting entity on behalf of another entity, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, along with the name of the entity on whose behalf the material is held;

(iv) The number of unexpended and expended critical stock allowances;

(v) The amount of methyl bromide produced or imported prior to the January 1, 2005, phaseout date owned by the reporting entity, as well as quantities held by the reporting entity on behalf of another entity, specifying the name of the entity on whose behalf the material is held.

(cc) Every third party applicator of methyl bromide (class I, Group VI controlled substances) that purchases or receives critical use methyl bromide must comply with recordkeeping and reporting requirements specified in this paragraph (cc).

(1) Recordkeeping—Every third party applicator of critical use methyl bromide must certify to the producer or importer or other entity from which they are acquiring quantities of critical use methyl bromide that such quantities received will be sold or used only for approved critical use(s) in accordance with the definitions and prohibitions in this subpart.

(i) Every third party applicator of a quantity of critical use methyl bromide must receive from any entity to whom they sell critical use methyl bromide, a certification of the quantity of critical use methyl bromide ordered, prior to delivery of the quantity, stating that the quantity will be sold or used only for approved critical uses in accordance with definitions and prohibitions in this subpart.

(ii) Every third party applicator of methyl bromide who receives a certification from an entity to which they sell critical use methyl bromide must maintain the certifications as records for 3 years.

(iii) Every third party applicator of a quantity of critical use methyl bromide must maintain invoice and order records related to the sale of such material for 3 years.

(2) Reporting—Every third party applicator of critical use methyl bromide must report to the Administrator annually, the following items:

(i) For critical uses of class I, Group VI controlled substances, an annual list of the amount of critical use methyl bromide bought;

(ii) For critical uses of class I, Group VI controlled substances, an annual list of the amount of critical use methyl bromide sold for each specified critical use in Appendix L of this subpart;

(iii) For critical uses of class I, Group VI controlled substances, report annually the amount of critical use methyl bromide owned by the reporting entity, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, as well as quantities held by the reporting entity on behalf of another entity, specifying quantities dedicated for pre-plant use and quantities dedicated for post-harvest use, along with the name of the entity on whose behalf the material is held;

(iv) The number of unexpended and expended critical stock allowances;

(v) The amount of methyl bromide produced or imported prior to the January 1, 2005 phaseout date owned by the reporting entity, as well as quantities held by the reporting entity on behalf of another entity, specifying the name of the entity on whose behalf the material is held.

(dd) Every approved critical user purchasing an amount of critical use methyl bromide or purchasing fumigation services with critical use methyl bromide must, for each request, identify the use as a critical use and certify being an approved critical user. The approved critical user certification will state, in part: "I certify, under penalty of law, I am an approved critical user and I will use this quantity of methyl bromide for an approved critical use. My action conforms to the requirements associated with the critical use exemption published in 40 CFR part 82. I am aware that any agricultural commodity within a treatment chamber, facility or field I fumigate with critical use methyl bromide cannot subsequently or concurrently be fumigated with non-critical use methyl bromide during the same control period, excepting a QPS treatment or a treatment for a different use (e.g., a different crop or commodity). I will not use this quantity of methyl bromide for a treatment chamber, facility, or field that I previously fumigated with non-critical use methyl bromide during the same control period, excepting a QPS treatment or a treatment for a different use (e.g., a different crop or commodity), unless a local township limit now prevents me from using methyl bromide alternatives or I have now become an approved critical user as a result of rulemaking." The certification will also identify the type of critical use methyl bromide purchased, the location of the treatment, the crop or commodity treated, the quantity of critical use methyl bromide purchased, and the acreage/square footage treated, and will be signed and dated by the approved critical user.

§82.15 Prohibitions for class II controlled substances.

(a) *Production.* (1) Effective January 21, 2003, no person may produce class II controlled substances in excess of the quantity of unexpended production allowances,

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unexpended Article 5 allowances, unexpended export production allowances, or conferred unexpended HCFC-141b exemption allowances held by that person for that substance under the authority of this subpart at that time in that control period, unless the substances are transformed or destroyed domestically or by a person of another Party, or unless they are produced using an exemption granted in paragraph (f) of this section. Every kilogram of excess production constitutes a separate violation of this subpart.

(2) Effective January 21, 2003, no person may use production allowances to produce a quantity of class II controlled substance unless that person holds under the authority of this subpart at the same time consumption allowances sufficient to cover that quantity of class II controlled substances. No person may use consumption allowances to produce a quantity of class II controlled substances unless the person holds under authority of this subpart at the same time production allowances sufficient to cover that quantity of class II controlled substances.

(b) *Import.* (1) Effective January 21, 2003, no person may import class II controlled substances (other than transshipments, heels or used class II controlled substances), in excess of the quantity of unexpended consumption allowances, or conferred unexpended HCFC-141b exemption allowances held by that person under the authority of this subpart at that time in that control period, unless the substances are for use in a process resulting in their transformation or their destruction, or unless they are produced using an exemption granted in paragraph (f) of this section. Every kilogram of excess import constitutes a separate violation of this subpart.

(2) Effective January 21, 2003, no person may import, at any time in any control period, a used class II controlled substance, without having submitted a petition to the Administrator and received a non-objection notice in accordance with §82.24(c)(3) and (4). A person issued a non-objection notice for the import of an individual shipment of used class II controlled substances may not transfer or confer the right to import, and may not import any more than the exact quantity (in kilograms) of the used class II controlled substance stated in the non-objection notice. Every kilogram of import of used class II controlled substance in excess of the quantity stated in the non-objection notice issued by the Administrator in accordance with §82.24(c)(3) and (4) constitutes a separate violation of this subpart.

(c) *Production with Article 5 allowances.* No person may introduce into U.S. interstate commerce any class II controlled substance produced with Article 5 allowances, except for export to an Article 5 Party as listed in Annex 4 of Appendix C of this subpart. Every kilogram of a class II controlled substance produced with Article 5 allowances that is introduced into interstate commerce other than for export to an Article 5 Party constitutes a separate violation under this subpart. No person may export any class II controlled substance produced with Article 5 allowances to a non-Article 5 Party. Every kilogram of a class II controlled substance that was produced with Article 5 allowances that is exported to a non-Article

5 Party constitutes a separate violation under this subpart.

(d) *Production with export production allowances.* No person may introduce into U.S. interstate commerce any class II controlled substance produced with export production allowances. Every kilogram of a class II controlled substance that was produced with export production allowances that is introduced into U.S. interstate commerce constitutes a separate violation under this subpart.

(e) *Trade with Parties.* No person may import or export any quantity of a class II controlled substance listed in Appendix A to this subpart, from or to any foreign state that is not either:

(1) A Party to the Montreal Protocol that has ratified the Beijing Amendments. Parties that have ratified the Beijing Amendments as of June 17, 2004 are listed in Annex 1 to Appendix C of this subpart. Or,

(2) A Party to the Montreal Protocol that has provided notice, certification, and data in accordance with Decision XV/3(c)(i), (ii), and (iii) respectively, to the Ozone Secretariat. A list of Parties that have provided notice, certification and data in accordance with Decision XV/3(c)(i), (ii), and (iii) respectively, by June 17, 2004 can be found in Annex 3 to Appendix C of this subpart and on a list maintained by the Ozone Secretariat. Or,

(3) A Party to the Montreal Protocol operating under Article 5(1) to the Montreal Protocol. A list of Parties operating under Article 5(1) to the Montreal Protocol as of June 17, 2004 can be found in Annex 4 to Appendix C of this subpart.

(f) *Exemptions.* (1) Medical Devices [Reserved]

(g) Introduction into interstate commerce or use.

(g)(1) Effective January 1, 2010, no person may introduce into interstate commerce or use HCFC-141b (unless used, recovered, and recycled) for any purpose except for use in a process resulting in its transformation or its destruction; for export to Article 5 Parties under §82.18(a); for HCFC-141b exemption needs; as a transshipment or heel; or for exemptions permitted in paragraph (f) of this section.

(g)(2)(i) Effective January 1, 2010, no person may introduce into interstate commerce or use HCFC-22 or HCFC-142b (unless used, recovered, and recycled) for any purpose other than for use in a process resulting in its transformation or its destruction; for use as a refrigerant in equipment manufactured before January 1, 2010; for export to Article 5 Parties under §82.18(a); as a transshipment or heel; or for exemptions permitted in paragraph (f) of this section.

(g)(2)(ii) Introduction into interstate commerce and use of HCFC-22 is not subject to the prohibitions in paragraph (g)(2)(i) of this section if the HCFC-22 is for use in medical equipment prior to January 1, 2015; for use in thermostatic expansion valves prior to January 1, 2015; or for use as a refrigerant in appliances manufactured before January 1, 2012, provided that the components are manufactured prior to January 1, 2010, and are specified in a building permit or a contract dated before January 1, 2010, for use on a particular project.

(g)(3) Effective January 1, 2015, no person may introduce into interstate commerce or use HCFC-141b (unless

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used, recovered, and recycled) for any purpose other than for use in a process resulting in its transformation or its destruction; for export to Article 5 Parties under §82.18(a), as a transshipment or heel; or for exemptions permitted in paragraph (f) of this section.

(g)(4) Effective January 1, 2015, no person may introduce into interstate commerce or use any class II controlled substance not governed by paragraphs (g)(1) through (3) of this section (unless used, recovered, and recycled) for any purpose other than for use in a process resulting in its transformation or its destruction; for use as a refrigerant in equipment manufactured before January 1, 2020; for export to Article 5 Parties under §82.18(a); as a transshipment or heel; or for exemptions permitted in paragraph (f) of this section.

(g)(5) Effective January 1, 2030, no person may introduce into interstate commerce or use any class II controlled substance (unless used, recovered, and recycled) for any purpose other than for use in a process resulting in its transformation or its destruction; for export to Article 5 Parties under §82.18(a); as a transshipment or heel; or for exemptions permitted in paragraph (f) of this section.

(g)(6) Effective January 1, 2040, no person may introduce into interstate commerce or use any class II controlled substance (unless used, recovered, and recycled) for any purpose other than for use in a process resulting in its transformation or its destruction, as a transshipment or heel, or for exemptions permitted in paragraph (f) of this section.

§82.16 Phaseout schedule of class II controlled substances.

(a) In each control period as indicated in the following table, each person is granted the specified percentage of baseline production allowances and baseline consumption allowances for the specified class II controlled substances apportioned under §§82.17 and 82.19:

Control period	Percent of HCFC-141b	Percent of HCFC-22	Percent of HCFC-142b	Percent of HCFC-123	Percent of HCFC-124	Percent of HCFC-225ca	Percent of HCFC-225cb
2003	0	100	100	.....	.....	.....	.....
2004	0	100	100	.....	.....	.....	.....
2005	0	100	100	.....	.....	.....	.....
2006	0	100	100	.....	.....	.....	.....
2007	0	100	100	.....	.....	.....	.....
2008	0	100	100	.....	.....	.....	.....
2009	0	100	100	.....	.....	.....	.....
2010	0	41.9	0.47	125	125	125	125
2011	0	38.0	0.47	125	125	125	125
2012	0	34.1	0.47	125	125	125	125
2013	0	30.1	0.47	125	125	125	125
2014	0	26.1	0.47	125	125	125	125

(b) Effective January 1, 2003, no person may produce HCFC-141b except for use in a process resulting in its transformation or its destruction, for export under §82.18(a) using unexpended Article 5 allowances, for export under §82.18(b) using unexpended export production allowances, for HCFC-141b exemption needs using unexpended HCFC-141b exemption allowances, or for exemptions permitted in §82.15(f). Effective January 1,

2003, no person may import HCFC-141b (other than transshipments, heels or used class II controlled substances) in excess of the quantity of unexpended HCFC-141b exemption allowances held by that person except for use in a process resulting in its transformation or its destruction, or for exemptions permitted in §82.15(f).

(c) Effective January 1, 2010, no person may produce HCFC-22 or HCFC-142b for any purpose other than for use in a process resulting in their transformation or their destruction, for use in equipment manufactured before January 1, 2010, for export under §82.18(a) using unexpended Article 5 allowances, or for export under §82.18(b) using unexpended export production allowances, or for exemptions permitted in §82.15(f). Effective January 1, 2010, no person may import HCFC-22 or HCFC-142b (other than transshipments, heels or used class II controlled substances) for any purpose other than for use in a process resulting in their transformation or their destruction, for exemptions permitted in §82.15(f), or for use in equipment manufactured prior to January 1, 2010.

(d) Effective January 1, 2015, no person may produce class II controlled substances not previously controlled, for any purpose other than for use in a process resulting in their transformation or their destruction, for use as a refrigerant in equipment manufactured before January 1, 2020, for export under §82.18(a) using unexpended Article 5 allowances, or for export under §82.18(b) using unexpended export production allowances, or for exemptions permitted in §82.15(f). Effective January 1, 2015, no person may import class II controlled substances not subject to the requirements of paragraph (b) or (c) of this section (other than transshipments, heels or used class II controlled substances) for any purpose other than for use in a process resulting in their transformation or their destruction, for exemptions permitted in §82.15(f), or for use as a refrigerant in equipment manufactured prior to January 1, 2020.

(e) Effective January 1, 2020, no person may produce HCFC-22 or HCFC-142b for any purpose other than for use in a process resulting in their transformation or their destruction, for export under §82.18(a) using unexpended Article 5 allowances, or for export under §82.18(b) using unexpended export production allowances, or for exemptions permitted in §82.15(f). Effective January 1, 2020, no person may import HCFC-22 or HCFC-142b for any purpose other than for use in a process resulting in their transformation or their destruction, or for exemptions permitted in §82.15(f).

(f) Effective January 1, 2030, no person may produce class II controlled substances, for any purpose other than for use in a process resulting in their transformation or their destruction, for export under §82.18(a) using unexpended Article 5 allowances, or for exemptions permitted in §82.15(f). Effective January 1, 2030, no person may import class II controlled substances for any purpose other than for use in a process resulting in their transformation or their destruction, or for exemptions permitted in §82.15(f).

(g) Effective January 1, 2040, no person may produce class II controlled substances for any purpose other than

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for use in a process resulting in their transformation or their destruction, or for exemptions permitted in §82.15(f).

(h) Petition for HCFC-141b exemption allowances.

(1) Effective January 21, 2003, a formulator of HCFC-141b, an agency, department, or instrumentality of the U.S., or a non-governmental space vehicle entity, may petition EPA for HCFC-141b exemption allowances for the production or import of HCFC-141b after the phase-out date, in accordance with this section. The petitioner must submit the following information to the Director of EPA's Office of Atmospheric Programs no later than April 21, 2003, for the 2003 control period; and, for any subsequent control period, no later than October 31st of the year preceding the control period for which the HCFC-141b exemption allowances are requested:

(i) Name and address of the HCFC-141b formulator, U.S. government entity or non-governmental space vehicle entity;

(ii) Name of contact person, phone number, fax number and e-mail address;

(iii) Quantity (in kilograms) of HCFC-141b needed for each relevant calendar year, supported by documentation about past use for at least the previous three years;

(iv) Quantities of HCFC-141b, if any, contained in systems that were sold to other systems houses for at least the previous three years;

(v) Description of the markets and applications served by the use of HCFC-141b or systems based on HCFC-141b;

(vi) Technical description of processes in which HCFC-141b is being used;

(vii) Technical description of the specific conditions under which the product will be applied;

(viii) Technical description of why alternatives and substitutes are not sufficient to eliminate the use of HCFC-141b;

(ix) Amount of stockpiled HCFC-141b (on-hand, taken title to, or available from a supplier) along with a detailed analysis showing why stockpiled, recovered or recycled quantities are deemed to be unavailable, or technically or commercially infeasible for use (for example, taking into consideration undue costs for storage and transportation);

(x) An estimate of the number of control periods over which such an exemption would be necessary;

(xi) A detailed description of continuing investigations into and progress on possible alternatives and substitutes;

(xii) A list of alternatives considered, purchased or sampled, including dates and copies of receipts for verification;

(xiii) A summary of the petitioner's in-house development program including summaries of all relevant test results and their significance to subsequent decision-making and technology selection. Full supporting test data must be available on request including alternative tested and date on which it was tested;

(xiv) A clear statement of the preferred technical option(s) being pursued at the time of the petition and the reasoning for this selection;

(xv) A summary of product test results conducted on the preferred technical option(s) by accredited organizations in order to determine whether products meet applicable codes. Relevant test reports and certifications must be made available on request; and

(xvi) A description of the further development testing to be carried out over the number of control periods identified under paragraph (h)(1)(x) of this section.

(2) Within 21 business days of receipt of the petition, the Director of EPA's Office of Atmospheric Programs will issue to a HCFC-141b formulator, agency, department, or instrumentality of the U.S., or non-governmental space vehicle entity that has petitioned for HCFC-141b exemption allowances, based on information received in accordance with paragraph (h)(1) of this section, a notice indicating one of the following:

(i) A determination by the Director of EPA's Office of Atmospheric Programs to grant a specific quantity of HCFC-141b exemption allowances (in kilograms) for the production or import of HCFC-141b in a specified control period based on an assessment that HCFC-141b is necessary to maintain either safety, or operational or technical viability;

(ii) A determination by the Director of EPA's Office of Atmospheric Programs to request additional information because the information received in accordance with paragraph (h)(1) of this section is not sufficient to decide whether to grant or deny HCFC-141b exemption allowances. The Director of EPA's Office of Atmospheric Programs will decide whether to grant or deny HCFC-141b exemption allowances within 30 days of receipt of the additional information. However, if the petitioner fails to submit the additional information within 20 days of the request, such failure constitutes a basis for denying the petition for HCFC-141b exemption allowances.

(iii) A determination by the Director of EPA's Office of Atmospheric Programs to deny a grant of HCFC-141b exemption allowances due to one or more of the following reasons:

(A) The needs can be met by the use of a substance other than HCFC-141b;

(B) The needs can be met by the use of existing supplies of HCFC-141b;

(C) There is evidence of fraud or misrepresentation;

(D) Approval of the HCFC-141b exemption allowances would be inconsistent with U.S. obligations under the provisions of the Montreal Protocol (including Decisions agreed by the Parties);

(E) Approval of the HCFC-141b exemption allowances would be inconsistent with the Clean Air Act;

(F) There is an inadequate demonstration of efforts undertaken to research and implement alternatives; or

(G) Granting the HCFC-141b exemption allowances may reasonably be expected to endanger human health or the environment.

(3) Within ten working days after receipt of a notice outlining a determination by the Director of EPA's Office of Atmospheric Programs to deny a grant of HCFC-141b exemption allowances due to one or more of the reasons in paragraph (h)(2)(iii) of this section, the petitioner may

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file with the Director of EPA's Office of Atmospheric Programs a one-time appeal with elaborated information. The Director of EPA's Office of Atmospheric Programs may affirm the determination to deny a grant of HCFC-141b exemption allowances or make a determination to grant HCFC-141b exemption allowance, in light of the available evidence submitted with the appeal. If no appeal is submitted by the tenth day after receipt of the notice outlining a determination by the Director of EPA's Office of Atmospheric Programs to deny a grant of HCFC-141b exemption allowances, the denial will be final on that day.

(4) Any entity that has previously petitioned for HCFC-141b exemption allowances under paragraph (h)(1) of this section may file a petition for renewal for a subsequent control period by October 31st of the year preceding that control period. The petition for renewal must contain the following information:

(i) Name and address of the HCFC-141b formulator, U.S. government entity or non-governmental space vehicle entity;

(ii) Name of contact person, phone number, fax number and e-mail address;

(iii) Quantity (in kilograms) of HCFC-141b needed for the control period;

(iv) Description of markets and applications being served by the use of HCFC-141b;

(v) A technical description of the process in which HCFC-141b is still being used;

(vi) A technical description of the specific conditions under which the product is still being applied;

(vii) Technical description of why alternatives and substitutes are still not sufficient to eliminate the use of HCFC-141b;

(viii) Amount of stockpiled HCFC-141b (on-hand, taken title to, or available from a supplier) along with a detailed analysis showing why stockpiled, recovered or recycled quantities are deemed to be technically or economically infeasible for use; and

(ix) A detailed description of continuing investigations into and progress on possible alternatives and substitutes and how this activity differs from information given in the previous request.

(5) A person granted HCFC-141b exemption allowances by the Director of EPA's Office of Atmospheric Programs under paragraph (h)(2)(i) or (h)(3) of this section may request a quantity of HCFC-141b be produced or imported in the specified control period listed in the notice by conferring the rights to produce or import to a producer or importer.

(6) The HCFC-141b exemption allowances held by one entity do not automatically transfer to an acquiring entity. Any entity acquiring another company holding HCFC-141b exemption allowances must submit a renewal application in accordance with paragraph (h)(4) of this section at the time of the acquisition in order to qualify for the HCFC-141b exemption allowances.

§82.17 Apportionment of baseline production allowances for class II controlled substances.

Effective January 1, 2010, the following persons are apportioned baseline production allowances for HCFC-22, HCFC-141b, HCFC-142b, HCFC-123, HCFC-124, HCFC-225ca, and HCFC-225cb, as set forth in the following table:

Person	Controlled substance	Allowances(kg)
AGC Chemicals Americas	HCFC-225ca	266,608
	HCFC-225cb	373,952
Arkema	HCFC-22	28,219,223
	HCFC-141b.....	24,647,925
DuPont	HCFC-142b.....	16,131,096
	HCFC-22	42,638,049
Honeywell	HCFC-124.....	2,269,210
	HCFC-22	37,378,252
MDA Manufacturing	HCFC-141b.....	28,705,200
	HCFC-142b.....	2,417,534
Solvay Solexis	HCFC-124.....	1,759,681
	HCFC-22.....	2,383,835
	HCFC-142b.....	6,541,764

§82.18 Availability of production in addition to baseline production allowances for class II controlled substances.

(a) *Article 5 allowances.* Effective January 1, 2003, a person apportioned baseline production allowances for HCFC-141b, HCFC-22, or HCFC-142b under §82.17 is also apportioned Article 5 allowances, equal to 15 percent of their baseline production allowances, for the specified HCFC for each control period up until December 31, 2009, to be used for the production of the specified HCFC for export only to foreign states listed in Annex 4 of Appendix C to this subpart.

(2) Effective January 1, 2010, a person apportioned baseline production allowances under §82.17 for HCFC-141b, HCFC-22, or HCFC-142b is also apportioned Article 5 allowances, equal to 10 percent of their baseline production allowances, for the specified HCFC for each control period up until December 31, 2019, to be used for the production of the specified HCFC for export only to foreign states listed in Annex 4 of Appendix C to this subpart.

(3) Effective January 1, 2015, a person apportioned baseline production allowances under §82.17 for HCFC-123, HCFC-124, HCFC-225ca, and HCFC-225cb is also apportioned Article 5 allowances, equal to 10 percent of their baseline production allowances, for the specified HCFC for each control period up until December 31, 2019, to be used for the production of the specified HCFC for export only to foreign states listed in Annex 4 of Appendix C to this subpart.

(b) *Export production allowances.* (1) Effective January 1, 2003, a person apportioned baseline production allowances for HCFC-141b under §82.17 is also apportioned export production allowances, equal to 100 percent of their baseline production allowances, for HCFC-141b for each control period up until December 31, 2009, to be

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used for the production of HCFC-141b for export only, in accordance with this section.

(2) [Reserved]

(c) *International trades of production allowances, export production allowances and Article 5 allowances.* (1) A person may increase or decrease its production allowances, export production allowances, or Article 5 allowances, for a specified control period through trades with another Party to the Protocol as set forth in this paragraph (c). Effective January 1, 2004, a nation listed either: in Appendix L of this subpart that is also listed in Appendix C, Annex 1 of the Protocol as having ratified the Beijing Amendments, or in Appendix C, Annex 1 of the Protocol as having ratified the Copenhagen Amendments but not listed in Appendix L of this subpart, or in Appendix C, Annex 2 of the Protocol, as being a foreign state complying with the Beijing Amendments if the foreign state is listed in Appendix L of this subpart, or as being a foreign state complying with the Copenhagen Amendments if the foreign state is not listed in Appendix L of this subpart must agree either to trade to the person for the current control period some quantity of production that the nation is permitted under the Montreal Protocol or to receive from the person for the current control period some quantity of production that the person is permitted under this subpart. The person must expend its consumption allowances allocated under §82.19, or obtained under §82.20 in order to produce with the additional production allowances.

(2) *Trade from a Party—Information requirements.* (i) A person requesting a trade from a Party must submit to the Administrator a signed document from the principal diplomatic representative in that nation's embassy in the U.S. stating that the appropriate authority within that nation will establish or revise production limits for the nation to equal the lowest of the following three production quantities:

(A) The maximum production that the nation is allowed under the Protocol minus the quantity (in kilograms) to be traded;

(B) The maximum production that is allowed under the nation's applicable domestic law minus the quantity (in kilograms) to be traded; or

(C) The average of the nation's actual national production level for the three years prior to the trade minus the production to be traded.

(ii) A person requesting a trade from a Party must also submit to the Administrator a true copy of the document that sets forth the following:

(A) The identity and address of the person;

(B) The identity of the Party;

(C) The names and telephone numbers of contact persons for the person and for the Party;

(D) The chemical type and quantity (in kilograms) of production being traded;

(E) Documentation that the Party possesses the necessary quantity of unexpended production rights;

(F) The control period(s) to which the trade applies; and

(G) For increased production intended for export to the Party from whom the allowances would be received, a signed statement of intent to export to the Party.

(3) *Trade to a Party—Information requirements.* A person requesting a trade to a Party must submit a request that sets forth the following information to the Administrator:

(i) The identity and address of the person;

(ii) The identity of the Party;

(iii) The names and telephone numbers of contact persons for the person and for the Party;

(iv) The chemical type and quantity (in kilograms) of allowable production being traded; and

(v) The control period(s) to which the trade applies.

(4) *Review of international trade request to a Party.* After receiving a trade request that meets the requirements of paragraph (c)(3) of this section, the Administrator may, at his/her discretion, consider the following factors by seeking concurrence from the Department of Commerce, the United States Trade Representative, and the Department of State, where appropriate, in deciding whether to approve such a trade:

(i) Possible creation of domestic economic hardship;

(ii) Possible effects on trade;

(iii) Potential environmental implications; and

(iv) The total quantity of unexpended production allowances held by U.S. entities.

(5) *Notice of trade.* If the request meets the requirement of paragraph (c)(2) of this section for trades from Parties and paragraphs (c)(3) and (4) of this section for trades to Parties, the Administrator will issue the person a notice. The notice will either grant or deduct production allowances or export production allowances or Article 5 allowances and specify the control period to which the trade applies. The Administrator may disapprove the trade request contingent on the consideration of factors listed in paragraph (c)(4) of this section for trades to Parties.

(i) For trades from a Party, the Administrator will issue a notice revising the allowances held by the recipient of the trade to equal the unexpended production allowances, unexpended export production allowances, or unexpended Article 5 allowances held by the recipient of the trade under this subpart plus the quantity of allowable production traded from the Party.

(ii) For trades to a Party, the Administrator will issue a notice revising the production limit for the trader to equal the lesser of:

(A) The unexpended production allowances, unexpended export production allowances or unexpended Article 5 allowances held by the trade or minus the quantity traded; or

(B) The unexpended production allowances held by the trader minus the amount by which the U.S. average annual production of the class II controlled substance being traded for the three years prior to the trade is less than the total allowable production of that class II controlled substance under this subpart minus the amount traded; or

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(C) The total U.S. allowable production of the class II controlled substance being traded minus the three-year average of the actual annual U.S. production of the class II controlled substance prior to the control period of the trade.

(6) Revised notices of production limits for subsequent traders. If after one person obtains approval of a trade of allowable production of a class II controlled substance to a Party and other persons obtain approval for trades of the same class II controlled substance during the same control period, the Administrator will issue revised notices. The notices will revise the production limits for each of the other persons trading to equal the lesser of:

(i) The unexpended production allowances, unexpended export production allowances or unexpended Article 5 allowances held by the trader under this subpart minus the quantity traded; or

(ii) The result of the following set of calculations:

(A) The total U.S. allowable production of the class II controlled substance minus the three-year average of the actual annual U.S. production of the class II controlled substance prior to the control period of the trade;

(B) The quantity traded divided by the total quantity traded by all the other persons trading the same class II controlled substance in the same control period;

(C) The result of paragraph (c)(6)(ii)(A) of this section multiplied by the result of paragraph (c)(6)(ii)(B) of this section;

(D) The quantity derived in paragraph (c)(6)(i) of this section, minus the result of paragraph (c)(6)(ii)(C) of this section;

(7) Production limit for previous traders. The Administrator will also issue a notice revising the production limit for each trader who previously obtained approval of a trade of the class II controlled substance to a Party in the same control period to equal the result of the following set of calculations:

(i) The total U.S. allowable production of the class II controlled substance minus the three-year average of the actual annual U.S. production of the class II controlled substance prior to the control period of the trade;

(ii) The quantity traded by the person divided by the quantity traded by all the persons who have traded that class II controlled substance in that control period;

(iii) The result of paragraph (c)(7)(i) of this section multiplied by the result of paragraph (c)(7)(ii) of this section.

(iv) The unexpended production allowances, unexpended export production allowances or unexpended Article 5 allowances held by the person plus the result of paragraph (c)(7)(iii) of this section;

(8) Effective date of revised production limits. The change in production allowances, export production allowances or Article 5 allowances will be effective on the date that the notice is issued.

§82.19 Apportionment of baseline consumption allowances for class II controlled substances.

Effective January 1, 2010, the following persons are apportioned baseline consumption allowances for HCFC-22, HCFC-141b, HCFC-142b, HCFC-123, HCFC-124,

HCFC-225ca, and HCFC-225cb, as set forth in the following table:

Person	Controlled substance	Allowances (kg)
ABCO Refrigeration Supply	HCFC-22.....	279,366
AGC Chemicals Americas.....	HCFC-225ca.....	285,328
	HCFC-225cb.....	286,832
Altair Partners.....	HCFC-22.....	302,011
Arkema	HCFC-22.....	29,524,481
	HCFC-141b.....	25,405,570
	HCFC-142b.....	16,672,675
	HCFC-124	3,719
Carrier	HCFC-22.....	54,088
Condor Products	HCFC-22.....	74,843
	HCFC-124	3,746
Continental Industrial Group	HCFC-141b.....	20,315
Coolgas, Inc	HCFC-141b.....	16,097,869
	HCFC-123	20,000
Coolgas Investment Property.....	HCFC-22.....	590,737
Discount Refrigerants	HCFC-22.....	375,328
	HCFC-141b.....	994
DuPont.....	HCFC-22.....	38,814,862
	HCFC-141b.....	9,049
	HCFC-142b.....	52,797
	HCFC-123	1,877,042
	HCFC-124	743,312
H.G. Refrigeration Supply	HCFC-22.....	40,068
Honeywell.....	HCFC-22.....	35,392,492
	HCFC-141b.....	20,749,489
	HCFC-142b.....	1,315,819
	HCFC-124	1,284,265
ICC Chemical Corp ...	HCFC-141b.....	81,225
ICOR.....	HCFC-124	81,220
Ineos Fluor Americas ..	HCFC-22.....	2,546,305
Kivlan & Company	HCFC-22.....	2,081,018
MDA Manufacturing....	HCFC-22.....	2,541,545
Mondy Global	HCFC-22.....	281,824
National Refrigerants ..	HCFC-22.....	5,528,316
	HCFC-123	72,600
	HCFC-124	50,380
Perfect Technology Center, LP	HCFC-123	9,100
Refricenter of Miami ..	HCFC-22.....	381,293
Refricentro	HCFC-22.....	45,979
R-Lines	HCFC-22.....	63,172
Saez Distributors.....	HCFC-22.....	37,936
Solvay Fluorides	HCFC-22.....	413,509
	HCFC-141b.....	3,940,115
Solvay Solexis	HCFC-142b.....	3,047,386
Tulstar Products	HCFC-141b.....	89,913
	HCFC-123	34,800
	HCFC-124	229,582
A Refrigerants.....	HCFC-22.....	14,865

§82.20 Availability of consumption allowances in addition to baseline consumption allowances for class II controlled substances.

(a) A person may obtain at any time during the control period, in accordance with the provisions of this section, consumption allowances equivalent to the quantity of class II controlled substances that the person exported from the U.S. and its territories to a foreign state, in

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accordance with this section, when that quantity of class II controlled substance was produced in the U.S. with expended consumption allowances.

(1) The exporter must submit to the Administrator a request for consumption allowances setting forth the following:

- (i) The identities and addresses of the exporter and the recipient of the exports;
- (ii) The exporter's Employer Identification Number;
- (iii) The names and telephone numbers of contact persons for the exporter and the recipient;
- (iv) The quantity (in kilograms) and type of class II controlled substances reported;
- (v) The source of the class II controlled substances and the date purchased;
- (vi) The date on which, and the port from which, the class II controlled substances were exported from the U.S. or its territories;
- (vii) The country to which the class II controlled substances were exported;
- (viii) A copy of the bill of lading and the invoice indicating the net quantity (in kilograms) of class II controlled substances shipped and documenting the sale of the class II controlled substances to the purchaser;
- (ix) The commodity codes of the class II controlled substances reported; and
- (x) A written statement from the producer that the class II controlled substances were produced with expended allowances.

(2) The Administrator will review the information and documentation submitted under paragraph (a)(1) of this section and will issue a notice.

(i) The Administrator will determine the quantity of class II controlled substances that the documentation verifies was exported and issue consumption allowances equivalent to the quantity of class II controlled substances that were exported.

(A) The grant of the consumption allowances will be effective on the date the notice is issued.

(B) The consumption allowances will be granted to the person the exporter indicates, whether it is the producer or the exporter.

(ii) The Administrator will issue a notice that the consumption allowances are not granted if the Administrator determines that the information and documentation do not satisfactorily substantiate the exporter's claims.

(b) *International trades of consumption allowances.* (1) A person may increase its consumption allowances for a specified control period through trades with another Party to the Protocol as set forth in this paragraph (b). A person may only receive consumption from Poland or Norway, or both, and only if the nation agrees to trade to the person for the current control period some quantity of consumption that the nation is permitted under the Montreal Protocol.

(2) Trade from a Party—Information requirements. A person must submit the following information to the Administrator:

(i) A signed document from the principal diplomatic representative in the Polish or Norwegian embassy in the U.S. stating that the appropriate authority within that nation will establish or revise consumption limits for the nation to equal the lowest of the following three consumption quantities:

(A) The maximum consumption that the nation is allowed under the Protocol minus the quantity (in kilograms) traded;

(B) The maximum consumption that is allowed under the nation's applicable domestic law minus the quantity (in kilograms) traded; or

(C) The average of the nation's actual consumption level for the three years prior to the trade minus the consumption traded.

(ii) A person requesting a consumption trade from Poland or Norway must also submit to the Administrator a true copy of the document that sets forth the following:

(A) The identity and address of the person;

(B) The identity of the Party;

(C) The names and telephone numbers of contact persons for the person and for the Party;

(D) The chemical type and quantity (in kilograms) of consumption being traded;

(E) Documentation that the Party possesses the necessary quantity of unexpended consumption rights;

(F) The control period(s) to which the trade applies; and

(3) *Notice of trade.* If the request meets the requirement of paragraph (b)(2) of this section for trades from Parties, the Administrator will issue the person a notice. The notice will grant consumption allowances and specify the control period to which the trade applies. The Administrator may disapprove the trade request if it does not meet the requirements of paragraph (b)(2) of this section.

(4) *Trade from a Party.* The Administrator will issue a notice revising the allowances held by the recipient of the trade to equal the unexpended consumption allowances held by the recipient of the trade under this subpart plus the quantity of allowable consumption traded from the Party.

(5) *Effective date of revised consumption limits.* The change in consumption allowances will be effective on the date that the notice is issued.

§§82.21-82.22 [Reserved]

§82.23 Transfers of allowances of class II controlled substances.

(a) *Inter-company transfers.* Effective January 1, 2003, a person ("transferor") may transfer to any other person ("transferee") any quantity of the transferor's class II consumption allowances, production allowances, export production allowances, or Article 5 allowances for the same type of allowance as follows:

(i) The transferor must submit to the Administrator a transfer claim setting forth the following:

(A) The identities and addresses of the transferor and the transferee;

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(B) The name and telephone numbers of contact persons for the transferor and the transferee;

(C) The type of allowances being transferred, including the names of the class II controlled substances for which allowances are to be transferred;

(D) The quantity (in kilograms) of allowances being transferred;

(E) The control period(s) for which the allowances are being transferred;

(F) The quantity of unexpended allowances of the type and for the control period being transferred that the transferor holds under authority of this subpart on the date the claim is submitted to EPA; and

(G) For trades of consumption allowances, production allowances, export production allowances, or Article 5 allowances, the quantity of the 0.1 percent offset applied to the unweighted quantity traded that will be deducted from the transferor's allowance balance.

(ii) The Administrator will determine whether the records maintained by EPA indicate that the transferor possesses unexpended allowances sufficient to cover the transfer claim on the date the transfer claim is processed. The transfer claim is the quantity (in kilograms) to be transferred plus, in the case of transfers of production or consumption allowances, 0.1 percent of that quantity. The Administrator will take into account any previous transfers, any production, and allowable imports and exports of class II controlled substances reported by the transferor. Within three working days of receiving a complete transfer claim, the Administrator will take action to notify the transferor and transferee as follows:

(A) The Administrator will issue a notice indicating that EPA does not object to the transfer if EPA's records show that the transferor has sufficient unexpended allowances to cover the transfer claim. In the case of transfers of production or consumption allowances, EPA will reduce the transferor's balance of unexpended allowances by the quantity to be transferred plus 0.1 percent of that quantity. In the case of transfers of export production or Article 5 allowances, EPA will reduce the transferor's balance of unexpended allowances, respectively, by the quantity to be transferred. The transferor and the transferee may proceed with the transfer when EPA issues a no objection notice. However, if EPA ultimately finds that the transferor did not have sufficient unexpended allowances to cover the claim, the transferor and transferee, where applicable, will be held liable for any knowing violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer.

(B) The Administrator will issue a notice disallowing the transfer if EPA's records show that the transferor has insufficient unexpended allowances to cover the transfer claim, or that the transferor has failed to respond to one or more Agency requests to supply information needed to make a determination. Either party may file a notice of appeal, with supporting reasons, with the Administrator within 10 working days after receipt of notification. The Administrator may affirm or vacate the disallowance. If no appeal is taken by the tenth working day after notification, the disallowance shall be final on that day.

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(iii) The transferor and transferee may proceed with the transfer if the Administrator does not respond to a transfer claim within the three working days specified in paragraph (a)(1)(ii) of this section. In the case of transfers of production or consumption allowances, EPA will reduce the transferor's balance of unexpended allowances by the quantity to be transferred plus 0.1 percent of that quantity. In the case of transfers of export production allowances or Article 5 allowances, EPA will reduce the transferor's balance of unexpended allowances by the quantity to be transferred plus 0.1 percent of that quantity. If EPA ultimately finds that the transferor did not have sufficient unexpended allowances to cover the claim, the transferor and/or the transferee, where applicable, will be held liable for any knowing violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer.

(b) *Inter-pollutant transfers.* (1) Effective January 1, 2003, a person (transferor) may convert consumption allowances or production allowances for one class II controlled substance to the same type of allowance for another class II controlled substance listed in Appendix B of this subpart, following the procedures described in paragraph (b)(3) of this section.

(2) Inter-pollutant transfers will be permitted at any time during the control period and during the 30 days after the end of a control period.

(3) The transferor must submit to the Administrator a transfer claim that includes the following:

- (i) The identity and address of the transferor;
- (ii) The name and telephone number of a contact person for the transferor;
- (iii) The type of allowances being converted, including the names of the class II controlled substances for which allowances are to be converted;
- (iv) The quantity (in kilograms) and type of allowances to be converted;
- (v) The quantity (in kilograms) of allowances to be subtracted from the transferor's unexpended allowances for the first class II controlled substance, to be equal to 100.1 percent of the quantity of allowances converted;
- (vi) The quantity (in kilograms) of allowances to be added to the transferee's unexpended allowances for the second class II controlled substance, to be equal to the quantity (in kilograms) of allowances for the first class II controlled substance being converted multiplied by the quotient of the ozone depletion potential of the first class II controlled substance divided by the ozone depletion potential of the second class II controlled substance, as listed in Appendix B to this subpart;
- (vii) The control period(s) for which the allowances are being converted; and
- (viii) The quantity (in kilograms) of unexpended allowances of the type and for the control period being converted that the transferor holds under authority of this subpart as of the date the claim is submitted to EPA.

(4) The Administrator will determine whether the records maintained by EPA indicate that the convertor possesses unexpended allowances sufficient to cover the

transfer claim on the date the transfer claim is processed (i.e., the quantity (in kilograms) to be converted plus 0.1 percent of that quantity (in kilograms)). EPA will take into account any previous transfers, and any production, imports (not including transshipments or used class II controlled substances), or exports (not including transshipments or used class II controlled substances) of class II controlled substances reported by the convertor. Within three working days of receiving a complete transfer claim, the Administrator will take action to notify the convertor as follows:

(i) The Administrator will issue a notice indicating that EPA does not object to the transfer if EPA's records show that the convertor has sufficient unexpended allowances to cover the transfer claim. EPA will reduce the transferor's balance of unexpended allowances by the quantity to be converted plus 0.1 percent of that quantity (in kilograms). When EPA issues a no objection notice, the transferor may proceed with the transfer. However, if EPA ultimately finds that the transferor did not have sufficient unexpended allowances to cover the claim, the transferor will be held liable for any violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer.

(ii) The Administrator will issue a notice disallowing the transfer if EPA's records show that the transferor has insufficient unexpended allowances to cover the transfer claim, or that the transferor has failed to respond to one or more Agency requests to supply information needed to make a determination. The transferor may file a notice of appeal, with supporting reasons, with the Administrator within 10 working days after receipt of notification. The Administrator may affirm or vacate the disallowance. If no appeal is taken by the tenth working day after notification, the disallowance shall be final on that day.

(iii) The transferor may proceed with the transfer if the Administrator does not respond to a transfer claim within the three working days specified in paragraph (b)(4) of this section. EPA will reduce the transferor's balance of unexpended allowances by the quantity (in kilograms) to be converted plus 0.1 percent of that quantity (in kilograms). The transferor will be held liable for any violations of the regulations of this subpart that occur as a result of, or in conjunction with, the improper transfer if EPA ultimately finds that the transferor did not have sufficient unexpended allowances or credits to cover the claim.

(c) *Inter-company transfers and Inter-pollutant transfers.* If a person requests an inter-company transfer and an inter-pollutant transfer simultaneously, the quantity (in kilograms) subtracted from the transferor's unexpended production or consumption allowances for the first class II controlled substance will be equal to 100.1 percent of the quantity (in kilograms) of allowances that are being converted and transferred.

(d) A person receiving a permanent transfer of baseline production allowances or baseline consumption allowances (the transferee) for a specific class II controlled substance will be the person who has their baseline allowances adjusted in accordance with phase-out schedules in this section.

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§82.24 Recordkeeping and reporting requirements for class II controlled substances.

(a) *Recordkeeping and reporting.* Any person who produces, imports, exports, transforms, or destroys class II controlled substances must comply with the following recordkeeping and reporting requirements:

(1) Reports required by this section must be mailed to the Administrator within 30 days of the end of the applicable reporting period, unless otherwise specified.

(2) Revisions of reports that are required by this section must be mailed to the Administrator within 180 days of the end of the applicable reporting period, unless otherwise specified.

(3) Records and copies of reports required by this section must be retained for three years.

(4) Quantities of class II controlled substances must be stated in terms of kilograms in reports required by this section.

(5) Reports and records required by this section may be used for purposes of compliance determinations. These requirements are not intended as a limitation on the use of other evidence admissible under the Federal Rules of Evidence. Failure to provide the reports, petitions and records required by this section and to certify the accuracy of the information in the reports, petitions and records required by this section, will be considered a violation of this subpart. False statements made in reports, petitions and records will be considered violations of Section 113 of the Clean Air Act and under 18 U.S.C. 1001.

(b) *Producers.* Persons (“producers”) who produce class II controlled substances during a control period must comply with the following recordkeeping and reporting requirements:

(1) *Reporting—Producers.* For each quarter, each producer of a class II controlled substance must provide the Administrator with a report containing the following information:

(i) The quantity (in kilograms) of production of each class II controlled substance used in processes resulting in their transformation by the producer and the quantity (in kilograms) intended for transformation by a second party;

(ii) The quantity (in kilograms) of production of each class II controlled substance used in processes resulting in their destruction by the producer and the quantity (in kilograms) intended for destruction by a second party;

(iii) The expended allowances for each class II controlled substance;

(iv) The producer’s total of expended and unexpended production allowances, consumption allowances, export production allowances, and Article 5 allowances at the end of that quarter;

(v) The quantity (in kilograms) of class II controlled substances sold or transferred during the quarter to a person other than the producer for use in processes resulting in their transformation or eventual destruction;

(vi) A list of the quantities and names of class II controlled substances, exported by the producer to a Party

to the Protocol, that will be transformed or destroyed and therefore were not produced expending production or consumption allowances;

(vii) For transformation in the U.S. or by a person of another Party, one copy of a transformation verification from the transformer for a specific class II controlled substance and a list of additional quantities shipped to that same transformer for the quarter;

(viii) For destruction in the U.S. or by a person of another Party, one copy of a destruction verification as required in paragraph (e) of this section for a particular destroyer, destroying the same class II controlled substance, and a list of additional quantities shipped to that same destroyer for the quarter;

(ix) In cases where the producer produced class II controlled substances using export production allowances, a list of U.S. entities that purchased those class II controlled substances and exported them to a Party to the Protocol;

(x) In cases where the producer produced class II controlled substances using Article 5 allowances, a list of U.S. entities that purchased those class II controlled substances and exported them to Article 5 countries; and

(xi) A list of the HCFC 141b-exemption allowance holders from whom orders were received and the quantity (in kilograms) of HCFC-141b requested and produced.

(2) *Recordkeeping—Producers.* Every producer of a class II controlled substance during a control period must maintain the following records:

(i) Dated records of the quantity (in kilograms) of each class II controlled substance produced at each facility;

(ii) Dated records of the quantity (in kilograms) of class II controlled substances produced for use in processes that result in their transformation or for use in processes that result in their destruction;

(iii) Dated records of the quantity (in kilograms) of class II controlled substances sold for use in processes that result in their transformation or for use in processes that result in their destruction;

(iv) Dated records of the quantity (in kilograms) of class II controlled substances produced with export production allowances or Article 5 allowances;

(v) Copies of invoices or receipts documenting sale of class II controlled substances for use in processes that result in their transformation or for use in processes that result in their destruction;

(vi) Dated records of the quantity (in kilograms) of each class II controlled substance used at each facility as feedstocks or destroyed in the manufacture of a class II controlled substance or in the manufacture of any other substance, and any class II controlled substance introduced into the production process of the same class II controlled substance at each facility;

(vii) Dated records of the quantity (in kilograms) of raw materials and feedstock chemicals used at each facility for the production of class II controlled substances;

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(viii) Dated records of the shipments of each class II controlled substance produced at each plant;

(ix) The quantity (in kilograms) of class II controlled substances, the date received, and names and addresses of the source of used materials containing class II controlled substances which are recycled or reclaimed at each plant;

(x) Records of the date, the class II controlled substance, and the estimated quantity of any spill or release of a class II controlled substance that equals or exceeds 100 pounds;

(xi) Transformation verification in the case of transformation, or the destruction verification in the case of destruction as required in paragraph (e) of this section showing that the purchaser or recipient of a class II controlled substance, in the U.S. or in another country that is a Party, certifies the intent to either transform or destroy the class II controlled substance, or sell the class II controlled substance for transformation or destruction in cases when allowances were not expended;

(xii) Written verifications from a U.S. purchaser that the class II controlled substance was exported to a Party in accordance with the requirements in this section, in cases where export production allowances were expended to produce the class II controlled substance;

(xiii) Written verifications from a U.S. purchaser that the class II controlled substance was exported to an Article 5 country in cases where Article 5 allowances were expended to produce the class II controlled substance;

(xiv) Written verifications from a U.S. purchaser that HCFC-141b was manufactured for the express purpose of meeting HCFC-141b exemption needs in accordance with information submitted under §82.16(h), in cases where HCFC-141b exemption allowances were expended to produce the HCFC-141b.

(3) For any person who fails to maintain the records required by this paragraph, or to submit the report required by this paragraph, the Administrator may assume that the person has produced at full capacity during the period for which records were not kept, for purposes of determining whether the person has violated the prohibitions at §82.15.

(c) *Importers.* Persons (“importers”) who import class II controlled substances during a control period must comply with the following recordkeeping and reporting requirements:

(1) *Reporting—Importers.* For each quarter, an importer of a class II controlled substance (including importers of used class II controlled substances) must submit to the Administrator a report containing the following information:

(i) Summaries of the records required in paragraphs (c)(2)(i) through (xvi) of this section for the previous quarter;

(ii) The total quantity (in kilograms) imported of each class II controlled substance for that quarter;

(iii) The commodity code for the class II controlled substances imported, which must be one of those listed in Appendix K to this subpart;

(iv) The quantity (in kilograms) of those class II controlled substances imported that are used class II controlled substances;

(v) The quantity (in kilograms) of class II controlled substances imported for that quarter and totaled by chemical for the control period to date;

(vi) The importer’s total sum of expended and unexpended consumption allowances by chemical as of the end of that quarter;

(vii) The quantity (in kilograms) of class II controlled substances imported for use in processes resulting in their transformation or destruction;

(viii) The quantity (in kilograms) of class II controlled substances sold or transferred during that quarter to each person for use in processes resulting in their transformation or eventual destruction; and

(ix) Transformation verifications showing that the purchaser or recipient of imported class II controlled substances intends to transform those substances or destruction verifications showing that the purchaser or recipient intends to destroy the class II controlled substances (as provided in paragraph (e) of this section).

(x) [Reserved]

(xi) A list of the HCFC 141b-exemption allowance holders from whom orders were received and the quantity (in kilograms) of HCFC-141b requested and imported.

(2) *Recordkeeping—Importers.* An importer of a class II controlled substance (including used class II controlled substances) must maintain the following records:

(i) The quantity (in kilograms) of each class II controlled substance imported, either alone or in mixtures, including the percentage of each mixture which consists of a class II controlled substance;

(ii) The quantity (in kilograms) of those class II controlled substances imported that are used and the information provided with the petition as required under paragraph (c)(3) of this section;

(iii) The quantity (in kilograms) of class II controlled substances other than transshipments or used substances imported for use in processes resulting in their transformation or destruction;

(iv) The quantity (in kilograms) of class II controlled substances other than transshipments or used substances imported and sold for use in processes that result in their destruction or transformation;

(v) The date on which the class II controlled substances were imported;

(vi) The port of entry through which the class II controlled substances passed;

(vii) The country from which the imported class II controlled substances were imported;

(viii) The commodity code for the class II controlled substances shipped, which must be one of those listed in Appendix K to this subpart;

(ix) The importer number for the shipment;

(x) A copy of the bill of lading for the import;

(xi) The invoice for the import;

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(xii) The quantity (in kilograms) of imports of used class II controlled substances;

(xiii) The U.S. Customs entry form;

(xiv) Dated records documenting the sale or transfer of class II controlled substances for use in processes resulting in their transformation or destruction;

(xv) Copies of transformation verifications or destruction verifications indicating that the class II controlled substances will be transformed or destroyed (as provided in paragraph (e) of this section).

(xvi) Written verifications from a U.S. purchaser that HCFC-141b was imported for the express purpose of meeting HCFC-141b exemption needs in accordance with information submitted under §82.16(h), and that the quantity will not be resold, in cases where HCFC-141b exemption allowances were expended to import the HCFC-141b.

(3) *Petition to import used class II controlled substances and transshipments—Importers.* For each individual shipment over 5 pounds of a used class II controlled substance as defined in §82.3, an importer must submit directly to the Administrator, at least 40 working days before the shipment is to leave the foreign port of export, the following information in a petition:

(i) The name and quantity (in kilograms) of the used class II controlled substance to be imported;

(ii) The name and address of the importer, the importer ID number, the contact person, and the phone and fax numbers;

(iii) Name, address, contact person, phone number and fax number of all previous source facilities from which the used class II controlled substance was recovered;

(iv) A detailed description of the previous use of the class II controlled substance at each source facility and a best estimate of when the specific controlled substance was put into the equipment at each source facility, and, when possible, documents indicating the date the material was put into the equipment;

(v) A list of the name, make and model number of the equipment from which the material was recovered at each source facility;

(vi) Name, address, contact person, phone number and fax number of the exporter and of all persons to whom the material was transferred or sold after it was recovered from the source facility;

(vii) The U.S. port of entry for the import, the expected date of shipment and the vessel transporting the chemical. If at the time of submitting a petition the importer does not know the U.S. port of entry, the expected date of shipment and the vessel transporting the chemical, and the importer receives a non-objection notice for the individual shipment in the petition, the importer is required to notify the Administrator of this information prior to the actual U.S. Customs entry of the individual shipment;

(viii) A description of the intended use of the used class II controlled substance, and, when possible, the name, address, contact person, phone number and fax number of the ultimate purchaser in the United States;

(ix) The name, address, contact person, phone number and fax number of the U.S. reclamation facility, where applicable;

(x) If someone at the source facility recovered the class II controlled substance from the equipment, the name and phone and fax numbers of that person;

(xi) If the imported class II controlled substance was reclaimed in a foreign Party, the name, address, contact person, phone number and fax number of any or all foreign reclamation facility(ies) responsible for reclaiming the cited shipment;

(xii) An export license from the appropriate government agency in the country of export and, if recovered in another country, the export license from the appropriate government agency in that country;

(xiii) If the imported used class II controlled substance is intended to be sold as a refrigerant in the U.S., the name and address of the U.S. reclaiming person who will bring the material to the standard required under subpart F of this part, if not already reclaimed to those specifications; and

(xiv) A certification of accuracy of the information submitted in the petition.

(4) *Review of petition to import used class II controlled substances and transshipments—Importers.* Starting on the first working day following receipt by the Administrator of a petition to import a used class II controlled substance, the Administrator will initiate a review of the information submitted under paragraph(c)(3) of this section and take action within 40 working days to issue either an objection-notice or a non-objection notice for the individual shipment to the person who submitted the petition to import the used class II controlled substance.

(i) The Administrator may issue an objection notice to a petition for the following reasons:

(A) If the Administrator determines that the information is insufficient, that is, if the petition lacks or appears to lack any of the information required under paragraph (c)(3) of this section;

(B) If the Administrator determines that any portion of the petition contains false or misleading information, or the Administrator has information from other U.S. or foreign government agencies indicating that the petition contains false or misleading information;

(C) If the transaction appears to be contrary to provisions of the Vienna Convention on Substances that Deplete the Ozone Layer, the Montreal Protocol and Decisions by the Parties, or the non-compliance procedures outlined and instituted by the Implementation Committee of the Montreal Protocol;

(D) If the appropriate government agency in the exporting country has not agreed to issue an export license for the cited individual shipment of used class II controlled substance;

(E) If reclamation capacity is installed or is being installed for that specific class II controlled substance in the country of recovery or country of export and the capacity is funded in full or in part through the Multilateral Fund.

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(ii) Within ten (10) working days after receipt of the objection notice, the importer may re-petition the Administrator, only if the Administrator indicated “insufficient information” as the basis for the objection notice. If no appeal is taken by the tenth working day after the date on the objection notice, the objection shall become final. Only one re-petition will be accepted for any original petition received by EPA.

(iii) Any information contained in the re-petition which is inconsistent with the original petition must be identified and a description of the reason for the inconsistency must accompany the re-petition.

(iv) In cases where the Administrator does not object to the petition based on the criteria listed in paragraph (c)(4)(i) of this section, the Administrator will issue a non-objection notice.

(v) To pass the approved used class II controlled substances through U.S. Customs, the petition and the non-objection notice issued by EPA must accompany the shipment through U.S. Customs.

(vi) If for some reason, following EPA’s issuance of a non-objection notice, new information is brought to EPA’s attention which shows that the non-objection notice was issued based on false information, then EPA has the right to:

- (A) Revoke the non-objection notice;
- (B) Pursue all means to ensure that the class II controlled substance is not imported into the U.S.; and
- (C) Take appropriate enforcement actions.

(vii) Once the Administrator issues a non-objection notice, the person receiving the non-objection notice is permitted to import the individual shipment of used class II controlled substance only within the same control period as the date stamped on the non-objection notice.

(viii) A person receiving a non-objection notice from the Administrator for a petition to import used class II controlled substances must maintain the following records:

- (A) A copy of the petition;
- (B) The EPA non-objection notice;
- (C) The bill of lading for the import; and
- (D) U.S. Customs entry documents for the import that must include one of the commodity codes from Appendix K to this subpart.

(5) Recordkeeping for transshipments—Importers. Any person who transships a class II controlled substance must maintain records that indicate:

- (i) That the class II controlled substance shipment originated in a foreign country;
- (ii) That the class II controlled substance shipment is destined for another foreign country; and
- (iii) That the class II controlled substance shipment will not enter interstate commerce within the U.S.

(d) *Exporters.* Persons (“exporters”) who export class II controlled substances during a control period must comply with the following reporting requirements:

(1) *Reporting—Exporters.* For any exports of class II controlled substances not reported under §82.20 (addi-

tional consumption allowances), or under paragraph (b)(2) of this section (reporting for producers of class II controlled substances), each exporter who exported a class II controlled substance must submit to the Administrator the following information within 30 days after the end of each quarter in which the unreported exports left the U.S.:

- (i) The names and addresses of the exporter and the recipient of the exports;
- (ii) The exporter’s Employer Identification Number;
- (iii) The type and quantity (in kilograms) of each class II controlled substance exported and what percentage, if any of the class II controlled substance is used;
- (iv) The date on which, and the port from which, the class II controlled substances were exported from the U.S. or its territories;
- (v) The country to which the class II controlled substances were exported;
- (vi) The quantity (in kilograms) exported to each Article 5 country;
- (vii) The commodity code for the class II controlled substances shipped, which must be one of those listed in Appendix K to this subpart;

(viii) For persons reporting transformation or destruction, the invoice or sales agreement containing language similar to the transformation verifications that the purchaser or recipient of imported class II controlled substances intends to transform those substances, or destruction verifications showing that the purchaser or recipient intends to destroy the class II controlled substances (as provided in paragraph (e) of this section).

(2) *Reporting export production allowances—Exporters.* In addition to the information required in paragraph (d)(1) of this section, any exporter using export production allowances must also provide the following to the Administrator:

- (i) The Employer Identification Number on the Shipper’s Export Declaration Form or Employer Identification Number of the shipping agent shown on the U.S. Customs Form 7525;
- (ii) The exporting vessel on which the class II controlled substances were shipped; and
- (iii) The quantity (in kilograms) exported to each Party.

(3) *Reporting Article 5 allowances—Exporters.* In addition to the information required in paragraph (d)(1) of this section, any exporter using Article 5 allowances must also provide the following to the Administrator:

- (i) The Employer Identification Number on the Shipper’s Export Declaration Form or Employer Identification Number of the shipping agent shown on the U.S. Customs Form 7525; and
- (ii) The exporting vessel on which the class II controlled substances were shipped.

(4) *Reporting used class II controlled substances—Exporters.* Any exporter of used class II controlled substances must indicate on the bill of lading or invoice that the class II controlled substance is used, as defined in §82.3.

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(e) *Transformation and destruction.* Any person who transforms or destroys class II controlled substances must comply with the following recordkeeping and reporting requirements:

(1) *Recordkeeping—Transformation and destruction.* Any person who transforms or destroys class II controlled substances produced or imported by another person must maintain the following:

(i) Copies of the invoices or receipts documenting the sale or transfer of the class II controlled substances to the person;

(ii) Records identifying the producer or importer of the class II controlled substances received by the person;

(iii) Dated records of inventories of class II controlled substances at each plant on the first day of each quarter;

(iv) Dated records of the quantity (in kilograms) of each class II controlled substance transformed or destroyed;

(v) In the case where class II controlled substances were purchased or transferred for transformation purposes, a copy of the person's transformation verification as provided under paragraph (e)(3) of this section.

(vi) Dated records of the names, commercial use, and quantities (in kilograms) of the resulting chemical(s) when the class II controlled substances are transformed; and

(vii) Dated records of shipments to purchasers of the resulting chemical(s) when the class II controlled substances are transformed.

(viii) In the case where class II controlled substances were purchased or transferred for destruction purposes, a copy of the person's destruction verification, as provided under paragraph (e)(5) of this section.

(2) *Reporting—Transformation and destruction.* Any person who transforms or destroys class II controlled substances and who has submitted a transformation verification ((paragraph (e)(3) of this section) or a destruction verification (paragraph (e)(5) of this section) to the producer or importer of the class II controlled substances, must report the following:

(i) The names and quantities (in kilograms) of the class II controlled substances transformed for each control period within 45 days of the end of such control period; and

(ii) The names and quantities (in kilograms) of the class II controlled substances destroyed for each control period within 45 days of the end of such control period.

(3) *Reporting—Transformation.* Any person who purchases class II controlled substances for purposes of transformation must provide the producer or importer with a transformation verification that the class II controlled substances are to be used in processes that result in their transformation.

(i) The transformation verification shall include the following:

(A) Identity and address of the person intending to transform the class II controlled substances;

(B) The quantity (in kilograms) of class II controlled substances intended for transformation;

(C) Identity of shipments by purchase order number(s), purchaser account number(s), by location(s), or other means of identification;

(D) Period of time over which the person intends to transform the class II controlled substances; and

(E) Signature of the verifying person.

(ii) [Reserved]

(4) *Reporting—Destruction.* Any person who destroys class II controlled substances shall provide EPA with a one-time report containing the following information:

(i) The destruction unit's destruction efficiency;

(ii) The methods used to record the volume destroyed;

(iii) The methods used to determine destruction efficiency;

(iv) The name of other relevant federal or state regulations that may apply to the destruction process;

(v) Any changes to the information in paragraphs (e)(4)(i), (ii), and (iii) of this section must be reflected in a revision to be submitted to EPA within 60 days of the change(s).

(5) *Reporting—Destruction.* Any person who purchases or receives and subsequently destroys class II controlled substances that were originally produced without expending allowances shall provide the producer or importer from whom it purchased or received the class II controlled substances with a verification that the class II controlled substances will be used in processes that result in their destruction.

(i) The destruction verification shall include the following:

(A) Identity and address of the person intending to destroy class II controlled substances;

(B) Indication of whether those class II controlled substances will be completely destroyed, as defined in §82.3, or less than completely destroyed, in which case the destruction efficiency at which such substances will be destroyed must be included;

(C) Period of time over which the person intends to destroy class II controlled substances; and

(D) Signature of the verifying person.

(ii) [Reserved]

(f) *Heels—Recordkeeping and reporting.* Any person who brings into the U.S. a container with a heel, as defined in §82.3, of class II controlled substances, must comply with the following requirements:

(1) Any person who brings a container with a heel must indicate on its bill of lading or invoice that the class II controlled substance in the container is a heel.

(2) Any person who brings a container with a heel must report quarterly the quantity (in kilograms) brought into the U.S. and certify:

(i) That the residual quantity (in kilograms) in each shipment is no more than 10 percent of the volume of the container;

(ii) That the residual quantity (in kilograms) in each shipment will either:

(A) Remain in the container and be included in a future shipment;

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- (B) Be recovered and transformed;
 (C) Be recovered and destroyed; or
 (D) Be recovered for a non-emissive use.

(3) Any person who brings a container with a heel into the U.S. must report on the final disposition of each shipment within 45 days of the end of the control period.

(g) *HCFC 141b exemption allowances—Reporting and recordkeeping.* (1) Any person allocated HCFC-141b exemption allowances who confers a quantity of the HCFC-141b exemption allowances to a producer or import and places an order for the production or import of HCFC-141b with a verification that the HCFC-141b will only be used for the exempted purpose and not be resold must submit semi-annual reports, due 30 days after the end of the second and fourth respectively, to the Administrator containing the following information:

(i) Total quantity (in kilograms) HCFC-141b received during the 6 month period; and

(ii) The identity of the supplier of HCFC-141b on a shipment-by-shipment basis during the 6 month period.

(2) Any person allocated HCFC-141b exemption allowances must keep records of letters to producers and importers conferring unexpended HCFC-141b exemption allowances for the specified control period in the notice, orders for the production or import of HCFC-141b under those letters and written verifications that the HCFC-141b was produced or imported for the express purpose of meeting HCFC-141b exemption needs in accordance with information submitted under §82.16(h), and that the quantity will not be resold.

Appendix A to Subpart A of Part 82—Class I Controlled Substances

	Class 1 controlled substances	ODP
A.	Group I: CFC13-Trichlorofluoromethane (CFC-11) CF2 Cl2-Dichlorodifluoromethane (CFC-12) C2 F3 Cl3-Trichlorotrifluoroethane (CFC-113) C2 F4 Cl2-Dichlorotetrafluoroethane (CFC-114) C2 F5 Cl-Monochloropentafluoroethane (CFC-115) All isomers of the above chemicals.....	1.0 1.0 0.8 1.0 0.6
B.	Group II: CF2 ClBr-Bromochlorodifluoromethane (Halon-1211) CF3 Br-Bromotrifluoromethane (Halon-1301) C2 F4 Br2-Dibromotetrafluoroethane (Halon-2402) All isomers of the above chemicals	3.0 10.0 6.0
C.	Group III: CF3 Cl-Chlorotrifluoromethane (CFC-13) C2 FCI5-(CFC-111) C2 F2 Cl4-(CFC-112) C3 FCI7-(CFC-211) C3 F2 Cl6-(CFC-212) C3 F3 Cl5-(CFC-213) C3 F4 Cl4-(CFC-214) C3 F5 Cl3-(CFC-215) C3 F6 Cl2-(CFC-216) C3 F7 Cl-(CFC-217) All isomers of the above chemicals	1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
D.	Group IV: CCl4-Carbon Tetrachloride	1.1
E.	Group V: C2 H3 Cl3-1,1,1 Trichloroethane (Methyl chloroform) All isomers of the above chemical except 1,1,2- trichloroethane	0.1
F.	Group VI: CH3 Br-Bromomethane (Methyl Bromide)	0.7
G.	Group VII: CHFBR2 CHF2 Br (HBFC-2201) CH2 FBr C2 HFBr4 C2 HF2 Br3 C2 HF3 Br2 C2 HF4 Br C2 H2 FBr3 C2 H2 F2 Br2	1.00 0.74 0.73 0.3-0.8 0.5-1.8 0.4-1.6 0.7-1.2 0.1-1.1 0.2-1.5

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	Class 1 controlled substances	ODP
	C2 H2 F3 Br	0.7-1.6
	C2 H2 FBr2	0.1-1.7
	C2 H3 F2 Br	0.2-1.1
	C2 H4 FBr 0	0.7-0.1
	C3 HFBBr6	0.3-1.5
	C3 HF2 Br5	0.2-1.9
	C3 HF3 Br4	0.3-1.8
	C3 HF4 Br3	0.5-2.2
	C3 HF5 Br2	0.9-2.0
	C3 HF6 Br	0.7-3.3
	C3 H2 FBR5	0.1-1.9
	C3 H2 F2 BR4	0.2-2.1
	C3 H2 F3 Br3	0.2-5.6
	C3 H2 F4 Br2	0.3-7.5
	C3 H2 F5 BR	0.9-1.4
	C3 H3 FBR4	0.08-1.9
	C3 H3 F2 Br3	0.1-3.1
	C3 H3 F3 Br2	0.1-2.5
	C3 H3 F4 Br	0.3-4.4
	C3 H4 FBr3	0.03-0.3
	C3 H4 F2 Br2	0.1-1.0
	C3 H4 F3 Br	0.07-0.8
	C3 H5 FBr2	0.04-0.4
	C3 H5 F2 Br	0.07-0.8
	C3 H6 FB	0.02-0.7
H.	Group VIII: CH2BrCl (Chlorobromomethane)	0.12

Appendix B to Subpart A of Part 82—Class II Controlled Substances ^a

Controlled Substance	ODP
1. Dichlorodifluoromethane (HCFC-21)	0.04
2. Monochlorodifluoromethane (HCFC-22)	0.055
3. Monochlorodifluoromethane (HCFC-31)	0.02
4. Tetrachlorodifluoroethane (HCFC-121)	0.01-0.04
5. Trichlorodifluoroethane (HCFC-122)	0.02-0.08
6. Dichlorotrifluoroethane (HCFC-123)	0.02
7. Monochlorotetrafluoroethane (HCFC-124)	0.022
8. Trichlorofluoroethane (HCFC-131)	0.007-0.05
9. Dichlorodifluoroethane (HCFC-132)	0.008-0.05
10. Monochlorotrifluoroethane (HCFC-133)	0.02-0.06
11. Dichlorofluoroethane (HCFC-141b)	0.11
12. Monochlorodifluoroethane (HCFC-142b)	0.065
13. Chlorofluoroethane (HCFC-151)	0.003-0.005
14. Hexachlorofluoropropane (HCFC-221)	0.015-0.07
15. Pentachlorodifluoropropane (HCFC-222)	0.01-0.09
16. Tetrachlorotrifluoropropane (HCFC-223)	0.01-0.08
17. Trichlorotetrafluoropropane (HCFC-224)	0.01-0.09
18. Dichloropentafluoropropane (HCFC-225ca)	0.025
19. Dichloropentafluoropropane (HCFC-225cb)	0.033
20. Monochlorohexafluoropropane (HCFC- 226)	0.02-0.10
21. Pentachlorofluoropropane (HCFC-231)	0.05-0.09
22. Tetrachlorodifluoropropane (HCFC-232)	0.008-0.10
23. Trichlorotrifluoropropane (HCFC-233)	0.007-0.23
24. Dichlorotetrafluoropropane (HCFC-234)	0.01-0.28
25. Monochloropentafluoropropane (HCFC-235)	0.03-0.52
26. Tetrachlorofluoropropane (HCFC-241)	0.004-0.09
27. Trichlorodifluoropropane (HCFC-242)	0.005-0.13
28. Dichlorotrifluoropropane (HCFC-243)	0.007-0.12
29. Monochlorotetrafluoropropane (HCFC-244)	0.009-0.14
30. Trichlorofluoropropane (HCFC-251)	0.001-0.01
31. Dichlorodifluoropropane (HCFC-252)	0.005-0.04
32. Monochlorotrifluoropropane (HCFC-253)	0.003-0.03

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Controlled Substance	ODP
33. Dichlorofluoropropane (HCFC-261)	0.002-0.02
34. Monochlorodifluoropropane (HCFC-262)	0.002-0.02
35. Monochlorofluoropropane (HCFC-271)	0.001-0.03

^a According to Annex C of the Montreal Protocol, "Where a range of ODPs is indicated, the highest value in that range shall be used for the purposes of the Protocol. The ODPs listed as a single value have been determined from calculations based on laboratory measurements. Those listed as a range are based on estimates and are less certain. The range pertains to an isomeric group. The upper value is the estimate of the ODP of the isomer with the highest ODP, and the lower value is the estimate of the ODP of the isomer with the lowest ODP."

Appendix F to Subpart A of Part 82—Listing of Ozone-Depleting Chemicals

Controlled substance	ODP	AT L	CLP	BLP
A. Class I				
1. Group I:				
CFC13 Trichloro- fluoromethane (CFC-11)	1.0	60.0	1.0	0.00
CF2Cl2 Dichlorodifluoromethane (CFC-12)	1.0	120.0	1.5	0.00
C ₂ F3Cl3 -Trichlorotrifluoroethane (CFC-113)	0.8	90.0	1.11	0.00
C2F4Cl2-Dichlorotetrafluoroethane (CFC-114)	1.0	200.00	1.8	0.00
C2F5Cl1 Monochloropentafluoroethane (CFC-115)	0.6	400.0	2.0	0.00
All isomers of the above chemicals [reserved]				
2. Group II:				
CF2Cl1 Br-Bromochlorodifluoromethane (Halon-1211)	3.0	12	0.06	0.13
		-18	-0.08	-0.03
CF3 Br-Bromotrifluoromethane (Halon-1301)	10.0	72	0.00	1.00
		-107		
C ₂ F4Br2 Dibromotetrafluoroethane (Halon-2402)	6.0	23	0.00	0.30
		-28		-0.37
All isomers of the above chemicals [reserved]				
3. Group III:				
CF3Cl -Chlorotrifluoromethane (CFC-13)	1.0	120	0.88	0.00
	-250	-1.83		
C2FCI5- (CFC-111)	1.0	60	1.04	0.00
	-90	-1.56		
C3FC17- (CFC-211)	1.0	100	1.76	0.00
	-500	-8.81		
C3F2Cl6- (CFC-212)	1.0	100	1.60	0.00
C3F3Cl5- (CFC-213)	1.0	100	1.41	0.00
	-500	-7.06		
C3F4Cl4- (CFC-214)	1.0	100	1.20	0.00
	-500	-6.01		
C3F5Cl3- (CFC-215)	1.0	100	0.96	0.00
	-500	-4.82		
C3F6Cl2- (CFC-216)	1.0	100	0.69	0.00
	-500	-3.45		
C3 F7 Cl- (CFC-217)	1.0	100	0.37	0.00
	-500	-1.87		
All isomers of the above chemicals	[Reserved]			
4. Group IV:				
CCl4 -Carbon Tetrachloride	1.1	50.0	1.0	0.00
5. Group V:				
C2 H3 Cl3-1,1,1 Trichloroethane	0.1	6.3	0.11	0.00
(Methychloroform)				
All isomers of the above chemical except 1,1,2-	[Reserved]			
trichloroethane				
6. Group VI:				
CH3Br-Bromomethane (Methyl Bromide)	0.7		[Reserved]	
7. Group VII:				
CHFBr2	1.00		[Reserved]	
CHF2Br-(HBFC-22B1)	0.74		[Reserved]	
CH2FBr	0.73		[Reserved]	
C2HFBr4	0.3-0.8		[Reserved]	
C2HF2Br3	0.5-1.8		[Reserved]	

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Controlled substance	ODP	AT L	CLP	BLP
C2HF3Br2	0.4-16		[Reserved]	
C2HF4Br	0.7-1.2		[Reserved]	
C2H2FBr3	0.1-1.1	.....	[Reserved]	
C2H2F2Br2	0.2-1.5	.....	[Reserved]	
C2H2F3Br	0.7-1.6	.....	[Reserved]	
C2H3FBr2	0.1-1.7	.....	[Reserved]	
C2H3F2Br	0.2-1.1	.....	[Reserved]	
C2H4FBr	0.07-0.1	.....	[Reserved]	
C3HFBr6	0.3-1.5	.....	[Reserved]	
C3HF2Br5	0.2-1.9	.....	[Reserved]	
C3HF3Br4	0.3-1.8	.....	[Reserved]	
C3H2F3Br3	0.5-2.2	.....	[Reserved]	
C3H2F4Br2	0.3-7.5	.....	[Reserved]	
C3H2F5Br	0.9-1.4	.....	[Reserved]	
C3H3FBR4	0.08-1.9	.....	[Reserved]	
C3H3F2Br3	0.1-2.5	.....	[Reserved]	
C3H3F3Br2 .....		.....	[Reserved]	
C3H3F4Br	0.3-4.4	.....	[Reserved]	
C3H4FBr3	0.03-0.3	.....	[Reserved]	
C3H4F2Br2	0.1-1.0	.....	[Reserved]	
C3H4F3Br	0.07-0.8	.....	[Reserved]	
C3H5FBr2	0.04-0.4	.....	[Reserved]	
C3H5F2Br	0.07-0.8	.....	[Reserved]	
C3H6FB	0.02-0.7	.....	[Reserved]	
8. Group VIII:				
CH2BrCl (Chlorobromomethane)	0.12	.....	[Reserved]	
B. Class II:				
CHFCl2-Dichlorofluoromethane (HCFC-21)	[Reserved]	2.1	0.03	0.00
CHF2 Cl-Chlorodifluoromethane (HCFC-22)	0.05	15.3	0.14	0.00
CH2 FCl-Chlorofluoromethane (HCFC-31)	[Reserved]	1.44	0.02	0.00
C2 HFCI4- (HCFC-121)	[Reserved]	0.6	0.01	0.00
C2 HF2 Cl3- (HCFC-122)	[Reserved]	1.4	0.02	0.00
C2 HF3 Cl2- (HCFC-123)	0.02	1.6	0.016	0.00
C2 HF4 Cl- (HCFC-124)	0.02	6.6	0.04	0.00
C2 H2 FCI3- (HCFC-131)	[Reserved]	4.0	0.06	0.00
C2 H2 F2 Cl2- (HCFC-132b)	[Reserved]	4.2	0.05	0.00
C2 H2 F3 Cl- (HCFC-133a)	[Reserved]	4.8	0.03	0.00
C2 H3 FCI2- (HCFC-141b)	0.12	7.8	0.10	0.00
C2 H3 F2 Cl- (HCFC-142b)	0.06	19.1	0.14	0.00
C3 HFCI6- (HCFC-221)	[Reserved]			0.00
C3 HF2 Cl5- (HCFC-222)	[Reserved]			0.00
C3 HF3 Cl4- (HCFC-223)	[Reserved]			0.00
C3 HF4 Cl3- (HCFC-224)	[Reserved]			0.00
C3 HF5 Cl2- (HCFC-225ca)	[Reserved]	1.5	0.01	0.00
(HCFC-225cb)		-1.7		
C3 HF6 Cl- (HCFC-226)	[Reserved]			0.00
C3 H2 FCI5- (HCFC-231)	[Reserved]			0.00
C3 H2 F24- (HCFC-232)	[Reserved]			0.00
C3 H2 F3 Cl3- (HCFC-233)	[Reserved]			0.00
C3 H2 F4 Cl2- (HCFC-234)	[Reserved]			0.00
C3 H2 F5 Cl- (HCFC-235)	[Reserved]			0.00
C3 H3 FCI4- (HCFC-241)	[Reserved]			0.00
C3 H3 F2 Cl3- (HCFC-242)	[Reserved]			0.00
C3 H3 F3 Cl2- (HCFC-243)	[Reserved]			0.00
C3 H3 F4 Cl- (HCFC-244)	[Reserved]			0.00
C3 H4 FCI3- (HCFC-251)	[Reserved]			0.00
C3 H4 F2 Cl2- (HCFC-252)	[Reserved]			0.00
C3 H4 F3 Cl- (HCFC-253)	[Reserved]			0.00
C3 H5 FCI2- (HCFC-261)	[Reserved]			0.00
C2 H5 F2 Cl- (HCFC-262)	[Reserved]			0.00
C3 H6 FCI- (HCFC-271)	[Reserved]			0.00
All isomers of the above chemicals	[Reserved]			

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Appendix H to Subpart A—Clean Air Act Amendments of 1990 Phaseout Schedule for Production of Ozone-Depleting Substances

Date	Carbon tetrachloride (percent)	Methyl chloroform (percent)	Other class substances (percent)
1994.....	70	85	65
1995.....	15	70	50
1996.....	15	50	40
1997.....	15	50	15
1998.....	15	50	15
1999.....	15	50	15
2000.....		20	
2001.....		20	

Appendix I to Subpart A—Global Warming Potentials (Mass Basis), Referenced to the Absolute GWP for the Adopted Carbon Cycle Model CO₂ Decay Response and Future CO₂ Atmospheric Concentrations Held Constant at Current Levels. (Only Direct Effects Are Considered.)

Species (chemical)	Chemical formula	Global warming potential (time horizon)		
		20 years	100 years	500 years
CFC-11	CFC 13	5000	4000	1400
CFC-12	CF2 C12	7900	8500	4200
CFC-13	CC1F3	8100	11700	13600
CFC-113	C2 F3 C13	5000	5000	2300
CFC-114	C2 F4 C12	6900	9300	8300
CFC-115	C2 F5 C1	6200	9300	13000
H-1301	CF3 Br	6200	5600	2200
Carbon Tet.....	CC14	2000	1400	500
Methyl Chl	CH3 CC13	360	110	35
HCFC-22	CF2 HC1	4300	1700	520
HCFC-141b	C2 FH3 C12	1800	630	200
HCFC-142b	C2 F2 H3 C1	4200	2000	630
HCFC-123	C2 F3 HC12	300	93	29
HCFC-124	C2 F4 HC1	1500	480	150
HCFC-225ca.....	C3 F5 HC12	550	170	52
HCFC-225cb.....	C3 F5 HC12	1700	530	170

United Nations Environment Programme (UNEP), February 1995, Scientific Assessment of Ozone Depletion: 1994, Chapter 13, "Ozone Depleting Potentials, Global Warming Potentials and Future Chlorine/Bromine Loading," and do not reflect review of scientific documents published after that date.

Appendix L to Subpart A of Part 82—Approved Critical Uses and Limiting Critical Conditions for Those Uses for the 2014 and 2015 Control Periods

Column A	Column B	Column C
Approved Critical Uses.....	Approved Critical User, Location of Use, and Control Period	Limiting Critical Conditions that exist, or that the approved critical user reasonably expects could arise without methyl bromide fumigation.
PRE-PLANT USES:.....		
Strawberry Fruit.	California growers. Control periods 2014 and 2015	Moderate to severe black root rot or crown rot. Moderate to severe yellow or purple nutsedge infestation. Moderate to severe nematode infestation. Local township limits prohibiting 1,3-dichloropropene.
POST-HARVEST USES:.....		

Column A	Column B	Column C
Food Processing	(a) Rice millers in the U.S. who are members of the USA Rice Millers' Association. Control period 2014	Moderate to severe beetle, weevil, or moth infestation. Presence of sensitive electronic equipment subject to corrosion.
.....	(b) Pet food manufacturing facilities in the U.S. who are members of the Pet Food Institute. Control period 2014	Moderate to severe beetle, moth, or cockroach infestation. Presence of sensitive electronic equipment subject to corrosion.
.....	(c) Members of the North American Millers' Association in the U.S. Control period 2014	Moderate to severe beetle infestation. Presence of sensitive electronic equipment subject to corrosion.
Commodities	California entities storing walnuts, dried plums, figs, raisins, and dates (in Riverside county only) in California. Control period 2014	Rapid fumigation required to meet a critical market window, such as during the holiday season.

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Column A	Column B	Column C
Dry Cured Pork Products	Members of the National Country Ham Association and the American Association of Meat Processors, Nahunta Pork Center (North Carolina), and Gwaltney of Smithfield Inc. Control periods 2014 and 2015	Red legged ham beetle infestation. Cheese/ham skipper infestation. Dermestid beetle infestation. Ham mite infestation.

Subpart B—Servicing of Motor Vehicle Air Conditioners

§82.30 Purpose and scope.

(a) The purpose of the regulations in this subpart B is to implement section 609 of the Clean Air Act, as amended (Act) regarding the servicing of motor vehicle air conditioners (MVACs), and to implement section 608 of the Act regarding certain servicing, maintenance, repair and disposal of air conditioners in MVACs and MVAC-like appliances (as that term is defined in 40 CFR 82.152).

(b) These regulations apply to any person performing service on a motor vehicle for consideration when this service involves the refrigerant in the motor vehicle air conditioner.

§82.32 Definitions.

(a) *Approved independent standards testing organization* means any organization which has applied for and received approval from the Administrator pursuant to §82.38.

(b) *Approved refrigerant recycling equipment* means equipment certified by the Administrator or an organization approved under §82.38 as meeting either one of

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Reserved

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the standards in §82.36. Such equipment extracts and recycles refrigerant or extracts refrigerant for recycling on-site or reclamation off-site.

(c) *Motor vehicle* as used in this subpart means any vehicle which is self-propelled and designed for transporting persons or property on a street or highway, including but not limited to passenger cars, light duty vehicles, and heavy duty vehicles. This definition does not include a vehicle where final assembly of the vehicle has not been completed by the original equipment manufacturer.

(d) *Motor vehicle air conditioners* means mechanical vapor compression refrigeration equipment used to cool the driver's or passenger's compartment of any motor vehicle. This definition is not intended to encompass the hermetically sealed refrigeration systems used on motor vehicles for refrigerated cargo and the air conditioning systems on passenger buses using HCFC-22 refrigerant.

(e) *Properly using*. (1) Properly using means using equipment in conformity with the regulations set forth in this subpart, including but not limited to the prohibitions and required practices set forth in §82.34, and the recommended service procedures and practices for the containment of refrigerant set forth in appendices A, B, C, D, E, and F of this subpart, as applicable. In addition, this term includes operating the equipment in accordance with the manufacturer's guide to operation and maintenance and using the equipment only for the controlled substance for which the machine is designed. For equipment that extracts and recycles refrigerant, properly using also means to recycle refrigerant before it is returned to a motor vehicle air conditioner or MVAC-like appliance, including to the motor vehicle air conditioner or MVAC-like appliance from which the refrigerant was extracted. For equipment that only recovers refrigerant, properly using includes the requirement to recycle the refrigerant on-site or send the refrigerant off-site for reclamation.

(2) Refrigerant from reclamation facilities that is used for the purpose of recharging motor vehicle air conditioners must be at or above the standard of purity developed by the Air-conditioning and Refrigeration Institute (ARI 700-93) (which is codified at 40 CFR part 82, subpart F, appendix A, and is available at 4301 North Fairfax Drive, Suite 425, Arlington, Virginia 22203). Refrigerant may be recycled off-site only if the refrigerant is extracted using recover only equipment, and is subsequently recycled off-site by equipment owned by the person that owns both the recover only equipment and owns or operates the establishment at which the refrigerant was extracted. In any event, approved equipment must be used to extract refrigerant prior to performing any service during which discharge of refrigerant from the motor vehicle air conditioner can reasonably be expected. Intentionally venting or disposing of refrigerant to the atmosphere is an improper use of equipment.

(3) Notwithstanding any other terms of this paragraph (e), approved refrigerant recycling equipment may be transported off-site and used to perform service involving refrigerant at other locations where such servicing occurs. Any such servicing involving refrigerant must

meet all of the requirements of this subpart B that would apply if the servicing occurred on-site.

(4) Facilities that charge MVACs or MVAC-like appliances with refrigerant but do not perform any other service involving refrigerant (i.e., perform "top-offs" only) are considered to be engaged in "service involving refrigerant" and are therefore subject to any and all requirements of this subsection that apply to facilities that perform a wider range of refrigerant servicing. For facilities that charge MVACs, this includes the requirement to purchase approved refrigerant recycling equipment. For facilities that only charge MVAC-like appliances, this does not include the requirement to purchase approved refrigerant recycling equipment, but does include the requirement to be properly trained and certified by a technician certification program approved by the Administrator pursuant to either §82.40 or §82.161(a)(5).

(5) All persons opening (as that term is defined in §82.152) MVAC-like appliances must have at least one piece of approved recovery or recycling equipment available at their place of business.

(f) *Refrigerant* means any class I or class II substance used in a motor vehicle air conditioner. Class I and class II substances are listed in part 82, subpart A, appendix A. Effective November 15, 1995, refrigerant shall also include any substitute substance.

(g) *Service for consideration* means being paid to perform service, whether it is in cash, credit, goods, or services. This includes all service except that done for free.

(h) *Service involving refrigerant* means any service during which discharge or release of refrigerant from the MVAC or MVAC-like appliance to the atmosphere can reasonably be expected to occur. Service involving refrigerant includes any service in which an MVAC or MVAC-like appliance is charged with refrigerant but no other service involving refrigerant is performed (i.e., a "top-off").

(i) *Motor vehicle disposal facility* means any commercial facility that engages in the disposal (which includes dismantling, crushing or recycling) of MVACs or MVAC-like appliances, including but not limited to automotive recycling facilities, scrap yards, landfills and salvage yards engaged in such operations. Motor vehicle repair and/or servicing facilities, including collision repair facilities, are not considered motor vehicle disposal facilities.

§82.34 Prohibitions and required practices.

(a) No person repairing or servicing MVACs for consideration, and no person repairing or servicing MVAC-like appliances, may perform any service involving the refrigerant for such MVAC or MVAC-like appliance:

(1) Without properly using equipment approved pursuant to §82.36;

(2) Unless any such person repairing or servicing an MVAC has been properly trained and certified by a technician certification program approved by the Administrator pursuant to §82.40; and

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(3) Unless any such person repairing or servicing an MVAC-like appliance has been properly trained and certified by a technician certification program approved by the Administrator pursuant to either §82.40 or §82.161(a)(5).

(b) Effective November 15, 1992, no person may sell or distribute, or offer for sale or distribution, any class I or class II substance that is suitable for use as a refrigerant in motor vehicle air-conditioner and that is in a container which contains less than 20 pounds of such refrigerant to any person unless that person is properly trained and certified under §82.40 or intended the containers for resale only, and so certifies to the seller under §82.42(b)(3).

(c) No technician training programs may issue certificates unless the program complies with all of the standards in §82.40(a).

(d) *Motor vehicle disposal facilities.* (1) Any refrigerant that is extracted from an MVAC or an MVAC-like appliance (as that term is defined in §82.152) bound for disposal and located at a motor vehicle disposal facility may not be subsequently used to charge or recharge an MVAC or MVAC-like appliance, unless, prior to such charging or recharging, the refrigerant is either:

(i) Recovered, and reclaimed in accordance with the regulations promulgated under §82.32(e)(2) of this subpart B; or

(ii) (A) Recovered using approved refrigerant recycling equipment dedicated for use with MVACs and MVAC-like appliances, either by a technician certified under paragraph (a)(2) of this section, or by an employee, owner, or operator of, or contractor to, the disposal facility; and

(B) Subsequently recycled by the facility that charges or recharges the refrigerant into an MVAC or MVAC-like appliance, properly using approved refrigerant recycling equipment in accordance with any applicable recommended service procedures set forth in the appendices to this subpart B.

(2) Any refrigerant the sale of which is restricted under subpart F that is extracted from an MVAC or an MVAC-like appliance bound for disposal and located at a motor vehicle disposal facility but not subsequently reclaimed in accordance with the regulations promulgated under subpart F, may be sold prior to its subsequent re-use only to a technician certified under paragraph (a)(2) of this section. Any technician certified under paragraph (a)(2) of this section who obtains such a refrigerant may subsequently re-use such refrigerant only in an MVAC or MVAC-like appliance, and only if it has been reclaimed or properly recycled.

(e) Refrigerant handling equipment manufactured or imported for use during the maintenance, service or repair of MVACs for consideration cannot be introduced into interstate commerce unless meeting the requirements of §82.36.

§82.36 Approved refrigerant handling equipment.

(a)(1) Refrigerant recycling equipment must be certified by the Administrator or an independent standards testing organization approved by the Administrator under §82.38 to meet the following standard:

(2) Equipment that recovers and recycles CFC-12 refrigerant must meet the standards set forth in appendix A of this subpart (Recommended Service Procedure for the Containment of CFC-12, Extraction and Recycle Equipment for Mobile Automotive Air-Conditioning Systems, and Standard of Purity for Use in Mobile Air Conditioning Systems).

(3) Equipment that recovers but does not recycle CFC-12 refrigerant must meet the standards set forth in appendix B of this subpart (Recommended Service Procedure for the Containment of CFC-12 and Extraction Equipment for Mobile Automotive Air-Conditioning Systems).

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(4) Effective January 1, 2008, equipment that recovers and recycles HFC-134a refrigerant and equipment that recovers and recycles HFC-134a refrigerant and recharges systems with HFC-134a refrigerant must meet the standards set forth in Appendix C of this subpart based upon J2788—HFC-134a (R-134a) Recovery/Recycling Equipment and Recovery/Recycling/Recharging for Mobile Air-Conditioning Systems.

(5) Equipment that recovers but does not recycle HFC-134a refrigerant must meet the standards set forth in appendix D of this subpart (HFC-134a Recover-Only Equipment and Recommended Service Procedure for the Containment of HFC-134a).

(6) Equipment that recovers and recycles both CFC-12 and HFC-134a using common circuitry must meet the standards set forth in appendix E of this subpart (Automotive Refrigerant Recycling Equipment Intended for Use with both CFC-12 and HFC-134a, Recommended Service Procedure for the Containment of CFC-12, and Recommended Service Procedure for the Containment of HFC-134a).

(7) Equipment that recovers but does not recycle refrigerants other than HFC-134a and CFC-12 must meet the standards set forth in appendix F of this subpart (Recover-Only Equipment that Extracts a Single, Specific Refrigerant Other Than CFC-12 or HFC-134a).

(b)(1) Refrigerant recycling equipment that has not been certified under paragraph (a) of this section shall be considered approved if it is substantially identical to the applicable equipment certified under paragraph (a) of this section, and:

(i) For equipment that recovers and recycles CFC-12 refrigerant, it was initially purchased before September 4, 1991;

(ii) For equipment that recovers but does not recycle CFC-12 refrigerant, it was initially purchased before April 22, 1992;

(iii) For equipment that recovers and recycles HFC-134a refrigerant, it was initially purchased before March 6, 1996;

(iv) For equipment that recovers but does not recycle HFC-134a refrigerant, it was initially purchased before March 6, 1996;

(v) For equipment that recovers but does not recycle any single, specific refrigerant other than CFC-12 or HFC-134a, it was initially purchased before March 6, 1996; and

(vi) For equipment that recovers and recycles HFC-134a and CFC-12 refrigerant using common circuitry, it was initially purchased before March 6, 1996.

(2) Equipment manufacturers or owners may request a determination by the Administrator by submitting an application and supporting documents that indicate that the equipment is substantially identical to approved equipment to: MVACs Recycling Program Manager, Stratospheric Protection Division (6205J), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW, Washington, DC 20460, Attn: Substantially Identical Equipment Review. Supporting documents must include process flow sheets, lists of components and any other information that would indi-

cate that the equipment is capable of processing the refrigerant to the standards in appendix A, B, C, D, E or F of this subpart, as applicable. Authorized representatives of the Administrator may inspect equipment for which approval is being sought and request samples of refrigerant that has been extracted and/or recycled using the equipment. Equipment that fails to meet appropriate standards will not be considered approved.

(3) Refrigerant recycling equipment that recovers or recovers and recycles CFC-12 refrigerant and has not been certified under paragraph (a) or approved under paragraphs(b)(1) and (b)(2) of this section shall be considered approved for use with an MVAC-like appliance if it was manufactured or imported before November 15, 1993, and is capable of reducing the system pressure to 102 mm of mercury vacuum under the conditions set forth in appendix A of this subpart.

(c) The Administrator will maintain a list of approved equipment by manufacturer and model. Persons interested in obtaining a copy of the list should send written inquiries to the address in paragraph (b) of this section.

§82.38 Approved independent standards testing organizations.

(a) Any independent standards testing organization may apply for approval by the Administrator to certify equipment as meeting the standards in appendix A, B, C, D, E, or F of this subpart, as applicable. The application shall be sent to: MVACs Recycling Program Manager, Stratospheric Protection Division (6205J), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW, Washington, DC 20460.

(b) Applications for approval must document the following:

(1) That the organization has the capacity to accurately test whether refrigerant recycling equipment complies with the applicable standards. In particular, applications must document:

(i) The equipment present at the organization that will be used for equipment testing;

(ii) The expertise in equipment testing and the technical experience of the organization's personnel;

(iii) Thorough knowledge of the standards as they appear in the applicable appendices of this subpart; and

(iv) The test procedures to be used to test equipment for compliance with applicable standards, and why such test procedures are appropriate for that purpose.

(2) That the organization has no conflict of interest and will receive no financial benefit based on the outcome of certification testing; and

(3) That the organization agrees to allow the Administrator access to verify the information contained in the application.

(c) If approval is denied under this section, the Administrator shall give written notice to the organization setting forth the basis for his or her determination.

(d) If at any time an approved independent standards testing organization is found to be conducting certification tests for the purposes of this subpart in a manner not consistent with the representations made in its

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application for approval under this section, the Administrator reserves the right to revoke approval.

§82.40 Technician training and certification.

(a) Any technician training and certification program may apply for approval, in accordance with the provisions of this paragraph, by submitting to the Administrator at the address in §82.38(a) verification that the program meets all of the following standards:

(1) *Training.* Each program must provide adequate training, through one or more of the following means: on-the-job training, training through self-study of instructional material, or on-site training involving instructors, videos or a hands-on demonstration.

(2) *Test subject material.* The certification tests must adequately and sufficiently cover the following:

(i) The standards established for the service and repair of MVACs and MVAC-like appliances as set forth in appendices A, B, C, D, E, and F of this subpart. These standards relate to the recommended service procedures for the containment of refrigerant, extraction equipment, extraction and recycle equipment, and the standard of purity for refrigerant in motor vehicle air conditioners.

(ii) Anticipated future technological developments, such as the introduction of HFC-134a in new motor vehicle air conditioners.

(iii) The environmental consequences of refrigerant release and the adverse effects of stratospheric ozone layer depletion.

(iv) As of August 13, 1992, the requirements imposed by the Administrator under section 609 of the Act.

(3) *Test administration.* Completed tests must be graded by an entity or individual who receives no benefit based on the outcome of testing; a fee may be charged for grading. Sufficient measures must be taken at the test site to ensure that tests are completed honestly by each technician. Each test must provide a means of verifying the identification of the individual taking the test. Programs are encouraged to make provisions for non-English speaking technicians by providing tests in other languages or allowing the use of a translator when taking the test. If a translator is used, the certificate received must indicate that translator assistance was required.

(4) *Proof of certification.* Each certification program must offer individual proof of certification, such as a certificate, wallet-sized card, or display card, upon successful completion of the test. Each certification program must provide a unique number for each certified technician.

(b) In deciding whether to approve an application, the Administrator will consider the extent to which the applicant has documented that its program meets the standards set forth in this section. The Administrator reserves the right to consider other factors deemed relevant to ensure the effectiveness of certification programs. The Administrator may approve a program which meets all of the standards in paragraph (a) of this section except test administration if the program, when viewed as a whole, is at least as effective as a program

that does meet all the standards. Such approval shall be limited to training and certification conducted before August 13, 1992. If approval is denied under this section, the Administrator shall give written notice to the program setting forth the basis for his determination.

(c) *Technical revisions.* Directors of approved certification programs must conduct periodic reviews of test subject material and update the material based upon the latest technological developments in motor vehicle air conditioner service and repair. A written summary of the review and any changes made must be submitted to the Administrator every two years.

(d) *Recertification.* The Administrator reserves the right to specify the need for technician recertification at some future date, if necessary.

(e) If at any time an approved program is conducted in a manner not consistent with the representations made in the application for approval of the program under this section, the Administrator reserves the right to revoke approval.

(f) Authorized representatives of the Administrator may require technicians to demonstrate on the business entity's premises their ability to perform proper procedures for recovering and/or recycling refrigerant. Failure to demonstrate or failure to properly use the equipment may result in revocation of the technician's certificate by the Administrator. Technicians whose certification is revoked must be recertified before servicing or repairing any motor vehicle air conditioners.

§82.42 Certification, recordkeeping and public notification requirements.

(a) *Certification requirements.* (1) No later than January 1, 1993, any person repairing or servicing motor vehicle air conditioners for consideration shall certify to the Administrator that such person has acquired, and is properly using, approved equipment and that each individual authorized to use the equipment is properly trained and certified. Certification shall take the form of a statement signed by the owner of the equipment or another responsible officer and setting forth:

(i) The name of the purchaser of the equipment;

(ii) The address of the establishment where the equipment will be located; and

(iii) The manufacturer name and equipment model number, the date of manufacture, and the serial number of the equipment. The certification must also include a statement that the equipment will be properly used in servicing motor vehicle air conditioners, that each individual authorized by the purchaser to perform service is properly trained and certified in accordance with §82.40, and that the information given is true and correct.

(A) Owners or lessees of recycling or recovery equipment having their places of business in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont must send their certifications to: CAA section 609 Enforcement Contact; EPA Region I; Mail Code SEA; JFK Federal Building; One Congress Street, Suite 1100; Boston, MA 02114-2023.

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(B) Owners or lessees of recycling or recovery equipment having their places of business in New York, New Jersey, Puerto Rico, Virgin Islands must send their certifications to: CAA section 609 Enforcement Contact; EPA Region II (2DECA-AC); 290 Broadway, 21st Floor; New York, NY 10007-1866.

(C) Owners or lessees of recycling or recovery equipment having their places of business in Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia must send their certifications to: CAA section 609 Enforcement Contact; EPA Region III—Wheeling Operations Office; Mail Code 3AP12; 303 Methodist Building; 11th and Chapline Streets; Wheeling, WV 26003.

(D) Owners or lessees of recycling or recovery equipment having their places of business in Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee must send their certifications to: CAA section 609 Enforcement Contact; EPA Region IV (APT-AE); Atlanta Federal Center; 61 Forsyth Street, SW.; Atlanta, GA 30303.

(E) Owners or lessees of recycling or recovery equipment having their places of business in Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin must send their certifications to: CAA section 609 Enforcement Contact; EPA Region V (AE17J); 77 West Jackson Blvd.; Chicago, IL 60604-3507.

(F) Owners or lessees of recycling or recovery equipment having their places of business in Arkansas, Louisiana, New Mexico, Oklahoma, Texas must send their certifications to: CAA section 609 Enforcement Contact; EPA Region VI (6EN-AA); 1445 Ross Avenue, Suite 1200; Dallas, Texas 75202.

(G) Owners or lessees of recycling or recovery equipment having their places of business in Iowa, Kansas, Missouri, Nebraska must send their certifications to: CAA section 609 Enforcement Contact; EPA Region VII; Mail Code APCO/ARTD; 901 North 5th Street; Kansas City, KS 66101.

(H) Owners or lessees of recycling or recovery equipment having their places of business in Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming must send their certifications to: CAA section 609 Enforcement Contact, EPA Region VIII, Mail Code 8ENF-T, 999 18th Street, Suite 500, Denver, CO 80202-2466.

(I) Owners or lessees of recycling or recovery equipment having their places of business in American Samoa, Arizona, California, Guam, Hawaii, Nevada must send their certifications to: CAA section 609 Enforcement Contact; EPA Region IX; Mail Code AIR-5; 75 Hawthorne Street; San Francisco, CA 94105.

(J) Owners or lessees of recycling or recovery equipment having their places of business in Alaska, Idaho, Oregon, Washington must send their certifications to: CAA section 609 Enforcement Contact; EPA Region X (OAQ-107); 1200 Sixth Avenue; Seattle, WA 98101.

(2) The prohibitions in §82.34(a) shall be effective as of January 1, 1993 for persons repairing or servicing motor vehicle air conditioners for consideration at an entity which performed service on fewer than 100 motor

vehicle air conditioners in calendar year 1990, but only if such person so certifies to the Administrator no later than August 13, 1992. Persons must retain adequate records to demonstrate that the number of vehicles serviced was fewer than 100.

(3) Certificates of compliance are not transferable. In the event of a change of ownership of an entity which services motor vehicle air conditioners for consideration, the new owner of the entity shall certify within thirty days of the change of ownership pursuant to §82.42(a)(1).

(b) *Recordkeeping requirements.* (1) Any person who owns approved refrigerant recycling equipment certified under §82.36(a)(2) must maintain records of the name and address of any facility to which refrigerant is sent.

(2) Any person who owns approved refrigerant recycling equipment must retain records demonstrating that all persons authorized to operate the equipment are currently certified under §82.40.

(3) Any person who sells or distributes any class I or class II substance that is suitable for use as a refrigerant in a motor vehicle air conditioner and that is in a container of less than 20 pounds of such refrigerant must verify that the purchaser is properly trained and certified under §82.40. The seller must have a reasonable basis for believing that the information presented by the purchaser is accurate. The only exception to these requirements is if the purchaser is purchasing the small containers for resale only. In this case, the seller must obtain a written statement from the purchaser that the containers are for resale only and indicate the purchasers name and business address. Records required under this paragraph must be retained for a period of three years.

(4) All records required to be maintained pursuant to this section must be kept for a minimum of three years unless otherwise indicated. Entities which service motor vehicle air conditioners for consideration must keep these records on-site.

(5) All entities which service motor vehicle air conditioners for consideration must allow an authorized representative of the Administrator entry onto their premises (upon presentation of his or her credentials) and give the authorized representative access to all records required to be maintained pursuant to this section.

(c) *Public notification.* Any person who conducts any retail sales of a class I or class II substance that is suitable for use as a refrigerant in a motor vehicle air conditioner, and that is in a container of less than 20 pounds of refrigerant, must prominently display a sign where sales of such containers occur which states:

“It is a violation of federal law to sell containers of Class I and Class II refrigerant of less than 20 pounds of such refrigerant to anyone who is not properly trained and certified to operate approved refrigerant recycling equipment.”

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Appendix A to Subpart B of Part 82—Standard for Recycle/Recover Equipment

Standard of Purity for Use in Mobile Air-Conditioning Systems

Foreword

Due to the CFC's damaging effect on the ozone layer, recycle of CFC-12 (R-12) used in mobile air-conditioning systems is required to reduce system venting during normal service operations. Establishing recycle specifications for R-12 will assure that system operation with recycled R-12 will provide the same level of performance as new refrigerant.

Extensive field testing with the EPA and the auto industry indicate that reuse of R-12 removed from mobile air-conditioning systems can be considered, if the refrigerant is cleaned to a specific standard. The purpose of this standard is to establish the specific minimum levels of R-12 purity required for recycled R-12 removed from mobile automotive air-conditioning systems.

1. Scope

This information applies to refrigerant used to service automobiles, light trucks, and other vehicles with similar CFC-12 systems. Systems used on mobile vehicles for refrigerated cargo that have hermetically sealed, rigid pipe are not covered in this document.

2. References

SAE J1989, Recommended Service Procedure for the Containment of R-12

SAE J1990, Extraction and Recycle Equipment for Mobile Automotive Air-Conditioning Systems

ARI Standard 700-88

3. Purity Specification

The refrigerant in this document shall have been directly removed from, and intended to be returned to, a mobile air-conditioning system. The contaminants in this recycled refrigerant shall be limited to moisture, refrigerant oil, and noncondensable gases, which shall not exceed the following level:

3.1 Moisture: 15 ppm by weight.

3.2 Refrigerant Oil: 4000 ppm by weight.

3.3 Noncondensable Gases (air): 330 ppm by weight.

4. Refrigeration Recycle Equipment Used in Direct Mobile Air-Conditioning Service Operations Requirement

4.1 The equipment shall meet SAE J1990, which covers additional moisture, acid, and filter requirements.

4.2 The equipment shall have a label indicating that it is certified to meet this document.

5. Purity Specification of Recycled R-12 Refrigerant Supplied in Containers From Other Recycle Sources

Purity specification of recycled R-12 refrigerant supplied in containers from other recycle sources, for service of mobile air-conditioning systems, shall meet ARI Standard 700-88 (Air Conditioning and Refrigeration Institute).

6. Operation of the Recycle Equipment

This shall be done in accordance with SAE J1989.

Rationale

Not applicable.

Relationship of SAE Standard to ISO Standard

Not applicable.

Reference Section

SAE J1989, Recommended Service Procedure for the Containment of R-12

SAE J1990, Extraction and Recycle Equipment for Mobile Automotive Air-Conditioning Systems

ARI Standard 700-88

Application

This information applies to refrigerant used to service automobiles, light trucks, and other vehicles with similar CFC-12 systems. Systems used on mobile vehicles for refrigerated cargo that have hermetically sealed, rigid pipe are not covered in this document.

Committee Composition

Developed by the SAE Defrost and Interior Climate Controls Standards Committee

W.J. Atkinson, Sun Test Engineering, Paradise Valley, AZ—Chairman

J.J. Amin, Union Lake, MI

H.S. Andersson, Saab Scania, Sweden

P.E. Anglin, ITT Higbie Mfg. Co., Rochester, MI

R.W. Bishop, GMC, Lockport, NY

D. Hawks, General Motors Corporation, Pontiac, MI

J.J. Hernandez, NAVISTAR, Ft. Wayne, IN

H. Kaltner, Volkswagen AG, Germany, Federal Republic

D.F. Last, GMC, Troy, MI

D.E. Linn, Volkswagen of America, Warren, MI

J.H. McCorkel, Freightliner Corp., Charlotte, NC

C.J. McLachlan, Livonia, MI

H.L. Miner, Climate Control Inc., Decatur, IL

R.J. Niemiec, General Motors Corp., Pontiac, MI

N. Novak, Chrysler Corp., Detroit, MI

S. Oulouhjian, Mobile Air Conditioning Society, Upper Darby, PA

J. Phillips, Air International, Australia

R.H. Proctor, Murray Corp., Cockeysville, MD

G. Rolling, Behr America Inc., Ft. Worth, TX

C.D. Sweet, Signet Systems Inc., Harrodsburg, KY

J.P. Telesz, General Motors Corp., Lockport, NY

Extraction and Recycle Equipment for Mobile Automotive Air Conditioning Systems

SAE Recommended Practice, SAE J1990 (1991)¹

0. Foreword

Due to the CFC's damaging effect on the ozone layer, recycle of CFC-12 (R-12) used in mobile air-conditioning systems is required to replace system venting during normal service operations. Establishing recycle specifications for R-12 will provide the same level of performance as new refrigerant.

Extensive field testing with the EPA and the auto industry indicates that R-12 can be reused, provided that it is cleaned to specifications in SAE J1991. The purpose of this document is to establish the specific minimum equipment specification required for recycle of R-12 that has been directly removed from mobile systems for reuse in mobile automotive air-conditioning systems.

1. Scope

The purpose of this document is to provide equipment specifications for CFC-12 (R-12) recycling equipment. This information applies to equipment used to service automobiles, light trucks, and other vehicles with similar CFC-12 air-conditioning systems.

This standard is appropriate for equipment certified after February 1, 1992. This equipment may be marked design certified for compliance with SAE J1990 (1991). The standard for approval for equipment certified on or before February 1, 1992 is SAE J1990 (1989). This equipment may be marked design certified for compliance with SAE J1990 (1989). Both types of equipment are considered approved under the requirements of this regulation.

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Systems used on mobile vehicles for refrigerated cargo that have hermetically sealed systems are not covered in this document. The equipment in this document is intended for use with refrigerant that has been directly removed from, and intended to be returned to, a mobile air-conditioning system. Should other revisions due to operational or technical requirements occur, this document may be amended.

2. References

2.1 Applicable Documents:

2.1.1 SAE Publications—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1991—Standard of Purity for Use in Mobile Air-Conditioning Systems

SAE J2196—Service Hose for Automotive Air-Conditioning

2.1.2 CGA Publications—Available from CGA, Crystal Gateway #1, Ste. 501, 1235 Jefferson Davis Hwy., Arlington, VA 22202

CGA Pamphlet S-1.1—Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases

3. Specification and General Description

3.1 The equipment must be able to extract and process CFC-12 from mobile air-conditioning systems. The equipment shall process the contaminated R-12 samples as defined in 8.4 and shall clean the refrigerant to the level as defined in SAE J1991.

3.2 The equipment shall be suitable for use in an automotive service environment and be capable of continuous operation in ambients from 10 to 49 °C.

3.3 The equipment must be certified by Underwriters Laboratories or an equivalent certifying laboratory.

3.4 The equipment shall have a label "Design Certified by (Company Name) to Meet SAE J1991". The minimum letter size shall be bold type 3 mm in height.

4. Refrigeration Recycle Equipment Requirements

4.1 Moisture and Acid—The equipment shall incorporate a desiccant package that must be replaced before saturated with moisture and whose mineral acid capacity is at least 5% by weight of total system dry desiccant.

4.1.1 The equipment shall be provided with a moisture detection device that will reliably indicate when moisture in the CFC-12 exceeds the allowable level and requires the filter/dryer replacement.

4.2 Filter—The equipment shall incorporate an in-line filter that will trap particulates of 15 µm or greater.

4.3 Noncondensable Gas.

4.3.1 The equipment shall either automatically purge noncondensables (NCGs) if the acceptable level is exceeded or incorporate a device to alert the operator that NCG level has been exceeded. NCG removal must be part of normal operation of the equipment and instructions must be provided to enable the task to be accomplished within 30 minutes.

4.3.2 Refrigerant loss from noncondensable gas purging during testing described in Section 8 shall not exceed five percent (5%) by weight of the total contaminated refrigerant removed from the test system.

4.3.3 Transfer of Recycled Refrigerant—Recycled refrigerant for recharging and transfer shall be taken from the liquid phase only.

5. Safety Requirements

5.1 The equipment must comply with applicable federal, state and local requirements on equipment related to the handling of R-12 material. Safety precautions or notices related to the safe operation of the equipment shall be prominently displayed on the equipment and should also state "Caution—Should Be Operated By Qualified Personnel".

6. Operating Instructions

6.1 The equipment manufacturer must provide operating instructions, necessary maintenance procedures, and source information for replacement parts and repair.

6.2 The equipment must prominently display the manufacturer's name, address and any items that require maintenance or replacement that affect the proper operation of the equipment. Operation manuals must cover information for complete maintenance of the equipment to assure proper operation.

7. Functional Description

7.1 The equipment must be capable of ensuring recovery of the R-12 from the system being service, by reducing the system pressure below atmospheric to a minimum of 102 mm of mercury.

7.2 To prevent overcharge, the equipment must be equipped to protect the tank used to store the recycled refrigerant with a shutoff device and a mechanical pressure relief valve.

7.3 Portable refillable tanks or containers used in conjunction with this equipment must meet applicable Department of Transportation (DOT) or Underwriters Laboratories (UL) Standards and be adaptable to existing refrigerant service and charging equipment.

7.4 During operation, the equipment shall provide overfill protection to assure the storage container, internal or external, liquid fill does not exceed 80% of the tank's rated volume at 21.1 °C (70 °F) per DOT standards, CFR title 49, §173.304 and American Society of Mechanical Engineers.

7.4.1 Additional Storage Tank Requirements.

7.4.1.1 The cylinder valve shall comply with the standard for cylinder valves, UL 1769.

7.4.1.2 The pressure relief device shall comply with the Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases, CGA Pamphlet S-1.1.

7.4.1.3 The tank assembly shall be marked to indicate the first retest date, which shall be 5 years after date of manufacture. The marking shall indicate that retest must be performed every subsequent 5 years. The marking shall be in letters at least 1/4 in high.

7.5 All flexible hoses must meet SAE J2196 hose specification effective January 1, 1992.

7.6 Service hoses must have shutoff devices located within 30 cm (12 in) of the connection point to the system being serviced to minimize introduction of noncondensable gases into the recovery equipment and the release of the refrigerant when being disconnected.

7.7 The equipment must be able to separate the lubricant from the recovered refrigerant and accurately indicate the amount removed during the process, in 30 ml units. Refrigerant dissolves in lubricant sample. This creates the illusion that more lubricant has been recovered than actually has been. The equipment lubricant measuring system must take in account such dissolved refrigerant to prevent overcharging the vehicle system with lubricant. Note: Use only new lubricant to replace the amount removed during the recycle process. Used lubricant should be discarded per applicable federal, state, and local requirements.

7.8 The equipment must be capable of continuous operation in ambient of 10 to 49 °C (50 to 120 °F).

7.9 The equipment should be compatible with leak detection material that may be present in the mobile AC system.

8. Testing

This test procedure and the requirement are used for evaluation of the equipment for its ability to clean the contaminated R-12 refrigerant.

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8.1 The equipment shall clean the contaminated R-12 refrigerant to the minimum purity level as defined in SAE J1991, when tested in accordance with the following conditions:

8.2 For test validation, the equipment is to be operated according to the manufacturer's instructions.

8.3 The equipment must be preconditioned with 13.6 kg (30 lb) of the standard contaminated R-12 at an ambient of 21 °C (70 °F) before starting the test cycle. Sample amounts are not to exceed 1.13 kg (2.5 lb) with sample amounts to be repeated every 5 min. The sample method fixture, defined in Fig. 1, shall be operated at 24 °C (75 °F).

8.4 Contaminated R-12 Samples.

8.4.1 Standard contaminated R-12 refrigerant shall consist of liquid R-12 with 100 ppm (by weight) moisture at 21 °C (70 °F) and 45,000 ppm (by weight) mineral oil 525 suspension nominal and 770 ppm by weight of noncondensable gases (air).

8.4.2 High moisture contaminated sample shall consist of R-12 vapor with 1,000 ppm (by weight) moisture.

8.4.3 High oil contaminated sample shall consist of R-12 with 200,000 ppm (by weight) mineral oil 525 suspension viscosity nominal.

8.5 Test Cycle.

8.5.1 After preconditioning as stated in 8.3, the test cycle is started, processing the following contaminated samples through the equipment:

8.5.1.1 3013.6 kg (30 lb) of standard contaminated R-12.

8.5.1.2 1 kg (2.2 lb) of high oil contaminated R-12.

8.5.1.3 4.5 kg (10 lb) of standard contaminated R-12.

8.5.1.4 1 kg (2.2 lb) of high moisture contaminated R-12.

8.6 Equipment Operating Ambient.

8.6.1 The R-12 is to be cleaned to the minimum purity level, as defined in SAE J1991, with the equipment operating in a stable ambient of 10, 21, and 49 °C (50, 70, and 120 °F) and processing the samples as defined in 8.5.

8.7 Sample Analysis.

8.7.1 The processed contaminated sample shall be analyzed according to the following procedure.

8.8 Quantitative Determination of Moisture.

8.8.1 The recycled liquid phase sample of CFC-12 shall be analyzed for moisture content via Karl Fischer coulometer titration or an equivalent method. The Karl Fischer apparatus is an instrument for precise determination of small amounts of water dissolved in liquid and/or gas samples.

8.8.2 In conducting the test, a weighed sample of 30 to 130 grams is vaporized directly into the Karl Fischer analyte. A coulometer titration is conducted and the results are calculated and displayed as parts per million moisture (weight).

8.9 Determination of Percent Lubricant.

8.9.1 The amount of oil in the recycled sample of CFC-12 is to be determined by gravimetric analysis.

8.9.2 Following venting of noncondensable, in accordance with the manufacturer's operating instructions, the refrigerant container shall be shaken for 5 minutes prior to extracting samples for test.

8.9.3 A weighted sample of 175 to 225 grams of liquid CFC-12 is allowed to evaporate at room temperature. The percent oil is to be calculated from the weight of the original sample and the residue remaining after the evaporation.

8.10 Noncondensable Gas.

8.10.1 The amount of noncondensable gas is to be determined by gas chromatography. A sample of vaporized refrigerant liquid shall be separated and analyzed by gas chromatography. A Porapak Q column at 130 °C and a hot wire detector may be used for analysis.

8.10.2 This test shall be conducted on recycled refrigerant (taken from the liquid phase) within 30 minutes after the proper venting of noncondensable.

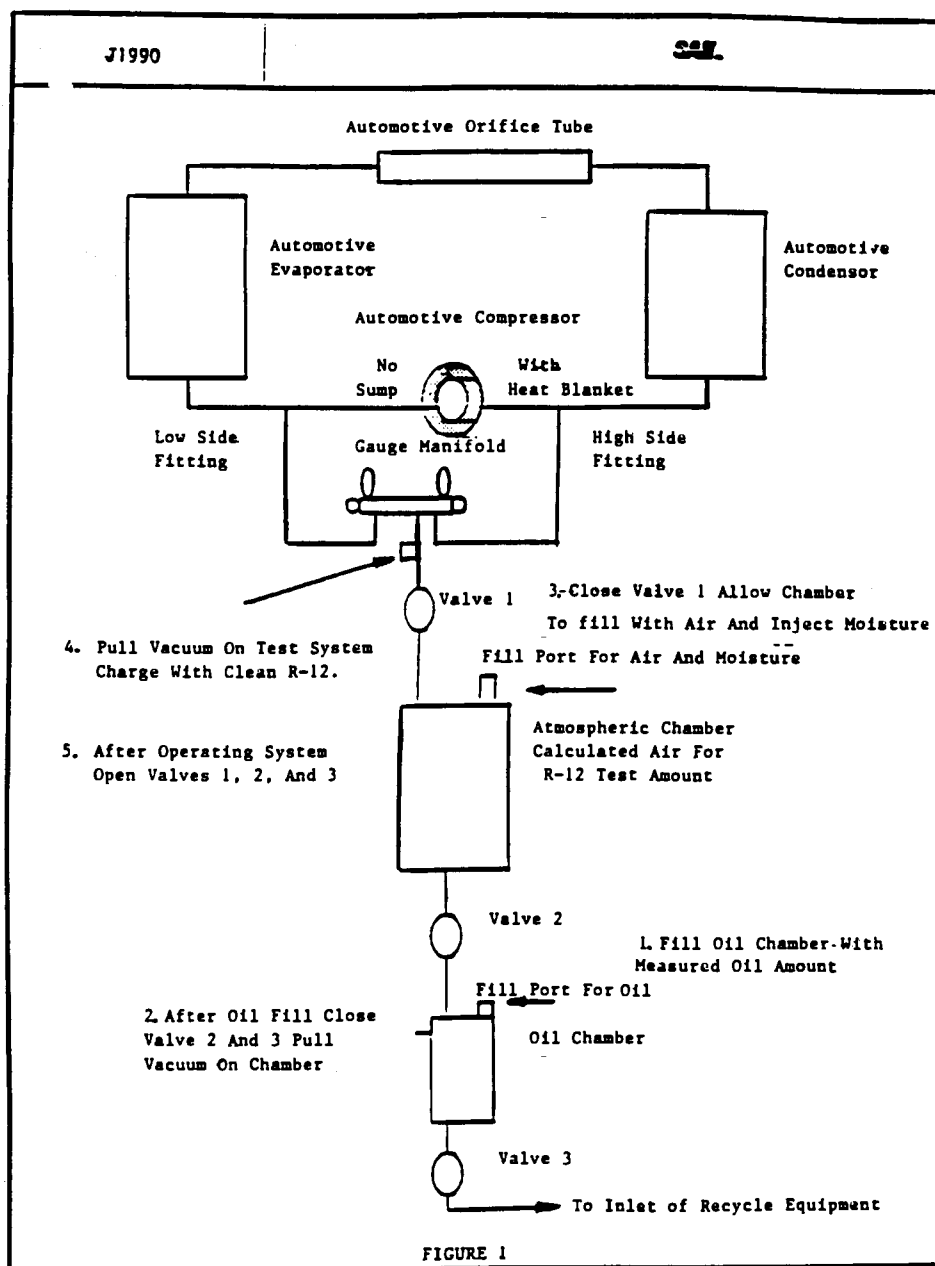
8.10.3 Samples shall be shaken for 8 hours prior to retesting while at a temperature of 24 ± 2.8 °C (75 ± 5 °F). Known volumes of refrigerant vapor are to be injected for separation and analysis by means of gas chromatography. A Porapak Q column at 130 °C (266 °F) and a hot wire detector are to be used for the analysis.

8.10.4 This test shall be conducted at 21 and 49 °C and may be performed in conjunction with the testing defined in Section 8.6. The equipment shall process at least 13.6 kg of standard contaminated refrigerant for this test.

8.11 Sample Requirements.

8.11.1 The sample shall be tested as defined in 8.7, 8.8, 8.9, and 8.10 at ambient temperatures of 10, 21, and 49 °C (50, 70, and 120 °F) as defined in 8.6.1.

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Recommended Service Procedure for the Containment of R-12

1. Scope

During service of mobile air-conditioning systems, containment of the refrigerant is important. This procedure provides service guidelines for technicians when repairing vehicles and operating equipment defined in SAE J1990.

2. References

SAE J1990, Extraction and Recycle Equipment for Mobile Automotive Air-Conditioning Systems

3. Refrigerant Recovery Procedure

3.1 Connect the recovery unit service hoses, which shall have shutoff valves within 12 in (30 cm) of the service ends, to the vehicle air-conditioning system service ports.

3.2 Operate the recovery equipment as covered by the equipment manufacturers recommended procedure.

3.2.1 Start the recovery process and remove the refrigerant from the vehicle AC system. Operate the recovery unit until the vehicle system has been reduced from a pressure to a vacuum. With the recovery unit shut off for at least 5 min, determine that there is no refrigerant remaining in the vehicle AC system. If the vehicle system has pressure, additional recovery operation is required to remove the remaining refrigerant. Repeat the operation until the vehicle AC system vacuum level remains stable for 2 min.

3.3 Close the valves in the service lines and then remove the service lines from the vehicle system. Proceed with the repair/

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service. If the recovery equipment has automatic closing valves, be sure they are properly operating.

4. Service With Manifold Gage Set

4.1 Service hoses must have shutoff valves in the high, low, and center service hoses within 12 in (30 cm) of the service ends. Valves must be closed prior to hose removal from the air-conditioning system. This will reduce the volume of refrigerant contained in the service hose that would otherwise be vented to atmosphere.

4.2 During all service operations, the valves should be closed until connected to the vehicle air-conditioning system or the charging source to avoid introduction of air and to contain the refrigerant rather than vent open to atmosphere.

4.3 When the manifold gage set is disconnected from the air-conditioning system or when the center hose is moved to another device which cannot accept refrigerant pressure, the gage set

hoses should first be attached to the reclaim equipment to recover the refrigerant from the hoses.

5. Recycled Refrigerant Checking Procedure for Stored Portable Auxiliary Container

5.1 To determine if the recycled refrigerant container has excess noncondensable gases (air), the container must be stored at a temperature of 65 °F (18.3 °C) or above for a period of time, 12 h, protected from direct sun.

5.2 Install a calibrated pressure gage, with 1 psig divisions (0.07 kg), to the container and determine the container pressure.

5.3 With a calibrated thermometer, measure the air temperature within 4 in (10 cm) of the container surface.

5.4 Compare the observed container pressure and air temperature to determine if the container exceeds the pressure limits found on Table 1, e.g., air temperature 70 °F (21 °C) pressure must not exceed 80 psig (5.62 kg/cm²).

TABLE 1

Temp °F	Psig	Temp °F	Psig	Temp °F	Psig	Temp °F	Psig	Temp °F	Psig
65	74	75	87	85	102	95	118	105	136
66	75	76	88	86	103	96	120	106	138
67	76	77	90	87	105	97	122	107	140
68	78	78	92	88	107	98	124	108	142
69	79	79	94	89	108	99	125	109	144
70	80	80	96	90	110	100	127	110	146
71	82	81	98	91	111	101	129	111	148
72	83	82	99	92	113	102	130	112	150
73	84	83	100	93	115	103	132	113	152
74	86	84	101	94	116	104	134	114	154

TABLE 1 — METRIC

Temp °C	Pres	Temp °C	Pres	Temp °C	Pres	Temp °C	Pres	Temp °C	Pres
18.3	5.20	23.9	6.11	29.4	7.17	35.0	8.29	40.5	9.56
18.8	5.27	24.4	6.18	30.0	7.24	35.5	8.43	41.1	9.70
19.4	5.34	25.0	6.32	30.5	7.38	36.1	8.57	41.6	9.84
20.0	5.48	25.5	6.46	31.1	7.52	36.6	8.71	42.2	9.98
20.5	5.55	26.1	6.60	31.6	7.59	37.2	8.78	42.7	10.12
21.1	5.62	26.6	6.74	32.2	7.73	37.7	8.92	43.3	10.26
21.6	5.76	27.2	6.88	32.7	7.80	38.3	9.06	43.9	10.40
22.2	5.83	27.7	6.95	33.3	7.94	38.8	9.13	44.4	10.54
22.7	5.90	28.3	7.03	33.9	8.08	39.4	9.27	45.0	10.68
23.3	6.04	28.9	7.10	34.4	8.15	40.0	9.42	45.5	10.82

Pres kg/sq cm.

5.5 If the container pressure is less than the Table 1 values and has been recycled, limits of noncondensable gases (air) have not been exceeded and the refrigerant may be used.

5.6 If the pressure is greater than the range and the container contains recycled material, slowly vent from the top of the container a small amount of vapor into the recycle equipment until the pressure is less than the pressure shown on Table 1.

5.7 If the container still exceeds the pressure shown on Table 1, the entire contents of the container shall be recycled.

6. Containers for Storage of Recycled Refrigerant

6.1 Recycled refrigerant should not be salvaged or stored in disposable refrigerant containers. This is the type of container in which virgin refrigerant is sold. Use only DOT CFR title 49 or UL approved storage containers for recycled refrigerant.

6.2 Any container of recycled refrigerant that has been stored or transferred must be checked prior to use as defined in section 5.

7. Transfer of Recycled Refrigerant

7.1 When external portable containers are used for transfer, the container must be evacuated at least 27 in of vacuum (75 mm Hg absolute pressure) prior to transfer of the recycled refrigerant. External portable containers must meet DOT and UL standards.

7.2 To prevent on-site overfilling when transferring to external containers, the safe filling level must be controlled by weight and must not exceed 60% of container gross weight rating.

8. Disposal of Empty/Near Empty Containers

8.1 Since all the refrigerant may not be removed from disposable refrigerant containers during normal system charging procedures, empty/near empty container contents should be reclaimed prior to disposal of the container.

8.2 Attach the container to the recovery unit and remove the remaining refrigerant. When the container has been reduced from a pressure to a vacuum, the container valve can be closed. The container should be marked empty and is ready for disposal.

Rationale

Not applicable.

Regulations

Relationship of SAE Standard to ISO Standard.

Not applicable.

Reference Section

SAE J1990, Extraction and Recycle Equipment for Mobile Automotive Air-Conditioning Systems

Application

During service of mobile air-conditioning systems, containment of the refrigerant is important. This procedure provides service guidelines for technicians when repairing vehicles and operating equipment defined in SAE J1990.

Committee Composition

Developed by the SAE Defrost and Interior Climate Control Standards Committee

W.J. Atkinson, Sun Test Engineering, Paradise Valley, AZ—Chairman

J.J. Amin, Union Lake, MI

H.S. Andersson, Saab Scania, Sweden

P.E. Anglin, ITT Higbie Mfg. Co., Rochester, MI

R.W. Bishop, GMC, Lockport, NY

D.Hawks, General Motors Corporation, Pontiac, MI

J.J. Hernandez, NAVISTAR, Ft. Wayne, IN

H. Kaltner, Volkswagen AG, Germany, Federal Republic

D.F. Last, GMC, Troy, MI

D.E. Linn, Volkswagen of America, Warren, MI

J.H. McCorkel, Freightliner Corp., Charlotte, NC

C.J. McLachlan, Livonia, MI

H.L. Miner, Climate Control Inc., Decatur, IL

R.J. Niemiec, General Motors Corp., Pontiac, MI

N. Novak, Chrysler Corp., Detroit, MI

S. Oulouhjian, Mobile Air Conditioning Society, Upper Darby, PA

J. Phillips, Air International, Australia

R.H. Proctor, Murray Corp., Cockeysville, MD

G. Rolling, Behr America Inc., Ft. Worth, TX

C.D. Sweet, Signet Systems Inc., Harrodsburg, KY

J.P. Telesz, General Motors Corp., Lockport, NY

Appendix B to Subpart B of Part 82—Standard for Recover Equipment

SAE J1989, Recommended Service Procedure for the Containment of R-12, as set forth under Appendix A, also applies to this Appendix B.

SAE J2209, issued June, 1992.

SAE Recommended Practice: CFC-12 (R-12) Extraction Equipment for Mobile Automotive Air-Conditioning Systems

Foreword

CFCs deplete the stratospheric ozone layer that protects the earth against harmful ultraviolet radiation. To reduce the emissions of CFCs, the 1990 Clean Air Act requires recycle of CFC-12 (R-12) used in mobile air-conditioning systems to eliminate system venting during service operations. SAE J1990 establishes equipment specifications for on-site recovery and reuse of CFCs in mobile air-conditioning systems. Establishing extraction equipment specifications for CFC-12 will provide service facilities with equipment to assure that venting of refrigerant will not occur.

1. Scope

The purpose of this document is to provide equipment specifications for CFC-12 (R-12) recovery for recycling on-site or for

transport off-site to a refrigerant reclamation facility that will process it to ARI (Air-Conditioning and Refrigeration Institute) standard 700-93 as a minimum. It is not acceptable that the refrigerant removed from a mobile air-conditioning system, with this equipment, be directly returned to a mobile air-conditioning system.

This information applies to equipment used to service automobiles, light trucks, and other vehicles with similar CFC-12 systems.

2. References

2. Applicable Documents—The following documents form a part of this specification to the extent specified herein.

2.1.1 SAE Publications—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J639—Vehicle Service Coupling

SAE J1990—Extraction and Recycle Equipment for Mobile Automotive Air-Conditioning Systems

SAE J2196—Service Hose for Automotive Air-Conditioning

2.1.2 ARI Publications—Available from Air-Conditioning and Refrigeration Institute, 1501 Wilson Boulevard, Sixth Floor, Arlington, VA 22209.

ARI 700-93—Specifications for Fluorocarbon Refrigerants

2.1.3 CGA Publications—Available from CGA, Crystal Gateway #1, Suite 501, 1235 Jefferson Davis Highway, Arlington, VA 22202.

CGA S-1.1—Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases

2.1.4 DOT Specifications—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

49 CFR, Section 173.304—Shippers—General Requirements for Shipments and Packagings

2.1.5 UL Publications—Available from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 1769—Cylinder Valves

3. Specifications and General Description

3.1 The equipment must be able to extract CFC-12 from a mobile air-conditioning system.

3.2 The equipment discharge or transfer fitting shall be unique to prevent the unintentional use of extracted CFC-12 to be used for recharging auto air conditioners.

3.3 The equipment shall be suitable for use in an automotive service garage environment as defined in 6.8.

3.4 Equipment Certification—The equipment must be certified by Underwriters Laboratories or an equivalent certifying laboratory to meet this standard.

3.5 Label Requirements—The equipment shall have a label "Design Certified by (company name) to meet SAE J2209 for use with CFC-12. The refrigerant from this equipment must be processed to ARI 700-93 specifications before reuse in a mobile air-conditioning system." The minimum letter size shall be bold type 3mm in height.

4. Safety Requirements

4.1 The equipment must comply with applicable federal, state and local requirements on equipment related to the handling of R-12 material. Safety precautions or notices or labels related to the safe operation of the equipment shall also be prominently displayed on the equipment and should also state "CAUTION—SHOULD BE OPERATED BY CERTIFIED PERSONNEL." The safety identification shall be located on the front near the controls.

4.2 The equipment must comply with applicable safety standards for electrical and mechanical requirements.

5. Operating Instructions

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5.1 The equipment manufacturer must provide operating instructions, necessary maintenance procedures and source information for replacement parts and repair.

5.2 The equipment must prominently display the manufacturer's name, address and any items that require maintenance or replacement that affect the proper operation of the equipment. Operation manuals must cover information for complete maintenance of the equipment to assure proper operation.

6. Functional Description

6.1 The equipment must be capable of ensuring recovery of the CFC-12 from the system being serviced, by reducing the system pressure to a minimum of 102 mm of mercury below atmospheric. To prevent system delayed outgassing, the unit must have a device that assures that the refrigerant has been recovered from the air-conditioning system.

6.1.1 Testing laboratory certification of the equipment capability is required which shall process contaminated refrigerant samples at specific temperatures.

6.2 The equipment must be preconditioned with 13.6 kg of the standard contaminated CFC-12 at an ambient of 21 °C before starting the test cycle. Sample amounts are not to exceed 1.13 kg with sample amounts to be repeated every 5 minutes. The sample method fixture defined in Figure 1 of appendix A shall be operated at 24 °C. Contaminated CFC-12 samples shall be processed at ambient temperatures of 10 and 49 °C.

6.2.1 Contaminated CFC-12 sample.

6.2.2 Standard contaminated CFC-12 refrigerant, 13.6 Kg sample size, shall consist of liquid CFC-12 with 100 ppm (by weight) moisture at 21 °C and 45,000 ppm (by weight) mineral oil 525 suspension nominal and 770 ppm (by weight) of noncondensable gases (air).

6.3 Portable refillable containers used in conjunction with this equipment must meet applicable DOT standards.

6.3.1 The container color must be gray with yellow top to identify that it contains used CFC-12 refrigerant. It must be permanently marked on the outside surface in black print at least 20 mm high "DIRTY R-12—DO NOT USE, MUST BE REPROCESSED".

6.3.2 The portable refillable container shall have a SAE 3/8 inch flare male thread connection as identified in SAE J639 CFC-12 High Pressure Charging Valve Figure 2.

6.3.3 During operation the equipment shall provide overfill protection to assure that the storage container liquid fill does not exceed 80% of the tank's rated volume at 21 °C per DOT standard, CFR Title 49, section 173.304 and the American Society of Mechanical Engineers.

6.4 Additional Storage Tank Requirements.

6.4.1 The cylinder valve shall comply with the standard for cylinder valves, UL 1769.

6.4.2 The pressure relief device shall comply with the pressure relief device standard part 1, CGA pamphlet S-1.1.

6.4.3 The container assembly shall be marked to indicate the first retest date, which shall be 5 years after date of manufacture. The marking shall indicate that retest must be performed every subsequent five years. The marking shall be in letters at least 6 mm high.

6.5 All flexible hoses must meet SAE J2196 standard for service hoses.

6.6 Service hoses must have shutoff devices located within 30 cm of the connection point to the system being serviced to minimize introduction of noncondensable gases into the recovery equipment during connection and the release of the refrigerant during disconnection.

6.7 The equipment must be able to separate the lubricant from the recovered refrigerant and accurately indicate the amount removed from the system during processing in 30 ml units.

6.7.1 The purpose of indicating the amount of lubricant removed is to ensure that a proper amount is returned to the mobile air-conditioning system for compressor lubrication.

6.7.2 Refrigerant dissolved in this lubricant must be accounted for to prevent system lubricant overcharge of the mobile air-conditioning system.

6.7.3 Only new lubricant, as identified by the system manufacturer, should be replaced in the mobile air-conditioning system.

6.7.4 Removed lubricant from the system and/or the equipment shall be disposed of in accordance with applicable federal, state and local procedures and regulations.

6.8 The equipment must be capable of continuous operation in ambient temperatures of 10 °C to 49 °C and comply with 6.1.

6.9 The equipment should be compatible with leak detection material that may be present in the mobile air-conditioning system.

7.0 For test validation, the equipment is to be operated according to the manufacturer's instructions.

[60 FR 21688, May 2, 1995]

Appendix C to Subpart B of Part 82—SAE J2788 Standard for Recovery/Recycle and Recovery/Recycle/Recharging Equipment for HFC-134a Refrigerant

Foreword

This Appendix establishes the specific minimum equipment requirements for the recovery/recycling of HFC-134a that has been directly removed from, and is intended for reuse in, mobile air-conditioning systems and recovery/recycling and system recharging of recycled, reclaimed or virgin HFC-134a. Establishing such specifications will ensure that system operation with recycled HFC-134a will provide the same level of performance and durability as new refrigerant.

1. Scope

The purpose of this SAE Standard is to establish the specific minimum equipment performance requirements for recovery and recycling of HFC-134a that has been directly removed from, and is intended for reuse in, mobile air-conditioning (A/C) systems. It also is intended to establish requirements for equipment used to recharge HFC-134a to an accuracy level that meets Section 9 of this document and SAE J2099. The requirements apply to the following types of service equipment and their specific applications.

- a. Recovery/Recycling Equipment,
- b. Recovery/Recycling—Refrigerant Charging,
- c. Refrigerant Recharging Equipment Only.

1.1 Improved refrigerant recovery equipment is required to ensure adequate refrigerant recovery to reduce emissions and provide for accurate recharging of mobile air conditioning systems. Therefore, 12 months following the publication date of this standard, requirements in this standard supplements and supersedes, SAE J2210.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

Regulations

SAE J2099 Standard of Purity for Recycled HFC–134a (R–134a) for Use in Mobile Air-Conditioning Systems

SAE J2196 Service Hoses for Automotive Air-Conditioning

SAE J2197 Service Hose Fittings for Automotive Air-Conditioning

SAE J2296 Retest of Refrigerant Container

2.1.2 CGA Publications

Available from CGA, 4221 Walney Road, 5th Floor, Chantilly VA 20151–2923, Tel: 703–788–2700, <http://www.cganet.com>.

CGA Pamphlet S–1.1 Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases 2.1.3 DOT Publications

Available from the Superintendent of Documents, U.S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402–9320.

OT Standard, CFR Title 49, Section 173.304 Shippers—General Requirements for Shipments and Packagings

2.1.4 UL Publications

Available from Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062–2096, Tel: 847–272–8800, <http://www.ul.com>.

UL 1769 Cylinder Valves

UL 1963 Refrigerant Recovery/Recycling Equipment

3. Specification and General Description

3.1 The equipment must be able to remove and process HFC–134a (R–134a) from mobile A/C systems to the purity level specified in SAE J2099.

3.2 The equipment shall be suitable for use in an automotive service garage environment and be capable of continuous operation in ambients from 10°C to 49°C (50 °F to 120°F). If it is designed to recharge a system, and it uses a scale for this purpose, the scale must demonstrate the ability to maintain accuracy per the test in 10.2.

3.3 The equipment must be certified that it meets this specification by an EPA listed certifying laboratory.

3.4 The equipment shall have a label, which states, “Certified by (Certifying Agent) to Meet SAE J2788 superseding SAE J2210” in bold-type letters a minimum of 3 mm (1/8 in) in height.

4. Refrigerant Recycling Equipment Requirements

4.1 Moisture and Acid

The equipment shall incorporate a desiccant package that must be replaced before saturation with moisture, and whose mineral acid capacity is at least 5% by weight of the dry desiccant.

4.1.1 The equipment shall be provided with a means of indicating when the filter desiccant moisture capacity has reached the allowable limit and desiccant replacement is required. This may include a reliable means of detecting moisture level or an algorithm based on the amount refrigerant recovered. The user must be clearly alerted to replace the filter prior to the full saturation. Warnings shall be displayed on screens and (printed on printouts where applicable). The warnings must explain that the machine is approaching the end of filter life. The manufacturer must incorporate a lockout when the end of filter life is reached.

4.1.2 The manufacturer shall use an identification system to ensure that a new filter has been installed to reset the machine for operation.

4.2 Filter

The equipment shall incorporate an in-line filter that will trap particulates of 15 micron spherical diameter or greater.

4.3 Scale (if used)

The scale must maintain accuracy when moved, as per the test in Section 10.

4.4 Purging Noncondensable Gases

4.4.1 The equipment shall automatically purge noncondensables (NCGs), which are primarily air, if the acceptable level is exceeded. NCG removal must be part of the normal operation of the equipment and instructions must be provided to enable the task to be accomplished within 30 min (to reach the refrigerant purity level specified in SAE J2099).

4.4.2 Refrigerant loss from noncondensable gas purging during the testing described in Section 8 shall be minimized by a method that initiates a purge when the machine has not been in use for a period long enough for air-refrigerant separation in the tank to have occurred.

4.5 Recharging and Transfer of Recycled Refrigerant

Recycled refrigerant for recharging and transfer shall be taken from the liquid phase only.

5. Safety Requirements

5.1 The equipment must comply with applicable federal, state, and local requirements on equipment related to handling HFC–134a material. Safety precautions or notices related to safe operation of the equipment shall be prominently displayed on the equipment and should also state “CAUTION—SHOULD BE OPERATED BY QUALIFIED PERSONNEL.”

5.2 Under NO CIRCUMSTANCES should any equipment be pressure tested or leak tested with air/HFC–134a mixtures.

Do not use compressed air (shop air) or leak detection in systems containing HFC–134a.

6. Operating Instructions

6.1 The equipment manufacturer shall provide a warning in the instruction manual regarding the possibility of refrigerant contamination in the mobile A/C system being serviced.

6.1.1 If recovery/recycle equipment has refrigerant identification equipment, the refrigerant identification equipment shall meet the requirements of SAE J1771.

6.1.2 Recovery/recycling equipment not having refrigerant identification capability shall have instructions in the equipment manual covering possible contamination problems to the equipment and the contamination of the existing recycled refrigerant in the container in the equipment.

6.2 The equipment manufacturer must provide operating instructions, including proper attainment of vehicle system vacuum (i.e., when to stop the extraction process), filter/desiccant replacement, and purging of noncondensable gases (air). Also to be included are any other necessary maintenance procedures, source information for replacement parts and, repair and safety precautions.

6.2.1 The manual shall identify the proper maintaining of hose and seals to prevent the addition of excess air, due to leaks, during the recovery process, which would increase the NCG level in the recovered refrigerant.

6.3 The equipment must prominently display the manufacturer's name, address, the type of refrigerant it is designed to recycle, a service telephone number, and the part number for the replacement filter/drier.

7. Functional Description

The ability of the equipment to meet the refrigerant recovery and recharge specifications of this section shall be determined by the test procedures of Section 10.

7.1 The equipment must be capable of continuous operation in ambient temperatures of 10°C (50°F) to 49°C (120 °F). Continuous is defined as completing recovery/recycle and recharge (if applicable) operations with no more than a brief reset period between vehicles, and shall not include time delays for allowing a system to outgas (which shall be part of the recovery period provided by this standard). Continuous may include time out for an air

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purge if necessary, although it is understood that extended equipment-off time is preferred to allow NCG and refrigerant separation in the supply tank for optimum results.

7.1.1 The equipment shall be capable of removing a minimum of 95.0% of the refrigerant from the test system in 30 minutes or less, without external heating, or use of any device (such as shields, reflectors, special lights, etc.) which could heat components of the system. The recovery procedures shall be based on 21 to 24°C (70 to 75°F) ambient temperature. The test system for qualifying shall be a 1.4 kg (3.0 lbs) capacity orifice tube/accumulator system in a 2005 Chevrolet Suburban with front and rear A/C, or the test option described in 10.5, and shall be determined by accurately weighing the recovery machine with the resolution and accuracy of within 3 g (.006 lb) in the range of the machine's weight. The laboratory shall maintain records of the vehicle, including its VIN (vehicle identification number).

7.1.2 However, the preceding shall not preclude a brief period of engine operation at fast idle (up to 15 minutes, up to 2000 rpm) to circulate refrigerant and oil, and provide some engine and warm-up of A/C refrigeration components. The laboratory shall monitor coolant temperature per the vehicle engine coolant temperature sensor, and coolant temperature shall not be allowed to exceed 105°C (221°F). The time required shall not be included in the total time of 30 minutes set forth in 7.1.1.

7.1.3 The refrigerant that is recovered, following oil separation, shall be measured and the quantity displayed, accurate to within ±30 g (1.0 oz). The equipment must include a provision for checking the accuracy, per the requirements of 9.1.

7.2 During recovery operation, the equipment shall provide overfill protection to assure that the liquid fill of the storage container (which may be integral or external) does not exceed 80% of the tank's rated volume at 21°C per Department of Transportation (DOT) Standard, CFR Title 49, Section 173.304 and the American Society of Mechanical Engineers.

7.3 Portable refillable tanks or containers used in conjunction with this equipment must be labeled "HFC-134a (R-134a)," meet applicable Department of Transportation (DOT) or Underwriters Laboratories (UL) Standards, and shall incorporate fittings per SAE J2197.

7.3.1 The cylinder valve shall comply with the standard for cylinder valves, UL 1769.

7.3.2 The pressure relief device shall comply with the Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases, CGA Pamphlet S-1.1.

7.3.3 The tank assembly shall be marked to indicate the first retest date, which shall be 5 years after the date of manufacture. The marking shall indicate that retest must be performed every subsequent 5 years. SAE J2296 provides an inspection procedure. The marking shall be in letters at least 6 mm (¼ in) high.

7.3.4 ASME tanks as defined in UL-1963 may be used and are exempt from the retest requirements.

7.3.5 If the machine is designed for recharging, and the marketer permits use of a non-refillable refrigerant tank, the machine shall include a way to ensure refrigerant remaining in the tank (called the "heel") to no more than 2% of tank rated capacity when the tank is indicated to be empty. This may be done by the machine marketer as follows:

- Specify a non-venting procedure, to minimize the amount of unused refrigerant remaining in the tank. The machine shall include any devices required for the procedure, other than ordinary service shop tools and supplies, and include in the operator's manual, any instructions.
- Provide an automatic or (with instructions in the operator's manual) semiautomatic non-venting procedure with the machine.

The laboratory shall test for the 2% capability. For testing purposes it may use a refillable tank, minimum 15 lb capacity (6.8 kg) containing a minimum of 7.5 lbs (3.4 kg) refrigerant. The test is as follows:

a. Weigh the tank at the start of the test, on a scale accurate to plus/minus 3 grams, to ensure it contains sufficient refrigerant.

b. Operate the machine to remove refrigerant from the tank, charging into a holding container until the tank is indicated to be empty. Continue with the marketer's recommended procedure for the 2% capability.

c. Weigh the tank, on a scale accurate to plus/minus 3 grams.

d. Using the recovery compressor and/or a vacuum pump, draw the tank into a vacuum of 9 to 10 inches Mercury (225 to 250 mm Mercury). The tank must hold that vacuum with a decay of less than 10% in 10 minutes. If vacuum decays 10% or more, the procedure shall be repeated as necessary to ensure the tank is empty.

e. Weigh the tank on a scale accurate to plus/minus 3 grams. The difference in weight from Steps 3 to 5 shall be within 2% of the weight of the amount of refrigerant that is the tanks rated capacity.

f. This test may be performed at the conclusion of testing in 10.4 or 10.5. If the machine passes or has passed all other testing in this standard, the marketer may make modifications in procedure and/or machine operation and retest once at a later date, within 90 days. If the machine fails the retest, the machine must be completely retested per this standard, or may be certified per the following alternative. The marketer of the machine may specify use of a nonrefillable refrigerant tank that provides for recycling and/or disposal of the residual refrigerant, in either case in a manner that does not vent. Or the marketer may exclude use of a one-way container, in the machine's operating instructions.

7.4 All flexible hoses must comply with SAE J2196.

7.5 Service hoses must have shutoff devices located at the connection point to the system being serviced. Any hoses or lines connected to refrigerant containers on or in the machine also shall have shutoff devices at the connection points, so that the containers may be changed without loss of refrigerant. A tank that is a permanent installation is exempt from this requirement.

7.6 The equipment shall separate oil from the refrigerant, measure the amount accurate to 20 ml (0.7 oz.), so the technician has an accurate basis for adding oil to the system.

7.6.1 This statement shall be predominately identified in the equipment service manual.

Note: Use only new lubricant to replace the amount removed during the recycling process. Used lubricant should be discarded per applicable federal, state and local requirements.

8. Testing

This test procedure and its requirements are to be used to determine the ability of the recycling equipment to adequately recycle contaminated refrigerant.

8.1 The equipment shall be able to clean the contaminated refrigerant in §8.3 to the purity level defined in SAE J2099.

8.2 The equipment shall be operated in accordance with the manufacturer's operating instructions.

8.3 Contaminated HFC-134a (R-134a) Sample

8.3.1 The standard contaminated refrigerant shall consist of liquid HFC-134a with 1300 ppm (by weight) moisture (equivalent to saturation at 38°C, 100°F), 45000 ppm (by weight) HFC-134a compatible lubricant, and 1000 ppm (by weight) of noncondensable gases (air).

8.3.1.1 The HFC-134a compatible lubricant referred to in 8.3.1, shall be polyalkylene glycol (PAG), ISO 100 such as UCLN or PAG ISO 46-55, such as Idemitsu or equivalent, which shall contain no more than 1000 ppm by weight of moisture.

Regulations

8.3.1.2 Although the test lubricant is a PAG, to conform to that used in the test vehicle system, the equipment manufacturer also shall ensure that it is compatible with polyol ester lubricant, such as ND 11 as used in electrically driven compressors in some hybrid vehicles.

8.4 Test Cycle

8.4.1 The equipment must be preconditioned by processing 13.6 kg (30 lb) of the standard contaminated HFC-134a at an ambient of 21 to 24°C (70 to 75°F) before starting the test cycle. 1.13 kg (2.56 lb) samples are to be processed at 5 min intervals. The test fixture, depicted in Figure 1, shall be operated at 21 to 24°C (70 to 75°F).

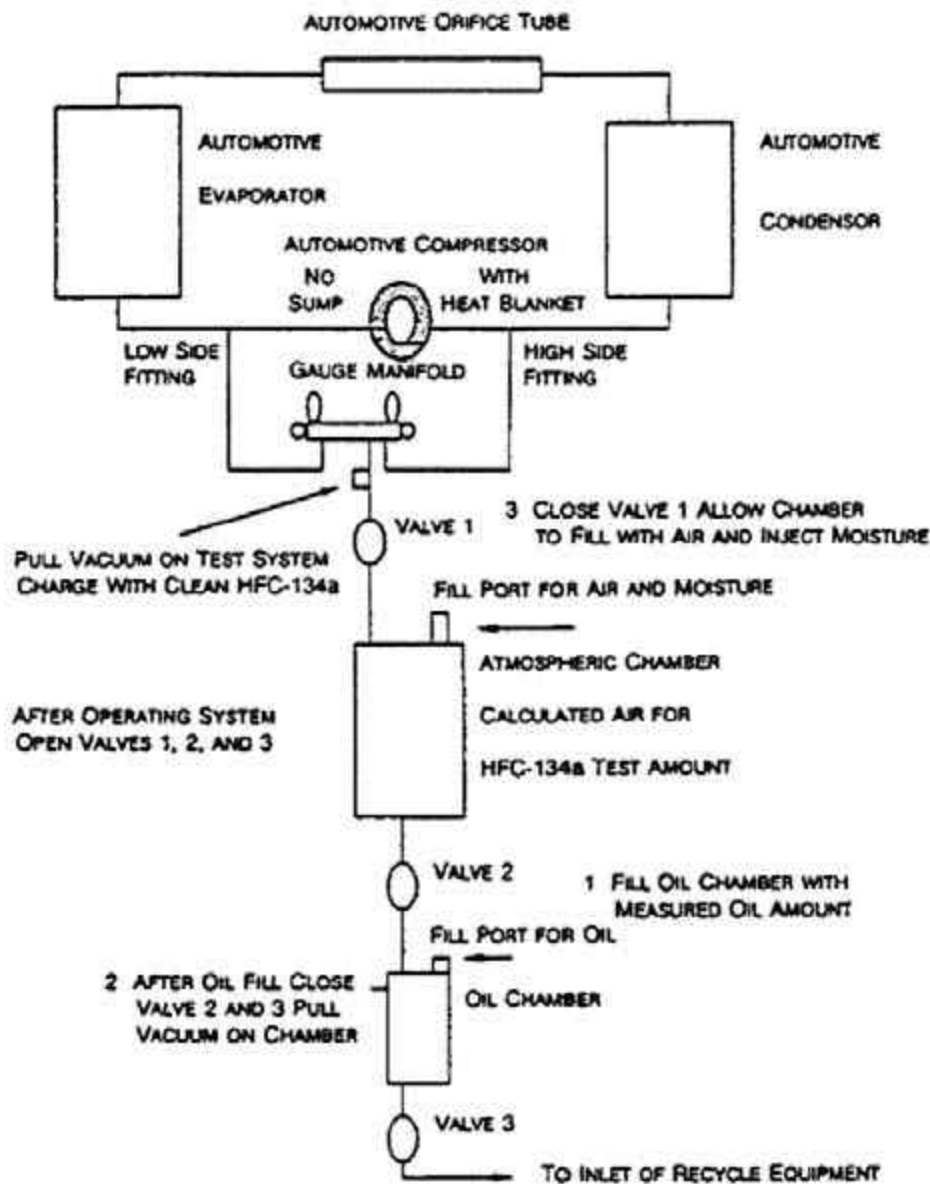


Figure 1—Test Fixture

8.4.2 Following the preconditioning procedure per 8.4.1, 18.2 kg (40 lb) of standard contaminated HFC-134a are to be processed by the equipment.

8.5 Sample Requirements

8.5.1 Samples of the standard contaminated refrigerant from 8.3.1 shall be processed as required in 8.6 and shall be analyzed after said processing as defined in 8.7, 8.8, and 8.9. Note exception for noncondensable gas determination in 8.9.4.

8.6 Equipment Operating Ambient

8.6.1 The HFC-134a is to be cleaned to the purity level, as defined in SAE J2099, with the equipment operating in a stable ambient of 10, 21, and 49°C (50, 70 and 120 °F) while processing the samples as defined in 8.4.

8.7 Quantitative Determination of Moisture

8.7.1 The recycled liquid phase sample of HFC-134a shall be analyzed for moisture content via Karl Fischer coulometric

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titration, or an equivalent method. The Karl Fischer apparatus is an instrument for precise determination of small amounts of water dissolved in liquid and/or gas samples.

8.7.2 In conducting this test, a weighed sample of 30 to 130 g is vaporized directly into the Karl Fischer anolyte. A coulometric titration is conducted and the results are reported as parts per million moisture (weight).

8.8 Determination of Percent Lubricant

8.8.1 The amount of lubricant in the recycled HFC-134a sample shall be determined via gravimetric analysis. The methodology must account for the hygroscopicity of the lubricant.

8.8.2 Following venting of noncondensable gases in accordance with the manufacturer's operating instructions, the refrigerant container shall be shaken for 5 min prior to extracting samples for testing.

8.8.3 A weighed sample of 175 to 225 g of liquid HFC-134a is allowed to evaporate at room temperature. The percent lubricant is calculated from weights of the original sample and the residue remaining after evaporation.

8.9 Noncondensable Gases—Testing for Amount

8.9.1 The amount of noncondensable gases shall be determined by gas chromatography. A sample of vaporized refrigerant liquid shall be separated and analyzed by gas chromatography. A Porapak Q column at 130°C (266°F) and a hot wire detector may be used for the analysis.

8.9.2 This test shall be conducted on liquid phase samples of recycled refrigerant taken from a full container as defined in 7.2 within 30 min following the proper venting of noncondensable gases.

8.9.3 The liquid phase samples in 8.9.2 shall be vaporized completely prior to gas chromatographic analysis.

8.9.4 This test shall be conducted at 10 and 49°C (50 and 120°F) and may be performed in conjunction with the testing defined in 8.6. The equipment shall process at least 13.6 kg (30 lb) of standard contaminated refrigerant for this test.

8.9.5 The equipment shall be capable of charging refrigerant into systems with various lubrication types and shall deliver less than 1% by weight residual oil during system charge if the machine permits oil charging with refrigerant (due to residual oil in the service hoses and recovery unit refrigerant circuit from prior recovery, diagnostics and oil injection. This shall be determined during SAE J2099 testing.)

9. Recharging the System

9.1 It is the responsibility of the equipment manufacturer to ensure that the vacuum removal performance leaves the system 98% free of NCGs before recharging, following recovery and recycle under the provisions of this document.

The equipment must be capable of both indicating and recharging the system to within 15 g (0.50 oz) of vehicle manufacturer's specifications. The laboratory shall test for this capability by choosing a charge amount that is within the range of the vehicle manufacturer's specifications. The equipment must indicate and charge the system with that chosen amount, within ± 15 g (0.5 oz).

Example: If 500 g is chosen, the actual and indicated charge must be 485 to 515 g, with any difference between actual and indicated charge within the laboratory scale accuracy requirements of this standard. If a scale is used in the machine, the equipment manufacturer shall provide a method or service for the technician to check scale accuracy, and include any necessary accuracy-checking device (such as a calibration weight(s)) with the machine. If a mass flow system is used for charge determination, it must maintain accuracy equal to the 15 g (0.50 oz) specification. The equipment manufacturer shall provide a method for checking accuracy and include any necessary accuracy testing device(s) with the machine. If the accuracy testing device(s) for a

scale or mass flow machine includes a consumable, the manufacturer shall include a quantity of replacement or refill devices for five years of periodic testing as recommended.

9.2 If any other system is used for charge determination, such as a positive displacement pump, the equipment manufacturer shall provide a method and any needed device(s) to check accuracy that is/are appropriate for its method of operation, including any temperature-compensating trim if used.

10. Equipment Test Procedure by Laboratory for Recovery/Recycling and Recovery/Recycling/Recharging Machines

10.1 Preliminary: Ambient (in shop) temperature shall be 21 to 24°C (70 to 75°F). Test vehicle shall be "overnight cold" (not run for at least eight hours).

10.2 The machine must have a selfcontained provision for checking accuracy of the indicated amount of refrigerant recovered in liquid or vapor or mixture form(s) from a vehicle system and (if applicable) charged into a vehicle, and adjusting if necessary, to meet requirements of 9.1, 9.2. Therefore: If the machine uses a scale for that purpose, check the accuracy of that scale and make any adjustment if necessary. If an alternative method of measuring refrigerant is used, follow the equipment manufacturer's procedure for ensuring accuracy. Next, move the machine, such as by rolling it, along the floor, a minimum of 20 feet (6.1 meters) within 10 seconds. Follow with the test procedure in 10.3, then 10.4 or 10.5.

10.3 Test Procedure

If desired, this test procedure may be preceded by engine/system operation for up to 15 minutes, up to 2000 rpm.

1. You must start with an empty system, using this method: (a) Operate machine to recover refrigerant, per equipment manufacturer's instructions. (b) Deepvacuum system to a minimum of 710 mm (28 in) of mercury. (c) Monitor vacuum for decay, checking every 20 minutes. If decay exceeds 75 mm (3 in), deep vacuum the system again. When system holds 710 mm (28 in) ± 0 /-75 mm (3 in) of mercury vacuum for three hours, it is considered empty.

2. Place machine on a platform scale with the capacity to weigh the recovery/recycle/recharge machine, and with the resolution and accuracy of within ± 3 g (.006 lb) in the range of the machine's weight. Weight should include the machine's service hoses draped over the machine, and with the machine's oil reservoir removed. If necessary to add oil to vehicle system as a result of a system operation preparatory to the recovery process, inject the needed quantity through the service valve at this time.

3. Record weight of machine in as weight A.

4. Reconnect service hoses to the test vehicle.

5. Follow the equipment manufacturer's specified procedure for charging the vehicle manufacturer's recommended amount of refrigerant into the system. Note: if this does not apply to the machine under test, i.e. a recovery/recycling only machine, the use of charging equipment that meets this standard and the platform scale shall be used to verify the accuracy of the charge.

6. Disconnect the service hoses from the test vehicle and drape them on the machine. Check and record the weight of the machine. Record this weight as weight B. The difference between weight A and weight B should be equal to the recommended charge that was installed per the machine's display, within 15 g (0.5 oz). If the difference is greater than 15 g (± 3 g), the machine fails the charge accuracy test, and no other tests shall be performed at that time. The manufacturer must document changes made to improve accuracy and furnish them to the laboratory prior to a new test. Exception: If the maximum deviation is no more than a total of 20 g, the calibration of the scale or other measuring system may be rechecked and readjusted once, and the entire test repeated just once.

10.4 Recovery Test Using a Vehicle

Regulations

1. Following a successful system charge, the system and engine shall be run for 15 minutes at 2000 rpm to circulate oil and refrigerant, following which engine and system shall rest for eight hours. Then the laboratory may begin the recovery test. If the machine manufacturer specifies, operate the engine/system for up to 15 minutes, at up to 2000 rpm, then shut off engine/system.

2. If the machine has an automatic air purge, disable it. Check the weight of the machine with the platform scale (service hoses draped over machine, oil reservoir removed). Record the number as Weight C. Reinstall oil reservoir if it had been removed in the recovery procedure.

3. Start timer. Connect service hoses to system of test vehicle and perform recovery per the equipment manufacturer's instructions. The vehicle system service valves' cores must remain in the fittings for this procedure.

4. When recovery is completed, including from service hoses if that is part of the recommended procedure, disconnect hoses and drape over machine. Stop timer. The elapsed time shall be 30.0 minutes or less. If it is in excess of this time, the machine fails the test and no retest is allowed. The manufacturer must document changes made to the machine to improve its performance before a new test is allowed, and furnish them to the laboratory.

5. If the recovery is completed in no more than the 30.0 minutes, measure the oil level in the reservoir, remove the reservoir and then determine the amount of refrigerant recovered, as detailed in Nos. 6 and 7: As measured by the machine and also by noting the weight of the platform scale, which shall be recorded as Weight D.

6. The platform scale shall indicate that a minimum of 95% of the amount charged into the system has been recovered. If the platform scale indicates a lower percentage has been recovered, the machine fails the recovery test.

7. The machine display shall indicate that a minimum of 95.0% of the amount charged into the system has been recovered, within a tolerance of ± 30 g (1 oz) when compared with the platform scale (Weight D minus Weight C). The 30 g (1 oz) tolerance may produce a machine display reading that is below the 95.0% recovery. If a greater difference between machine and platform scale occurs, the machine fails the recovery test.

10.5 Recovery Test Fixture Test Option

If an equipment manufacturer chooses, as an alternative to the actual vehicle, it may certify to SAE J2788 with a laboratory fixture that is composed entirely of all the original equipment parts of a single model year for the 3.0 lb capacity front/rear A/C system in the 2005–07 Chevrolet Suburban. All parts must be those OE-specified for one model year system and no parts may be eliminated or bypassed from the chosen system, or reproduced by a non-OE source. No parts may be added and/or relocated from the OE position in the 2005–07 Suburban. No parts may be modified in any way that could affect system performance for testing under this standard, except adding refrigerant line bends and/or loops to make the system more compact. Reducing the total length of the lines, however, is not permitted. The fixture system shall be powered by an electric motor, run at a speed not to exceed 2000 rpm, and for this test option, no system warm-up or equivalent procedure may be used. The certifying laboratory shall maintain records of all parts purchased, including invoices and payments. The assembly of the parts shall, as an outside-the-vehicle package, duplicate the OE system and its routing, including bends, except for permitted additions of bends and/or loops in refrigerant lines. Aside from the absence of engine operation and the limitations posed by the standard and the use of the electric motor, the test shall otherwise be the same as the test on the Suburban, including test temperature.

Appendix D to Subpart B of Part 82—Standard for HFC-134a Recover-Only Equipment

SAE J2211, Recommended Service Procedure for Containment of HFC-134a, as set forth under Appendix C of this subpart, also applies to this Appendix D

SAE J1732, issued December, 1994.

HFC-134a (R-134a) Extraction Equipment for Mobile Automotive Air-Conditioning Systems

Foreword

Appendix C established equipment specifications for on-site recovery and reuse of HFC-134a in air-conditioning systems. These specifications are for HFC-134a extraction only equipment that are intended to be used in conjunction with the on-site recycling equipment currently used at service facilities, or allow for off-site refrigerant reclamation.

1. Scope

The purpose of this standard is to provide equipment specification for only the recovery of HFC-134a refrigerant to be returned to a refrigerant reclamation facility that will process it to ARI Standard 700–93 or allow for recycling of the recovered refrigerant to SAE J2210 specifications by using Design Certified equipment of the same ownership. It is not acceptable that refrigerant removed from a mobile air conditioning system with this equipment be directly returned to a mobile air-conditioning system.

This information applies to equipment used to service automobiles, light trucks, and other vehicles with similar HFC-134a air conditioning systems.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified.

2.1.1 SAE Publications—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096–0001.

SAE J639—Vehicle Service Coupling

SAE J2210—HFC-134a Recycling Equipment for Mobile Automotive Air Conditioning Systems

SAE J2196—Service Hoses for Automotive Air-Conditioning

SAE J2197—Service Hose Fittings for Automotive Air-Conditioning

2.1.2 ARI Publication—Available from Air Conditioning and Refrigerant Institute, 1501 Wilson Blvd. Sixth Floor, Arlington, VA 22209.

ARI 700–93—Specifications for Fluorocarbon Refrigerants

2.1.3 CGA Publications—Available from CGA, 1235 Jefferson Davis Highway, Arlington, VA 22202.

CGA Pamphlet S–1.1—Pressure Relief Device Standard
Part 1—Cylinders for Compressed Gases

2.1.4 DOT Publications—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

DOT Standard, 49 CFR 49 173.304—Shippers-General Requirements for Shipments and Packagings

2.1.5 UL Publications—Available from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062–2096.

UL 1769—Cylinder Valves

3. Specification and General Description

3.1 The equipment must be able to extract HFC-134a from a mobile air-conditioning system.

3.2 The equipment shall be suitable for use in an automotive service garage environment as defined in section 6.8.

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3.3 Equipment Certification—The equipment shall be certified by Underwriters Laboratories or an equivalent certifying laboratory to meet this standard.

3.4 Label Requirements—The equipment shall have a label “Design Certified by (Company Name) to meet SAE J1732 for use only with HFC-134a. The refrigerant from this equipment must be processed to ARI 700–93 specifications or to SAE J2210 specifications by using Design Certified equipment of the same ownership.” The minimum letter size shall be bold type 3 mm in height.

4. Safety Requirements

4.1 The equipment must comply with applicable federal, state, and local requirements on equipment related to the handling of HFC-134a material. Safety precautions or notices or labels related to the safe operation of the equipment shall also be prominently displayed on the equipment and should state “CAUTION—SHOULD BE OPERATED BY CERTIFIED PERSONNEL.” The safety identification shall be located on the front near the controls.

4.2 The equipment must comply with applicable safety standards for electrical and mechanical requirements.

5. Operating Instructions

5.1 The equipment manufacturer must provide operating instructions that include information required by SAE J1629, necessary maintenance procedures, and source information for replacement parts and repair.

5.1.1 The instruction manual shall include the following information on the lubricant removed. Only new lubricant, as identified by the system manufacturer, should be replaced in the mobile air conditioning system. Removed lubricant from the system and/or the equipment shall be disposed of in accordance with the applicable federal, state, and local procedures and regulations.

5.2 The equipment must prominently display the manufacturer's name, address, the type of refrigerant it is designed to extract, a service telephone number, and any items that require maintenance or replacement that affect the proper operation of the equipment. Operation manuals must cover information for complete maintenance of the equipment to assure proper operation.

6. Functional Description

6.1 The equipment must be capable of ensuring removal of refrigerant from the system being serviced by reducing the system pressure to a minimum of 102 mm (4 in) of mercury below atmospheric pressure (i.e., vacuum). To prevent system delayed outgassing, the unit must have a device that assures the refrigerant has been recovered from the air-conditioning system.

6.1.1 Testing laboratory certification of the equipment capability is required which shall process contaminated refrigerant samples at specific temperatures.

6.2 The equipment must be preconditioned by processing 13.6 kg (30 lb) of the standard contaminated HFC-134a at an ambient of 21 °C (70 °F) before starting the test cycle. Sample amounts are not to exceed 1.13 kg (2.5 lb) with sample amounts to be repeated every 5 minutes. The test fixture shown in Figure 1 to Appendix A of this subpart shall be operated at 21 °C. Contaminated HFC-134a samples shall be processed at ambient temperatures of 10 and 49 °C, without equipment shutting due to any safety devices employed in this equipment.

6.2.1 Contaminated HFC-134a sample

6.2.2 Standard contaminated HFC-134a refrigerant, 13.6 kg sample size, shall consist of liquid HFC-134a with 1300 ppm (by weight) moisture at 21 °C and 45,000 ppm (by weight) of oil (polyalkylene glycol oil with 100 cs viscosity at 40 °C or equivalent) and 1000 ppm by weight of noncondensable gases (air).

6.3 Portable refillable containers used in conjunction with this equipment must meet applicable DOT Standards.

6.3.1 The container color must be blue with a yellow top to identify that it contains used HFC-134a refrigerant. It must be permanently marked on the outside surface in black print at least 20 mm high “DIRTY HFC-134a—DO NOT USE, MUST BE REPROCESSED”.

6.3.2 The portable refillable container shall have a 1/2 inch ACME thread.

6.3.3 During operation, the equipment shall provide overfill protection to assure that the storage container liquid fill does not exceed 80% of the tank's rated volume at 21 °C per DOT Standard, 49 CFR 173.304 and the American Society of Mechanical Engineers.

6.4 Additional Storage Tank Requirements

6.4.1 The cylinder valve shall comply with UL 1769.

6.4.2 The pressure relief device shall comply with CGA Pamphlet S–1.1.

6.4.3 The container assembly shall be marked to indicate the first retest date, which shall be 5 years after date of manufacture. The marking shall indicate that retest must be performed every subsequent 5 years. The markings shall be in letters at least 6 mm high.

6.5 All flexible hoses must meet SAE J2196 for service hoses.

6.6 Service hoses must have shutoff devices located within 30 cm (12 in) of the connection point to the system being serviced to minimize introduction of noncondensable gases into the recovery equipment during connection and the release of the refrigerant during disconnection.

6.7 The equipment must be able to separate the lubricant from recovered refrigerant and accurately indicate the amount removed from the simulated automotive system during processing in 30 mL units.

6.7.1 The purpose of indicating the amount of lubricant removed is to ensure that a proper amount of new lubricant is returned to the mobile air conditioning system for compressor lubrication.

6.7.2 Refrigerant dissolved in this lubricant must be accounted for to prevent system lubricant overcharge of the mobile air-conditioning system.

6.8 The equipment must be capable of continuous operation in ambient temperatures of 10 °C to 49 °C and comply with 6.1 and 6.2.

7. For test validation, the equipment is to be operated according to the manufacturer's instructions.

Application

The purpose of this standard is to provide equipment specification for only the recovery of HFC-134a refrigerant to be returned to a refrigerant reclamation facility that will process it to ARI Standard 700–93 or allow for the recycling of the recovered refrigerant to SAE J2210 specifications by using Design Certified equipment of the same ownership. It is not acceptable that the refrigerant removed from a mobile air-conditioning system with this equipment be directly returned to a mobile air-conditioning system.

This information applies to equipment used to service automobiles, light trucks, and other vehicles with similar HFC-134a air-conditioning systems.

Reference Section

SAE J639—Vehicle Service Coupling

SAE J2210—HFC-134a Recycling Equipment for Mobile Automotive Air Conditioning Systems

SAE J2196—Service Hoses for Automotive Air-Conditioning

ARI 700–93—Specifications for Fluorocarbon Refrigerants

CGA Pamphlet S–1.1—Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases

Regulations

UL 1769—Cylinder Valves

49 CFR 173.304—Shippers—General Requirements for Shipment and Packagings

Appendix E to Subpart B of Part 82—The Standard for Automotive Refrigerant Recycling Equipment Intended for Use With Both CFC-12 and HFC-134a

SAE J2211, Recommended Service Procedure for the Containment of HFC-134a, as set forth under Appendix C of this subpart, and SAE J1989, Recommended Service Procedure for the Containment of CFC-12, as set forth under Appendix A of this subpart, also apply to this Appendix E of this subpart.

SAE J1770, issued December, 1995.

Automotive Refrigerant Recycle Equipment Intended for Use With Both CFC-12 and HFC-134a

Foreword

The purpose of this standard is to establish specific minimum equipment requirements for automotive refrigerant recycling equipment intended for use with both CFC-12 and HFC-134a in a common refrigerant circuit. Establishing such specifications will assure that this equipment does not cross contaminate refrigerant above specified limits when used under normal operating conditions.

1. Scope

The purpose of this standard is to establish the specific minimum equipment intended for use with both CFC-12 and HFC-134a in a common refrigerant circuit that has been directly removed from, and is intended for reuse in, mobile air-conditioning (A/C) systems. This standard does not apply to equipment used for CFC-12 and HFC-134a having a common enclosure with separate circuits for each refrigerant.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified. The latest issue of SAE publications shall apply.

2.1.1 SAE Publications—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J2099—Standard of Purity for Recycled HFC-134a for Use in Mobile Air-Conditioning Systems

SAE 1991—Standard of Purity for Use in Mobile Air-Conditioning Systems

SAE J2196—Service Hoses for Automotive Air-Conditioning

SAE J2197—Service Hose Fittings for Automotive Air-Conditioning

SAE J2210—HFC-134a (R-134a) Recycling Equipment for Mobile A/C Systems

SAE J1990—Extraction and Recycling Equipment for Mobile A/C Systems

2.1.2 Compressed Gas Association (CGA) Publications—Available from CGA, 1235 Jefferson Davis Highway, Arlington, VA 22202.

CGA Pamphlet S-1.1—Pressure Relief Device Standard

Part 1—Cylinders for Compressed Gases

2.1.3 DOT Publications—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

2.1.4 UL Publications—Available from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 1769—Cylinder Valves

UL 1963—Refrigerant Recovery/Recycling Equipment

3. Specification and General Description

3.1 The equipment shall be suitable for use in an automotive service garage environment and be capable of continuous operation in ambients from 10 to 49 °C.

3.2 The equipment must be certified that it meets this specification by Underwriters Laboratories Inc. (UL), or by an equivalent Nationally Recognized Testing Laboratory (NRTL).

3.3 The equipment shall have a label which states "Design Certified by (Certifying Agent) to meet SAE J1770 for recycling CFC-12 and HFC-134a using common refrigerant circuits", in bold-type letters a minimum of 3 mm in height.

4. Equipment Requirements

4.1 General

4.1.1 The equipment shall be capable of preventing cross contamination to the level required by Section 9.2.1.G before an operation involving a different refrigerant can begin. The equipment must prevent initiation of the recovery operation if the equipment is not set up properly.

4.1.2 If an operator action is required to clear the unit prior to reconnecting for a different refrigerant, the equipment shall be provided with a means which indicates which refrigerant was last processed.

4.1.3 Means shall be provided to prevent recovery from both an CFC-12 and HFC-134a mobile air conditioning system concurrently.

4.1.4 Transfer of recycled refrigerant—Recycled refrigerant for recharging and transfer shall be taken from the liquid phase only.

4.2 Seat Leakage Test

4.2.1 Valves, including electrically operated solenoid valves, that are used to isolate CFC-12 and HFC-134a refrigerant circuits, shall have a seat leakage rate not exceeding 15 g/yr (1/2 oz/yr) before and after 100,000 cycles of operation. This Endurance Test shall be conducted with HFC-134a at maximum operating pressure as determined by sections 8.1 and 8.2. The Seat Leakage Test shall be performed at 1.5 times this pressure at an ambient of 24 °C.

4.3 Interlocks

4.3.1 Electrical interlock devices used to prevent cross contamination of refrigerant shall be operated for 100,000 cycles and there shall be no failure that would permit cross contamination of refrigerant. Solid state inter lock devices shall comply with the Transient Overvoltage Test and the Fast Transient (Electric Noise) Test contained in the Standard for Tests for Safety Related Controls Employing Solid-State Devices, UL 991.

4.4 Noncondensable Gases

4.4.1 The equipment shall either automatically purge noncondensables (NCGs) if the acceptable level is exceeded or incorporate a device that indicates to the operator the NCG level has been exceeded. A pressure gauge used to indicate an NCG level shall be readable in 1 psig increments. NCG removal must be part of the normal operation of the equipment and instructions must be provided to enable the task to be accomplished within 30 minutes.

4.4.2 Refrigerant loss from noncondensable gas purging, oil removal, and refrigerant clearing shall not exceed more than 5 percent by weight of the total amount of refrigerant through the equipment as detailed in Sections 8.1, 8.2, and 9.2.

4.5 Filter

4.5.1 A 15 micron filter, or other equivalent means, to remove particulates of 15 micrometers spherical diameter or greater shall be located before any manual electrically operated valves that may cause cross contamination.

4.6 Moisture and Acid

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4.6.1 The equipment shall incorporate a desiccant package that must be replaced before saturated with moisture, and whose acid capacity is at least 5% by weight of the dry desiccant.

4.6.2 The equipment shall be provided with a moisture detection means that will reliably indicate when moisture in the HFC-134a exceeds 50 ppm, or in the CFC-12 exceeds 15 ppm, and requires the filter/drier replacement.

5. Operating Instructions

5.1 The equipment manufacturer must provide operating instructions, including proper attainment of vehicle system vacuum (i.e., when to stop the extraction process, and also to stop the extraction process if it is noticed that the A/C system being serviced has a leak), filter/desiccant replacement, and purging of noncondensable gases (air). The instructions shall indicate that the correct sequence of operation be followed so that the equipment can properly remove contaminants to the acceptable level. Also to be included are any other necessary maintenance procedures, source information for replacement parts and repair, and safety precautions.

5.2 The equipment must prominently display the manufacturer's name, address, the type of refrigerant (CFC-12 and HFC-134a), a service telephone number, and the part number for the replacement filter/drier. Operation manuals must cover information for complete maintenance of the equipment to assure proper operation.

6. Safety Requirements

6.1 The equipment must comply with applicable federal, state, and local requirements on equipment related to handling CFC-12 and HFC-134a material. Safety precautions or notices related to the safe operation of the equipment shall be prominently displayed on the equipment and should also state "CAUTION—SHOULD BE OPERATED BY QUALIFIED PERSONNEL".

6.2 HFC-134a has been shown to be nonflammable at ambient temperature and atmospheric pressure. The following statement shall be in the operating manual: "Caution: HFC-134a service equipment or vehicle A/C systems should not be pressure tested or leak tested with compressed air. Some mixtures of air and HFC-134a have been shown to be combustible at elevated pressures (when contained in a pipe or tank). These mixtures may be potentially dangerous, causing injury or property damage. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers."

7. Functional Description

7.1 General

7.1.1 The equipment must be capable of ensuring recovery of the CFC-12 and HFC-134a from the system being serviced, by reducing the system to a minimum of 102 mm of mercury below atmospheric pressure (i.e., vacuum).

7.1.2 The equipment must be compatible with leak detection material that may be present in the mobile A/C system.

7.2 Shut Off Device

7.2.1 To prevent overcharge, the equipment must be equipped to protect the tank used to store the recycled refrigerant with a shutoff device and a mechanical pressure relief valve.

7.3 Storage Tanks

7.3.1 Portable refillable tanks or containers shall be supplied with this equipment and must be labeled "HFC-134a" or "CFC-12" as appropriate, meet applicable Department of Transportation (DOT) or NRTL's Standards and be adaptable to existing refrigerant service and charging equipment.

7.3.2 The cylinder valve shall comply with the Standard for Cylinder Valves, UL 1769.

7.3.3 The pressure relief device shall comply with the Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases, CGA Pamphlet S-1.1.

7.3.4 The tank assembly shall be marked to indicate the first retest date, which shall be 5 years after the date of manufacture. The marking shall indicate that retest must be performed every subsequent 5 years. The marking shall be in letters at least 6 mm high.

7.4 Overfill Protection

7.4.1 During operation, the equipment must provide overfill protection to assure that during filling or transfer, the tank or storage container cannot exceed 80% of volume at 21.1 °C of its maximum rating as defined by DOT standards, 49 CFR 173.304 and American Society of Mechanical Engineers.

7.5 Hoses and Connections

7.5.1 Separate inlet and outlet hoses with fittings and separate connections shall be provided for each refrigerant circuit.

7.5.2 All flexible hoses and fittings must meet SAE J2196 (for CFC-12) and SAE J2197 (for HFC-134a).

7.5.3 Service hoses must have shutoff devices located within 30 cm of the connection point to the system being serviced.

7.6 Lubricant Separation

7.6.1 The equipment must be able to separate the lubricant from the removed refrigerant and accurately indicate the amount of lubricant removed during the process, in 30 mL (1 fl oz) units. Refrigerant dissolves in lubricant and, as a result, increases the volume of the recovered lubricant sample. This creates the illusion that more lubricant has been recovered than actually has been. The equipment lubricant measuring system must take into account such dissolved refrigerant removed from the A/C system being serviced to prevent overcharging the vehicle system with lubricant.

(Note: Use only new lubricant to replace the amount removed the recycling process. Used lubricant should be discarded per applicable federal, state and local requirements.)

7.6.2 The equipment must be provided with some means, such as a lockout device, which will prevent initiation of the recovery operation after switching to the other refrigerant, if the lubricant has not been drained from the oil separator.

8. Testing

8.0 Equipment shall be tested in sequence as noted in sections 8.1, 8.2 and 9.2. The filter/drier may be replaced only as noted by section 4.6.2.

8.1 CFC-12 Recycling Cycle

8.1.1 The maximum operating pressure of the equipment shall be determined when recycling CFC-12 while conducting the following tests. This pressure is needed for the Seat Leakage Test, Section 4.2.

8.1.2 The equipment must be preconditioned with 13.6 kg of the standard contaminated CFC-12 (see section 8.1.2a) at an ambient of 21 °C before starting the test cycle. Sample amounts shall be 1.13 kg with sample amounts to be repeated every 5 minutes. The sample method fixture, defined in Figure 1 to Appendix A, shall be operated at 21 °C.

8.1.2a Standard contaminated CFC-12 refrigerant shall consist of liquid CFC-12 with 100 ppm (by weight) moisture at 21 °C and 45,000 ppm (by weight) mineral oil 525 suspension viscosity nominal and 770 ppm by weight of noncondensable gases (air).

8.1.3 The high moisture contaminated sample shall consist of CFC-12 vapor with 1000 ppm (by weight) moisture.

8.1.4 The high oil contaminated sample shall consist of CFC-12 with 200,000 ppm (by weight) mineral oil 525 suspension viscosity nominal.

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8.1.5 After preconditioning as stated in section 8.1.2, the test cycle is started, processing the following contaminated samples through the equipment.

- A. 13.6 kg (1.13 kg per batch) of standard contaminated CFC-12.
- B. 1 kg of high oil contaminated CFC-12.
- C. 4.5 kg (1.13 kg per batch) of standard contaminated CFC-12.
- D. 1 kg of high moisture contaminated CFC-12.

8.1.6 The CFC-12 is to be cleaned to the minimum purity level, as defined in SAE J1991, with the equipment operating in a stable ambient of 10, 21, and 49 °C and processing the samples as defined in section 8.1.5.

8.2 HFC-134a Recycling Cycle

8.2.1 The maximum operating pressure of the equipment shall be determined when recycling HFC-134a while conducting the following tests. This pressure is needed for the Seat Leakage Test, Section 4.2.

8.2.2 The equipment must be preconditioned by processing 13.6 kg of the standard contaminated HFC-134a (see section 8.2.2a) at an ambient of 21 °C before starting the test cycle. 1.13 kg samples are to be processed at 5 minute intervals. The test fixture shown in Figure 1 to Appendix A shall be operated at 21 °C.

8.2.2a The standard contaminated refrigerant shall consist of liquid HFC-134a with 1300 ppm (by weight) moisture (equivalent to saturation at 38°[100 °F]), 45,000 ppm (by weight) HFC-134a compatible lubricant, and 1000 ppm (by weight) of noncondensable gases (air).

8.2.2b The HFC-134a compatible lubricant referred to in section 8.2.2a shall be a polyalkylene glycol based synthetic lubricant or equivalent, which shall contain no more than 1000 ppm by weight of moisture.

8.2.3 Following the preconditioning procedure per section 8.2.2, 18.2 kg of standard contaminated HFC-134a are to be processed by the equipment at each stable ambient temperature of 10, 21, and 49 °C.

8.2.4 The HFC-134a is to be cleaned to the purity level, as defined in SAE J2099.

9. Refrigerant Cross Contamination Test

9.1 General

9.1.1 For test validation, the equipment is to be operated according to the manufacturer's instruction.

9.1.2 The equipment shall clean the contaminated CFC-12 refrigerant to the minimum purity level as defined in Appendix A, when tested in accordance with the requirements in section 8.1.

9.1.3 The equipment shall clean the contaminated HFC-134a refrigerant to the purity level defined in Appendix C, when tested in accordance with the requirements in section 8.2.

9.2 Test Cycle

9.2.1 The following method shall be used after the tests and requirements in Sections 8.1 and 8.2, respectively, are completed. Following the manufacturer's instructions, the equipment shall be cleared of HFC-134a, prior to beginning step A. The only refrigerant used for this is noted in steps A, C, and E of section 9.2.1. The test fixture shown in Figure 1 to Appendix A shall be used and the test shall be conducted at 10, 21, and 49 °C ambients.

A. A 1.13 kg standard contaminated sample of CFC-12 (see section 8.1.2a) shall be processed by the equipment.

B. Follow manufacturer's instructions to clear the equipment of CFC-12 before processing HFC-134a.

C. Process a 1.13 kg, standard contaminated sample of HFC-134a (see section 8.2.2a) through the equipment.

D. Follow manufacturer's instructions to clear the equipment of HFC-134a before processing CFC-12.

E. Process a 1.13 kg standard contaminated sample of CFC-12 (see section 8.1.2a) through the equipment.

F. Follow manufacturer's instructions to clear the equipment of CFC-12.

G. The amount of cross contaminated refrigerant, as determined by gas chromatography, in samples processed during steps C and E of section 9.2.1., shall not exceed 0.5 percent by weight.

10. Sample Analysis

10.1 General

10.1.1 The processed contaminated samples shall be analyzed according to the following procedure.

10.2 Quantitative Determination of Moisture

10.2.1 The recycled liquid phase sample of refrigerant shall be analyzed for moisture content via Karl Fischer coulometer titration or an equivalent method. The Karl Fischer apparatus is an instrument for precise determination of small amounts of water dissolved in liquid and/or gas samples.

10.2.2 In conducting the test, a weighed sample of 30 to 130 g is vaporized directly into the Karl Fischer anolyte. A coulometer titration is conducted and the results are calculated and displayed as parts per million moisture (weight).

10.3 Determination of Percent Lubricant

10.3.1 The amount of lubricant in the recycled sample of refrigerant/lubricant is to be determined by gravimetric analysis.

10.3.2 Following venting of noncondensable, in accordance with the manufacturer's operating instructions, the refrigerant container shall be shaken for 5 minutes prior to extracting samples for test.

10.3.3 A weighed sample of 175 to 225 g of liquid refrigerant/lubricant is allowed to evaporate at room temperature. The percent lubricant is to be calculated from the weight of the original sample and the residue remaining after the evaporation.

10.4 Noncondensable Gas

10.4.1 The amount of noncondensable gas is to be determined by gas chromatography. A sample of vaporized refrigerant liquid shall be separated and analyzed by gas chromatography. A Propak Q column at 130 °C and a hot wire detector may be used for analysis.

10.4.2 This test shall be conducted on liquid phase samples of recycled refrigerant taken from a full container as defined in 7.4 within 30 minutes following the proper venting of noncondensable gases.

10.4.3 The samples shall be shaken for at least 15 minutes prior to testing while at a temperature of 24 °C ±2.8 °C.

10.5 Refrigerant Cross Contamination

10.5.1 The amount of cross contamination of CFC-12 in HFC-134a or HFC-134a in CFC-12 shall not exceed 0.5 percent by weight as determined by gas chromatography. A sample of vaporized refrigerant liquid shall be separated and analyzed by gas chromatography. A 1% SP-1000 on Carbowax B (60/80 mesh) column may be used for the analysis.

Appendix F to Subpart B of Part 82—Standard for Recover-Only Equipment That Extracts a Single, Specific Refrigerant Other Than CFC-12 or HFC-134a

Foreword

These specifications are for equipment that recover, but does not recycle, any single, specific automotive refrigerant other than CFC-12 or HFC-134a, including a blend refrigerant.

1. Scope

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The purpose of this standard is to provide equipment specifications for the recovery of any single, specific refrigerant other than CFC-12 or HFC-134a, including a blend refrigerant, which are either (1) to be returned to a refrigerant reclamation facility that will process the refrigerant to ARI Standard 700-93 or equivalent new product specifications at a minimum, or (2) to be recycled in approved refrigerant recycling equipment, or (3) to be destroyed. This standard applies to equipment used to service automobiles, light trucks, and other vehicles with similar air conditioning systems.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified. The latest issue of SAE publications shall apply.

2.1.1 SAE Publications—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001. SAE J639—Vehicle Service Coupling. SAE J2196—Service Hoses for Automotive Air Conditioning (fittings modified)

2.1.2 ARI Publication—Available from Air Conditioning and Refrigeration Institute, 1501 Wilson Boulevard, Sixth Floor, Arlington, VA 22209. ARI 700-93—Specifications for Fluorocarbon Refrigerants.

2.1.3 Compressed Gas Association (CGA) Publications—Available from CGA, 1235 Jefferson Davis Highway, Arlington, VA 22202. CGA Pamphlet S-1.1—Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases.

2.1.4 DOT Publications—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

DOT Standard, 49 CFR 173.304—Shippers—General Requirements for Shipments and Packagings.

2.1.5 UL Publications—Available from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 1769—Cylinder Valves.

UL 1963—Refrigerant Recovery Recycling Equipment.

3. Specifications and General Description

3.1 The equipment must be able to extract from a mobile air conditioning system the refrigerant other than CFC-12 or HFC-134a to which the equipment is dedicated.

3.2 The equipment shall be suitable for use in an automotive service garage environment as defined in section 6.8.

3.3 The equipment discharge or transfer fitting shall be unique to prevent the unintentional use of the extracted refrigerant for recharging auto air conditioners.

3.4 Equipment Certification—The equipment shall be certified by Underwriters Laboratories or an—equivalent certifying laboratory to meet this standard.

3.5 Label Requirements—The equipment shall have a label "Designed Certified by (Company Name) to meet EPA requirements for use only with (the applicable refrigerant). The refrigerant from this equipment must be processed to ARI 700-93 specifications or equivalent new product specifications before reuse in a mobile air-conditioning system." The minimum letter size shall be bold type 3 mm in height.

4. Safety Requirements

4.1 The equipment must comply with applicable federal, state, and local requirements on equipment related to the handling of the applicable refrigerant material. Safety precautions or notices or labels related to the safe operation of the equipment shall also be prominently displayed on the equipment and should state "CAUTION—SHOULD BE OPERATED BY CERTIFIED PERSONNEL." The safety identification shall be located on the front near the controls.

4.2 The equipment must comply with applicable safety standards for electrical and mechanical requirements.

5. Operating Instructions

5.1 The equipment manufacturer must provide operating instructions that include information equivalent to that required by SAE J1629, necessary maintenance procedures, and source information for replacement parts and repair.

5.1.1 The instruction manual shall include the following information on the lubricant removed: Only new lubricant, as identified by the system manufacturer, should be replaced in the air conditioning system. Removed lubricant from the system and/or the equipment shall be disposed on in accordance with the applicable federal, state, and local procedures and regulations.

5.2 The equipment must prominently display the manufacturer's name, address, the type of refrigerant it is designed to extract, a service telephone number, and any items that require maintenance or replacement that affect the proper operation of the equipment. Operation manuals must cover information for complete maintenance of the equipment to assure proper operation.

6.1 Functional Description

6.1 The equipment must be capable of ensuring removal of refrigerant from the system being serviced by reducing the system pressure to a minimum of 102 mm (4 in) of mercury below atmospheric pressure (i.e., to a vacuum). To prevent system delayed outgassing, the unit must have a device that assures that the refrigerant has been recovered from the air-conditioning system.

6.1.1 Testing laboratory certification of the equipment capability is required which shall process contaminated refrigerant samples at specific temperatures.

6.2 The equipment must be preconditioned by processing 13.6 kg (30 lb) of the standard contaminated refrigerant at an ambient of 21 °C (70 °F) before starting the test cycle. Sample amounts are not to exceed 1.13 kg (2.5 lb) with sample amounts to be processed at 5 min. intervals. The test method fixture, depicted in Figure 1 to appendix A of this subpart, shall be operated at 21 °C (70 °F). Contaminated refrigerant samples shall be processed at ambient temperatures of 10 and 49 °C, without equipment shutting due to any safety devices employed in this equipment.

6.2.1 Standard contaminated refrigerant, 13.6 kg (30 lb) sample size, shall consist of liquid refrigerant with 1000 ppm (by weight) moisture at 21 °C and 45,000 ppm (by weight) of oil (total of one-third mineral oil 525 suspension nominal, one-third PAG with 100 cSt viscosity at 40 °C or equivalent, and one-third POE with 68 cSt viscosity at 40 °C or equivalent) and 1000 ppm by weight of noncondensable gases (air). Refrigerant shall be identified prior to the recovery process to ±2% of the original manufacturer's formulation submitted to, and accepted by, EPA under its Significant New Alternatives Policy program, with the exception that any flammable components shall be identified to ±1%.

6.3 Portable refillable containers used in conjunction with this equipment must meet applicable DOT Standards.

6.3.1 The container color must be gray with a yellow top to identify that it contains used refrigerant. It must be permanently marked on the outside surface in black print at least 20 mm high "DIRTY [NAME OF REFRIGERANT]—DO NOT USE, MUST BE PROCESSED".

6.3.2 The portable refillable container shall have a unique thread connection for the specific refrigerant.

6.3.3 During operation, the equipment shall provide overfill protection to assure that the storage container liquid fill does not exceed 80% of the tank's rated volume at 21 °C per DOT Standard, 49 CFR 173.304, and the American Society of Mechanical Engineers.

6.4 Additional Storage Tank Requirements

6.4.1 The cylinder valve shall comply with UL 1769.

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6.4.2 The pressure relief device shall comply with CGA Pamphlet S-1.1.

6.4.3 The container assembly shall be marked to indicate the first retest date, which shall be 5 years after date of manufacture. The marking shall indicate that retest must be performed every subsequent 5 years. The marking shall be in letters at least 6 mm high.

6.5 All flexible hoses must meet SAE J2196 for service hoses except that fittings shall be unique to the applicable refrigerant.

6.6 Service hoses must have shutoff devices located within 30 cm of the connection point to the system being serviced to minimize introduction of noncondensable gases into the recovery equipment during connection and the release of the refrigerant during disconnection.

6.7 The equipment must be able to separate the lubricant from the recovered refrigerant and accurately indicate the amount removed from the simulated automotive system during processing in 30 mL units.

6.7.1 The purpose of indicating the amount of lubricant is to ensure that a proper amount of new lubricant is returned to the mobile air conditioning system for compressor lubrication.

6.7.2 Refrigerant dissolved in this lubricant must be accounted for to prevent system lubricant overcharge of the mobile air-conditioning system.

6.8 The equipment must be capable of continuous operation in temperatures of 10 to 49 °C and must comply with 6.1 and 6.2.

7. For test validation, the equipment is to be operated according to the manufacturer's instructions.

Application

The purpose of this standard is to provide equipment specifications for the recovery of any refrigerant other than CFC-12 or HFC-134a for return to a refrigerant reclamation facility that will process it to ARI Standard 700-93 (or for recycling in other EPA approved recycling equipment, in the event that EPA in the future designates a standard for equipment capable of recycling refrigerants other than CFC-12 or HFC-134a).

Reference Section

- SAE J639—Vehicle Service Coupling
- SAE J2196—Service Hoses for Automotive Air-Conditioning
- ARI 700-93—Specifications for Fluorocarbon Refrigerants
- CGA Pamphlet S-1.1—Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases
- UL 1769—Cylinder Valves
- 49 CFR 173.304—Shippers—General Requirements for Shipment and Packagings

Subpart I - Protection of Stratospheric Ozone: Ban on the Sale or Distribution of Pre-Charged Appliances

§82.300 Purpose.

The purpose of this subpart is to protect stratospheric ozone by restricting the sale and distribution of HCFC containing appliances under authority of section 615 of the Clean Air Act as amended in 1990.

§82.302 Definitions.

As used in this subpart, the term:

Appliance means any device which contains and uses a refrigerant and which is used for household or com-

mercial purposes, including any air conditioner, refrigerator, chiller, or freezer.

Class I substance means any controlled substance designated as class I in 40 CFR part 82, appendix A to subpart A.

Class II substance means any controlled substance designated as class II in 40 CFR part 82, appendix B to subpart A.

Consumer, when used to describe a person taking action with regard to a product, means the ultimate purchaser, recipient or user of a product.

Distributor, when used to describe a person taking action with regard to a product, means:

(1) The seller of a product to a consumer or another distributor; or

(2) A person who sells or distributes that product in interstate commerce, including sale or distribution preceding export from, or following import to, the United States.

Hydrochlorofluorocarbon means any substance listed as class II in 40 CFR part 82, appendix B to subpart A.

Manufactured, for an appliance, means the date on which the appliance's refrigerant circuit is complete, the appliance can function, the appliance holds a refrigerant charge, and the appliance is ready for use for its intended purposes; for a pre-charged appliance component, "manufactured" means the date that the original equipment manufacturer has physically completed assembly of the component, the component is charged with refrigerant, and the component is ready for initial sale or distribution.

Person means any individual or legal entity, including an individual, corporation, partnership, association, State, municipality, political subdivision of a State, Indian tribe; any agency, department, or instrumentality of the United States; and any officer, agent, or employee thereof.

Pre-charged appliance means any appliance charged with refrigerant prior to sale or distribution, or offer for sale or distribution in interstate commerce.

Pre-charged appliance component means any portion of an appliance including but not limited to condensers, compressors, line sets, and coils that is charged with refrigerant prior to sale or distribution or offer for sale or distribution in interstate commerce.

Product means an item or category of items manufactured from raw or recycled materials which is used to perform a function or task.

Refrigerant means, for purposes of this subpart, any substance consisting in part or whole of a class I or class II ozone-depleting substance that is used for heat transfer purposes and provides a cooling effect.

§82.304 Prohibitions.

Effective January 1, 2010, no person may sell or distribute, or offer to sell or distribute, in interstate commerce any product identified in §82.306.

§82.306 Prohibited products.

Effective January 1, 2010, the following products are subject to the prohibitions specified under §82.304 -

(a) Any pre-charged appliance manufactured on or after January 1, 2010 containing HCFC-22, HCFC-142b or a

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blend containing one or both of these controlled substances.

(b) Any pre-charged appliance component for air-conditioning or refrigeration appliances manufactured on or after January 1, 2010 containing HCFC-22, HCFC-142b, or a blend containing one or both of these controlled substances.

Part 86—Control of emissions from new and in-use highway vehicles and engines

§86.004-11 Emission standards for 2004 and later model year diesel heavy-duty engines and vehicles.

This section applies to 2004 and later model year diesel HDEs.

(a)(1) Exhaust emissions from new 2004 and later model year diesel HDEs shall not exceed the following:

(i)(A) Oxides of Nitrogen plus Non-methane Hydrocarbons (NO_x + NMHC) for engines fueled with either petroleum fuel, natural gas, or liquefied petroleum gas, 2.4 grams per brake horsepower-hour (0.89 gram per megajoule), as measured under transient operating conditions.

(B) Oxides of Nitrogen plus Non-methane Hydrocarbon Equivalent (NO_x + NMHCE) for engines fueled with methanol, 2.4 grams per brake horsepower-hour (0.89 gram per megajoule), as measured under transient operating conditions.

(C) *Optional standard.* Manufacturers may elect to certify to an Oxides of Nitrogen plus Non-methane Hydrocarbons (or equivalent for methanol-fueled engines) standard of 2.5 grams per brake horsepower-hour (0.93 gram per megajoule), as measured under transient operating conditions, provided that Non-methane Hydrocarbons (or equivalent for methanol-fueled engines) do not exceed 0.5 grams per brake horsepower-hour (0.19 gram per megajoule) NMHC (or NMHCE for methanol-fueled engines), as measured under transient operating conditions.

(D) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the emissions ABT programs for HDEs, within the restrictions described in §86.004-15 or superseding applicable sections. If the manufacturer elects to include engine families in any of these programs, the NO_x plus NMHC (or NO_x plus NMHCE for methanol-fueled engines) FELs may not exceed 4.5 grams per brake horsepower-hour (1.7 grams per megajoule). This ceiling value applies whether credits for the family are derived from averaging, banking, or trading programs. Additionally, families certified to the optional standard contained in paragraph (a)(1)(i)(C) of this section shall not exceed 0.50 grams per brake horsepower-hour (0.19 gram per megajoule) NMHC (or NMHCE for methanol-fueled engines) through the use of credits.

(E) [Reserved]

(ii) *Carbon monoxide.* (A) 15.5 grams per brake horsepower-hour (5.77 grams per megajoule), as measured under transient operating conditions.

(B) 0.50 percent of exhaust gas flow at curb idle (methanol-, natural gas-, and liquefied petroleum gas-fueled diesel HDEs only).

(iii) *Particulate.* (A) For diesel engines to be used in urban buses, 0.05 gram per brake horsepower-hour (0.019 gram per megajoule) for certification testing and selective enforcement audit testing, and 0.07 gram per brake horsepower-hour (0.026 gram per megajoule) for in-use testing, as measured under transient operating conditions.

(B) For all other diesel engines, 0.10 gram per brake horsepower-hour (0.037 gram per megajoule), as measured under transient operating conditions.

(C) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the particulate ABT programs for HDEs, within the restrictions described in §86.004-15 or superseding applicable sections. If the manufacturer elects to include engine families in any of these programs, the particulate FEL may not exceed 0.25 gram per brake horsepower-hour (0.093 gram per megajoule).

(2) The standards set forth in paragraph (a)(1) of this section refer to the exhaust emitted over the operating schedule set forth in paragraph (f)(2) of appendix I to this part, and measured and calculated in accordance with the procedures set forth in subpart N or P of this part, except as noted in §86.098-23(c)(2) or superseding sections.

(b)(1) The opacity of smoke emission from new 2004 and later model year diesel HDEs shall not exceed:

- (i) 20 percent during the engine acceleration mode.
- (ii) 15 percent during the engine lugging mode.
- (iii) 50 percent during the peaks in either mode.

(2) The standards set forth in paragraph (b)(1) of this section refer to exhaust smoke emissions generated under the conditions set forth in subpart I of this part and measured and calculated in accordance with those procedures.

(3) Evaporative emissions (total of non-oxygenated hydrocarbons plus methanol) from heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed the following standards. The standards apply equally to certification and in-use vehicles. The spitback standard also applies to newly assembled vehicles.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs:

(A)(1) For the full three-diurnal test sequence described in §86.1230-96, diurnal plus hot soak measurements: 3.0 grams per test.

(2) For the supplemental two-diurnal test sequence described in §86.1230-96, diurnal plus hot soak measurements: 3.5 grams per test.

(B) Running loss test: 0.05 grams per mile.

(C) Fuel dispensing spitback test: 1.0 gram per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs:

(A)(1) For the full three-diurnal test sequence described in §86.1230-96, diurnal plus hot soak measurements: 4.0 grams per test.

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(2) For the supplemental two-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 4.5 grams per test.

(B) Running loss test: 0.05 grams per mile.

(iii)(A) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraph (b)(3) of this section refer to a composite sample of evaporative emissions collected under the conditions and measured in accordance with the procedures set forth in subpart M of this part. For certification vehicles only, manufacturers may conduct testing to quantify a level of nonfuel background emissions for an individual test vehicle. Such a demonstration must include a description of the source(s) of emissions and an estimated decay rate. The demonstrated level of nonfuel background emissions may be subtracted from emission test results from certification vehicles if approved in advance by the Administrator.

(B) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs., the standards set forth in paragraph (b)(3)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in §86.091–23(b)(4)(ii)).

(iv) All fuel vapor generated during in-use operations shall be routed exclusively to the evaporative control system (e.g., either canister or engine purge). The only exception to this requirement shall be for emergencies.

(4) Evaporative emissions from 2004 and later model year heavy-duty vehicles equipped with natural gas-fueled or liquefied petroleum gas-fueled HDEs shall not exceed the following standards. The standards apply equally to certification and in-use vehicles.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds for the full three-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 pounds for the full three-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 4.0 grams per test.

(iii)(A) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 pounds, the standards set forth in paragraph (b)(4) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in subpart M of this part and measured in accordance with those procedures.

(B) For vehicles with a Gross Vehicle Weight Rating greater than 26,000 pounds, the standards set forth in paragraphs (b)(3)(ii) and (b)(4)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in §86.091–23(b)(4)(ii)).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 2004 or later model year methanol-, natural gas-, or liquefied petroleum gas-fueled diesel, or any naturally-aspirated diesel HDE. For petroleum-fueled engines only, this provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction.

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in subpart I or N of this part to ascertain that such test engines meet the requirements of this section.

(e) The standards described in this section do not apply to diesel-fueled medium-duty passenger vehicles (MDPVs) that are subject to regulation under subpart S of this part, except as specified in subpart S of this part. The standards described in this section also do not apply to diesel engines used in such MDPVs, except as specified in the regulations in subpart S of this part. The term "medium-duty passenger vehicle" is defined in §86.1803.

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§86.007-11 Emission standards and supplemental requirements for 2007 and later model year diesel heavy-duty engines and vehicles.

This section applies to new 2007 and later model year diesel HDEs. Section 86.007-11 includes text that specifies requirements that differ from §86.004-11. Where a paragraph in §86.004-11 is identical and applicable to §86.007-11, this may be indicated by specifying the corresponding paragraph and the statement “[Reserved].” For guidance see §86.004-11.”.

(a)(1) Exhaust emissions from new 2007 and later model year diesel HDEs shall not exceed the following:

(i) *Oxides of Nitrogen (NO_x)*.

(A) 0.20 grams per brake horsepower-hour (0.075 grams permegajoule).

(B) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the NO_x and NO_x plus NMHC emissions ABT programs for HDEs, within the restrictions described in §86.007-15 or §86.004-15. If the manufacturer elects to include engine families in any of these programs, the NO_x FELs may not exceed the following FEL caps: 2.00 grams per brake horsepower-hour (0.75 grams per megajoule) for model years before 2010; 0.50 grams per brake horsepower-hour (0.19 grams per megajoule) for model years 2010 and later. This ceiling value applies whether credits for the family are derived from averaging, banking, or trading programs.

(ii)(A) *Non-Methane Hydrocarbons (NMHC) for engines fueled with either diesel fuel, natural gas, or liquefied petroleum gas*. 0.14 grams per brake horsepower-hour (0.052 grams permegajoule).

(B) *Non-Methane Hydrocarbon Equivalent (NMHCE) for engines fueled with methanol*. 0.14 grams per brake horsepower-hour (0.052 grams permegajoule).

(iii) *Carbon monoxide*. (A) 15.5 grams per brake horsepower-hour (5.77 grams permegajoule).

(B) 0.50 percent of exhaust gas flow at curb idle (methanol-, natural gas-, and liquefied petroleum gas-fueled diesel HDEs only). This does not apply for vehicles certified to the requirements of §86.005-17

(iv) *Particulate*. (A) 0.01 grams per brake horsepower-hour (0.0037 grams permegajoule).

(B) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the particulate ABT programs for HDEs, within the restrictions described in §86.007-15 or other applicable sections. If the manufacturer elects to include engine families in any of these programs, the particulate FEL may not exceed 0.02 grams per brake horsepower-hour (0.0075 grams per megajoule).

(2) The standards set forth in paragraph (a)(1) of this section refer to the exhaust emitted over the duty cycle specified in paragraphs (a)(2)(i) through (iii) of this section, where exhaust emissions are measured and calculated as specified in paragraphs (a)(2)(iv) and (v) of this section in accordance with the procedures set forth in subpart N of this part, except as noted in §86.007-23(c)(2):

(i) Perform the test interval set forth in paragraph (f)(2) of Appendix I of this part with a cold-start accord-

ing to 40 CFR part 1065, subpart F. This is the cold-start test interval.

(ii) Shut down the engine after completing the test interval and allow 20 minutes to elapse. This is the hot-soak.

(iii) Repeat the test interval. This is the hot-start test interval.

(iv) Calculate the total emission mass of each constituent, *m*, and the total work, *W*, over each test interval according to 40 CFR 1065.650.

(v) Determine your engine's brake-specific emissions using the following calculation, which weights the emissions from the cold-start and hot-start test intervals:

$$\text{brake-specific emissions} = \frac{m_{\text{cold-start}} + 6 \cdot m_{\text{hot-start}}}{W_{\text{cold-start}} + 6 \cdot W_{\text{hot-start}}}$$

(3) *SET* (i) Exhaust emissions, as determined under §86.1360-2007(b) pertaining to the supplemental emission test cycle, for each regulated pollutant shall not exceed 1.0 times the applicable emission standards or FELs specified in paragraph (a)(1) of this section.

(ii) Gaseous exhaust emissions shall not exceed the steady-state interpolated values determined by the Maximum Allowable Emission Limits (for the corresponding speed and load), as determined under §86.1360-2007(f), when the engine is operated in the steady-state control area defined under §86.1360-2007(d), during steady-state engine operation.

(4) *NTE* (i)(A) The brake-specific exhaust NMHC or NO_x emissions in g/ bhp-hr, as determined under §86.1370-2007 pertaining to the not-to-exceed test procedures, shall not exceed 1.5 times the applicable NMHC or NO_x emission standards or FELs specified in paragraph (a)(1) of this section, during engine and vehicle operation specified in paragraph (a)(4)(ii) of this section except as noted in paragraph (a)(4)(iii) of this section.

(B) For engines not having a NO_x FEL less than 1.50 g/ bhp-hr, the brake-specific NO_x and NMHC exhaust emissions in g/ bhp-hr, as determined under §86.1370-2007 pertaining to the not-to-exceed test procedures, shall not exceed 1.25 times the applicable emission standards or FELs specified in paragraph (a)(1) of this section (or of §86.004-11, as allowed by paragraph (g) of this section), during engine and vehicle operation specified in paragraph (a)(4)(ii) of this section except as noted in paragraph (a)(4)(iii) of this section.

(C) The brake-specific exhaust PM emissions in g/ bhp-hr, as determined under §86.1370-2007 pertaining to the not-to-exceed test procedures, shall not exceed 1.5 times the applicable PM emission standards or FEL (for FELs above the standard only) specified in paragraph (a)(1) of this section, during engine and vehicle operation specified in paragraph (a)(4)(ii) of this section except as noted in paragraph (a)(4)(iii) of this section.

(D) The brake-specific exhaust CO emissions in g/ bhp-hr, as determined under §86.1370-2007 pertaining to the not-to-exceed test procedures, shall not exceed 1.25 times the applicable CO emission standards or FEL specified in paragraph (a)(1) of this section, during engine and vehicle operation specified in paragraph (a)(4)(ii) of this

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section except as noted in paragraph (a)(4)(iii) of this section.

(ii) For each engine family, the not-to-exceed emission limits must apply during one of the following two ambient operating regions:

(A) The not-to-exceed limits apply for all altitudes less than or equal to 5,500 feet above sea-level, during all ambient conditions (temperature and humidity). Temperature and humidity ranges for which correction factors are allowed are specified in §86.1370-2007(e); or

(B)(1) The not-to-exceed emission limits apply at all altitudes less than or equal to 5,500 feet above sea-level, for temperatures less than or equal to the temperature determined by the following equation at the specified altitude:

$$T = -0.00254 \times A + 100$$

Where:

T = ambient air temperature in degrees Fahrenheit.

A = altitude in feet above sea-level (A is negative for altitudes below sea-level).

(2) Temperature and humidity ranges for which correction factors are allowed are specified in §86.1370-2007(e);

(iii) For engines equipped with exhaust gas recirculation, the not-to-exceed emission limits specified in paragraph (a)(4)(i) of this section do not apply to engine or vehicle operation during cold operating conditions as specified in §86.1370-2007(f).

(iv) *Deficiencies for NTE emission standards.* (A) For model years 2007 through 2009, upon application by the manufacturer, the Administrator may accept a HDDE as compliant with the NTE standards even though specific requirements are not fully met. Such compliances without meeting specific requirements, or deficiencies, will be granted only if compliance would be infeasible or unreasonable considering such factors as, but not limited to: Technical feasibility of the given hardware and lead time and production cycles including phase-in or phase-out of engines or vehicle designs and programmed upgrades of computers. Deficiencies will be approved on a engine model and/or horsepower rating basis within an engine family, and each approval is applicable for a single model year. A manufacturer's application must include a description of the auxiliary emission control device(s) which will be used to maintain emissions to the lowest practical level, considering the deficiency being requested, if applicable. An application for a deficiency must be made during the certification process; no deficiency will be granted to retroactively cover engines already certified.

(B) Unmet requirements should not be carried over from the previous model year except where unreasonable hardware or software modifications would be necessary to correct the deficiency, and the manufacturer has demonstrated an acceptable level of effort toward compliance as determined by the Administrator. The NTE deficiency should only be seen as an allowance for minor deviations from the NTE requirements. The NTE deficiency provisions allow a manufacturer to apply for relief from the NTE emission requirements under limited con-

ditions. EPA expects that manufacturers should have the necessary functioning emission control hardware in place to comply with the NTE.

(C) For model years 2010 through 2013, the Administrator may allow up to three deficiencies per engine family. The provisions of paragraphs (a)(4)(iv)(A) and (B) of this section apply for deficiencies allowed by this paragraph (a)(4)(iv)(C). In determining whether to allow the additional deficiencies, the Administrator may consider any relevant factors, including the factors identified in paragraph (a)(4)(iv)(A) of this section. If additional deficiencies are approved, the Administrator may set any additional conditions that he/she determines to be appropriate.

(v) The emission limits specified in paragraphs (a)(3) and (a)(4) of this section shall be rounded to the same number of significant figures as the applicable standards in paragraph (a)(1) of this section using ASTM E29-93a (Incorporated by reference at §86.1). * * * * *

(vi) Manufacturers are not required to provide engine information exclusively related to in-use testing as part of initial certification. However, upon request from EPA the manufacturers must provide the information which clearly identifies parameters defining all NTE deficiencies described under paragraph (a)(4)(iv) of this section and parameters defining all NTE limited testing regions described under §86.1370-2007(b)(6) and (7) that are requested. When requested, deficiencies and limited testing regions must be reported for all engine families and power ratings in English with sufficient detail for us to determine if a particular deficiency or limited testing region will be encountered in the emission test data from the portable emission-sampling equipment and field-testing procedures referenced in §86.1375. Such information is to be provided within 60 days of the request from EPA.

(b)(1) Introductory text through (b)(1)(iii) [Reserved]. For guidance see §86.004-11.

(b)(1)(iv) Operation within the NTE zone (defined in §86.1370-2007) must comply with a filter smoke number of 1.0 under steady-state operation, or the following alternate opacity limits:

(A) A 30 second transient test average opacity limit of 4% for a 5 inch path; and

(B) A 10 second steady state test average opacity limit of 4% for a 5 inch path.

(2)(i) The standards set forth in §86.004-11(b)(1)(i) through (iii) refer to exhaust smoke emissions generated under the conditions set forth in subpart I of this part and measured and calculated in accordance with those procedures.

(ii) The standards set forth in paragraph (b)(1)(iv) of this section refer to exhaust smoke emissions generated under the conditions set forth in §86.1370-2007 and calculated in accordance with the procedures set forth in §86.1372-2007.

(b)(3) and (b)(4) [Reserved]. For guidance see §86.004-11.

(c) No crankcase emissions shall be discharged directly into the ambient atmosphere from any new 2007 or later model year diesel HDE, with the following exception: HDEs equipped with turbochargers, pumps, blowers, or

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superchargers for air induction may discharge crankcase emissions to the ambient atmosphere if the emissions are added to the exhaust emissions (either physically or mathematically) during all emission testing. Manufacturers taking advantage of this exception must manufacture the engines so that all crankcase emission can be routed into a dilution tunnel (or other sampling system approved in advance by the Administrator), and must account for deterioration in crankcase emissions when determining exhaust deterioration factors. For the purpose of this paragraph (c), crankcase emissions that are routed to the exhaust upstream of exhaust aftertreatment during all operation are not considered to be “discharged directly into the ambient atmosphere.”

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in subpart I or N of this part to ascertain that such test engines meet the requirements of paragraphs (a), (b), (c), and (d) of this section.

(e) [Reserved]. For guidance see §86.004-11.

(f)(1) Model year 2007 and later diesel-fueled heavy-duty engines and vehicles for sale in Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands shall be subject to the same standards and requirements as apply to 2006 model year diesel heavy-duty engines and vehicles, but only if the vehicle or engine bears a permanently affixed label stating:

THIS ENGINE (or VEHICLE, as applicable) CONFORMS TO US EPA EMISSION STANDARDS APPLICABLE TO MODEL YEAR 2006. THIS ENGINE (or VEHICLE, as applicable) DOES NOT CONFORM TO US EPA EMISSION REQUIREMENTS IN EFFECT AT TIME OF PRODUCTION AND MAY NOT BE IMPORTED INTO THE UNITED STATES OR ANY TERRITORY OF THE UNITED STATES EXCEPT GUAM, AMERICAN SAMOA, OR THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS.

(2) The importation or sale of such a vehicle or engine for use at any location U.S. other than Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands shall be considered a violation of section 203(a)(1) of the Clean Air Act. In addition, vehicles or vehicle engines subject to this exemption may not subsequently be imported or sold into any state or territory of the United States other than Guam, American Samoa, or Commonwealth of the Northern Mariana Islands.

(g) **Phase-in options.** (1) For model years 2007, 2008, and 2009, manufacturers may certify some of their engine families to the combined NO_x plus NMHC standard applicable to model year 2006 engines under §86.004-11, in lieu of the separate NO_x and NMHC standards specified in paragraph (a)(1) of this section. These engines must comply with all other requirements applicable to model year 2007 engines. The combined number of engines in the engine families certified to the 2006 combined NO_x plus NMHC standard may not exceed 50 percent of the manufacturer's U.S.-directed production of heavy-duty diesel motor vehicle engines for model year 2007, 2008,

or 2009, except as explicitly allowed by this paragraph (g).

(2)(i) Manufacturers certifying engines to all of the applicable standards listed in paragraph (a) and (c) of this section (without using credits) prior to model year 2007 may reduce the number of engines that are required to meet the standards listed in paragraph (a) of this section in model year 2007, 2008 and/or 2009, taking into account the phase-in option provided in paragraph (g)(1) of this section. For every two engines that are certified early, the manufacturer may reduce the number of engines that are required by paragraph (g)(1) of this section to meet standards listed in paragraph (a)(1) of this section by three engines. For example, if a manufacturer produces 100 heavy-duty diesel engines in 2006 that meet all of the applicable standards listed in paragraph (a) of this section, and it produced 10,000 heavy-duty diesel engines in 2007, then only 4,850 $((10,000)(0.50) - (100)(1.5))$ of the engines would need to comply with the standards listed in paragraph (a) of this section.

(ii) Manufacturers certifying engines to the PM standards listed in paragraph (a), and to all of the applicable standards in paragraph (c) of this section (without using credits) prior to model year 2007 may reduce the number of engines that are required to meet the PM standard listed in paragraph (a) of this section in model year 2007, 2008 and/or 2009. For every two engines that are certified to the PM standard early, the manufacturer may reduce the number of engines that are otherwise required to meet the PM standard listed in paragraph (a)(1) of this section by three engines.

(3) Manufacturers may initially base compliance with the phase-in requirements of paragraph (g)(1) or (g)(2) of this section on projected U.S.-directed production estimates. This is allowed for model year 2007 and/or 2008. However, if a manufacturer's actual U.S. directed production volume of engines that comply with the model year 2007 NO_x and NMHC standards is less than the required amount, the shortfall (in terms of number of engines) must be made up prior to 2010. For example, if a manufacturer plans in good faith to produce 50 percent of its projected 10,000 2007 engines (i.e., 5,000 engines) in compliance with the 2007 NO_x and NMHC standard, but is only able to produce 4,500 such engines of an actual 10,000 2007 engines, the manufacturer would need to produce an extra 500 engines in 2008 or 2009 in compliance with the 2007 NO_x and NMHC standard. The deficit allowed by this paragraph (g)(3) may not exceed 25 percent of the U.S. directed production volume.

(4) Manufacturers certifying engines to a voluntary NO_x standard of 0.10 g/ bhp-hr (without using credits) in addition to all of the other applicable standards listed in paragraphs (a) and (c) of this section prior to model year 2007 may reduce the number of engines that are required to meet the standards listed in paragraph (a)(1) of this section in model year 2007, 2008 and/or 2009, taking into account the phase-in option provided in paragraph (g)(1) of this section. For every engine that is certified early under this provision, the manufacturer may reduce the number of engines that are required by paragraph (g)(1) of this section to meet the standards listed in paragraph (a)(1) of this section by two engines.

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(5) For engines certified under paragraph (g)(1) of this section to the NO_x+NMHC standard in §86.004-11, the standards or FELs to which they are certified shall be used for the purposes of paragraphs (a)(3) and (a)(4) of this section.

(6) Manufacturers may determine the number of engines and vehicles that are required to certify to the NO_x standard in this section (including the phase-out engines certified to the NO_x+NMHC standard referenced in this paragraph (g)) based on calendar years 2007, 2008, and 2009, rather than model years 2007, 2008, and 2009.

(h)(1) For model years prior to 2012, for purposes of determining compliance after title or custody has transferred to the ultimate purchaser, for engines having a NO_x FEL no higher than 1.30 g/ bhp-hr, the applicable compliance limit shall be determined by adding the applicable adjustment from paragraph (h)(2) of this section to the otherwise applicable standard or FEL for NO_x.

(2)(i) For engines with 110,000 or fewer miles, the adjustment is 0.10 g/bhp-hr.

(ii) For engines with 110,001 to 185,000 miles, the adjustment is 0.15 g/bhp-hr.

(iii) For engines with 185,001 or more miles, the adjustment is 0.20 g/bhp-hr.

(3) For model years prior to 2012, for purposes of determining compliance after title or custody has transferred to the ultimate purchaser, the applicable compliance limit shall be determined by adding 0.01 g/ bhp-hr to the otherwise applicable standard or FEL for PM.

§86.010-18 On-board Diagnostics for engines used in applications greater than 14,000 pounds GVWR.

(a) **General.** According to the implementation schedule shown in paragraph (o) of this section, heavy-duty engines intended for use in a heavy-duty vehicle weighing more than 14,000 pounds GVWR must be equipped with an on-board diagnostic (OBD) system capable of monitoring all emission-related engine systems or components during the life of the engine. The OBD system is required to detect all malfunctions specified in paragraphs (g), (h), and (i) of this §86.010-18 although the OBD system is not required to use a unique monitor to detect each of those malfunctions.

(1) When the OBD system detects a malfunction, it must store a pending, a MIL-on, or a previous-MIL-on diagnostic trouble code (DTC) in the onboard computer's memory. A malfunction indicator light (MIL) must also be activated as specified in paragraph (b) of this section.

(2) *Data link connector.* (i) For model years 2010 through 2012, the OBD system must be equipped with a data link connector to provide access to the stored DTCs as specified in paragraph (k)(2) of this section.

(ii) For model years 2013 and later, the OBD system must be equipped with a standardized data link connector to provide access to the stored DTCs as specified in paragraph (k)(2) of this section.

(3) The OBD system cannot be programmed or otherwise designed to deactivate based on age and/or mileage. This requirement does not alter existing law and enforcement practice regarding a manufacturer's liability for an

engine beyond its regulatory useful life, except where an engine has been programmed or otherwise designed so that an OBD system deactivates based on age and/or mileage of the engine.

(4) *Drive cycle or driving cycle*, in the context of this §86.010-18, means operation that meets any of the conditions of paragraphs (a)(4)(i) through (a)(4)(iv) of this section. Further, for OBD monitors that run during engine-off conditions, the period of engine-off time following engine shutoff and up to the next engine start may be considered part of the drive cycle for the conditions of paragraphs (a)(4)(i) and (a)(4)(iv) of this section. For engines/vehicles that employ engine shutoff OBD monitoring strategies that do not require the vehicle operator to restart the engine to continue vehicle operation (e.g., a hybrid bus with engine shutoff at idle), the manufacturer may use an alternative definition for drive cycle (e.g., key-on followed by key-off). Any alternative definition must be based on equivalence to engine startup and engine shutoff signaling the beginning and ending of a single driving event for a conventional vehicle. For engines that are not likely to be routinely operated for long continuous periods of time, a manufacturer may also request approval to use an alternative definition for drive cycle (e.g., solely based on engine start and engine shutoff without regard to four hours of continuous engine-on time). Administrator approval of the alternative definition will be based on manufacturer-submitted data and/or information demonstrating the typical usage, operating habits, and/or driving patterns of these vehicles.

(i) Begins with engine start and ends with engine shutoff;

(ii) Begins with engine start and ends after four hours of continuous engine-on operation;

(iii) Begins at the end of the previous four hours of continuous engine-on operation and ends after four hours of continuous engine-on operation; or

(iv) Begins at the end of the previous four hours of continuous engine-on operation and ends with engine shutoff.

(5) As an alternative to demonstrating compliance with the provisions of paragraphs (b) through (l) of this §86.010-18, a manufacturer may demonstrate how the OBD system they have designed to comply with California OBD requirements for engines used in applications greater than 14,000 pounds also complies with the intent of the provisions of paragraphs (b) through (l) of this section. To make use of this alternative, the manufacturer must demonstrate to the Administrator how the OBD system they intend to certify meets the intent behind all of the requirements of this section, where applicable (e.g., paragraph (h) of this section would not apply for a diesel fueled/CI engine). Furthermore, if making use of this alternative, the manufacturer must comply with the specific certification documentation requirements of paragraph (m)(3) of this section.

(6) *Temporary provisions to address hardship due to unusual circumstances.* (i) After considering the unusual circumstances, the Administrator may permit the manufacturer to introduce into U.S. commerce engines that do not comply with this §86.010-18 for a limited time if all the following conditions apply:

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(A) Unusual circumstances that are clearly outside the manufacturer's control prevent compliance with the requirements of this §86.010-18.

(B) The manufacturer exercised prudent planning and was not able to avoid the violation and has taken all reasonable steps to minimize the extent of the nonconformity.

(C) No other allowances are available under the regulations in this chapter to avoid the impending violation.

(ii) To apply for an exemption, the manufacturer must send to the Administrator a written request as soon as possible before being in violation. In the request, the manufacturer must show that all the conditions and requirements of paragraph (a)(6)(i) of this section are met.

(iii) The request must also include a plan showing how all the applicable requirements will be met as quickly as possible.

(iv) The manufacturer shall give the Administrator other relevant information upon request.

(v) The Administrator may include additional conditions on an approval granted under the provisions of this paragraph (a)(6), including provisions that may require field repair at the manufacturer's expense to correct the noncompliance.

(vi) Engines sold as non-compliant under this temporary hardship provision must display "non-OBD" in the data stream as required under paragraph (k)(4)(ii) of this section. Upon correcting the noncompliance, the data stream value must be updated accordingly.

(b) Malfunction indicator light (MIL) and Diagnostic Trouble Codes (DTC). The OBD system must incorporate a malfunction indicator light (MIL) or equivalent and must store specific types of diagnostic trouble codes (DTC). Unless otherwise specified, all provisions of this paragraph (b) apply for 2010 and later model years.

(1) *MIL specifications.* (i) For model years 2013 and later, the MIL must be located on the primary driver's side instrument panel and be of sufficient illumination and location to be readily visible under all lighting conditions. The MIL must be amber (yellow) in color; the use of red for the OBD-related MIL is prohibited. More than one general purpose malfunction indicator light for emission-related problems shall not be used; separate specific purpose warning lights (e.g., brake system, fasten seat belt, oil pressure, etc.) are permitted. When activated, the MIL shall display the International Standards Organization (ISO) engine symbol.

(ii) The OBD system must activate the MIL when the ignition is in the key-on/engine-off position before engine cranking to indicate that the MIL is functional. The MIL shall be activated continuously during this functional check for a minimum of 5 seconds. During this MIL key-on functional check, the data stream value (see paragraph (k)(4)(ii) of this section) for MIL status must indicate "commanded off" unless the OBD system has detected a malfunction and has stored a MIL-on DTC. This MIL key-on functional check is not required during vehicle operation in the key-on/engine-off position subsequent to the initial engine cranking of an ignition cycle (e.g.,

due to an engine stall or other non-commanded engine shutoff).

(iii) As an option, the MIL may be used to indicate readiness status (see paragraph (k)(4)(i) of this section) in a standardized format in the key-on/engine-off position.

(iv) A manufacturer may also use the MIL to indicate which, if any, DTCs are currently stored (e.g., to "blink" the stored DTCs). Such use must not activate unintentionally during routine driver operation.

(v) For model years 2013 and later, the MIL required by this paragraph (b) must not be used in any other way than is specified in this section.

(2) *MIL activation and DTC storage protocol.* (i) Within 10 seconds of detecting a potential malfunction, the OBD system must store a pending DTC that identifies the potential malfunction.

(ii) If the potential malfunction is again detected before the end of the next drive cycle during which monitoring occurs (i.e., the potential malfunction has been confirmed as a malfunction), then within 10 seconds of such detection the OBD system must activate the MIL continuously and store a MIL-on DTC (systems using the SAE J1939 standard protocol specified in paragraph (k)(1) of this section may either erase or retain the pending DTC in conjunction with storing the MIL-on DTC). If the potential malfunction is not detected before the end of the next drive cycle during which monitoring occurs (i.e., there is no indication of the malfunction at any time during the drive cycle), the corresponding pending DTC should be erased at the end of the drive cycle. Similarly, if a malfunction is detected for the first time and confirmed on a given drive cycle without need for further evaluation, then within 10 seconds of such detection the OBD system must activate the MIL continuously and store a MIL-on DTC (again, systems using the SAE J1939 standard protocol specified in paragraph (k)(1) of this section may optionally store a pending DTC in conjunction with storing the MIL-on DTC).

(iii) A manufacturer may request Administrator approval to employ alternative statistical MIL activation and DTC storage protocols to those specified in paragraphs (b)(2)(i) and (b)(2)(ii) of this section. Approval will depend upon the manufacturer providing data and/or engineering evaluations that demonstrate that the alternative protocols can evaluate system performance and detect malfunctions in a manner that is equally effective and timely. Strategies requiring on average more than six drive cycles for MIL activation will not be accepted.

(iv) The OBD system must store a "freeze frame" of the operating conditions (as defined in paragraph (k)(4)(iii) of this section) present upon detecting a malfunction or a potential malfunction. In the event that a pending DTC has matured to a MIL-on DTC, the manufacturer shall either retain the currently stored freeze frame conditions or replace the stored freeze frame with freeze frame conditions regarding the MIL-on DTC. Any freeze frame stored in conjunction with any pending DTC or MIL-on DTC should be erased upon erasure of the corresponding DTC.

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(v) If the engine enters a limp-home mode of operation that can affect emissions or the performance of the OBD system, or in the event of a malfunction of an onboard computer(s) itself that can affect the performance of the OBD system, the OBD system must activate the MIL and store a MIL-on DTC within 10 seconds to inform the vehicle operator. If the limp-home mode of operation is recoverable (i.e., operation automatically returns to normal at the beginning of the following ignition cycle), the OBD system may wait to activate the MIL and store the MIL-on DTC if the limp-home mode of operation is again entered before the end of the next ignition cycle rather than activating the MIL within 10 seconds on the first drive cycle during which the limp-home mode of operation is entered.

(vi) Before the end of an ignition cycle, the OBD system must store a permanent DTC(s) that corresponds to any stored MIL-on DTC(s).

(3) *MIL deactivation and DTC erasure protocol*—(i) *Deactivating the MIL*. Except as otherwise provided for in paragraphs (g)(2)(iv)(E) and (g)(6)(iv)(B) of this section for diesel misfire malfunctions and empty reductant tanks, and paragraphs (h)(1)(iv)(F), (h)(2)(viii), and (h)(7)(iv)(B) of this section for gasoline fuel system, misfire, and evaporative system malfunctions, once the MIL has been activated, it may be deactivated after three subsequent sequential drive cycles during which the monitoring system responsible for activating the MIL functions and the previously detected malfunction is no longer present and provided no other malfunction has been detected that would independently activate the MIL according to the requirements outlined in paragraph (b)(2) of this section.

(ii) *Erasing a MIL-on DTC*. The OBD system may erase a MIL-on DTC if the identified malfunction has not again been detected in at least 40 engine warm up cycles and the MIL is presently not activated for that malfunction. The OBD system may also erase a MIL-on DTC upon deactivating the MIL according to paragraph (b)(3)(i) of this section provided a previous-MIL-on DTC is stored upon erasure of the MIL-on DTC. The OBD system may erase a previous-MIL-on DTC if the identified malfunction has not again been detected in at least 40 engine warm up cycles and the MIL is presently not activated for that malfunction.

(iii) *Erasing a permanent DTC*. The OBD system can erase a permanent DTC only if:

(A) The OBD system itself determines that the malfunction that caused the corresponding permanent DTC to be stored is no longer present and is not commanding activation of the MIL, concurrent with the requirements of paragraph (b)(3)(i) of this section which, for purposes of this paragraph (b)(3)(iii), shall apply to all monitors.

(B) All externally erasable DTC information stored in the onboard computer has been erased (i.e., through the use of a scan tool or battery disconnect) and the monitor of the malfunction that caused the permanent DTC to be stored is subject to the minimum ratio requirements of paragraph (d) of this section, the OBD system shall erase the permanent DTC at the end of a drive cycle if the monitor has run and made one or more determinations during a drive cycle that the malfunction of the compo-

nent or the system is not present and has not made any determinations within the same drive cycle that the malfunction is present.

(C)(1) All externally erasable DTC information stored in the onboard computer has been erased (i.e., through the use of a scan tool or battery disconnect) and the monitor of the malfunction that caused the permanent DTC to be stored is not subject to the minimum ratio requirements of paragraph (d) of this section, the OBD system shall erase the permanent DTC at the end of a drive cycle provided the following two criteria have independently been satisfied:

(i) The monitor has run and made one or more determinations during a drive cycle that the malfunction is no longer present and has not made any determinations within the same drive cycle that the malfunction is present; and,

(ii) The monitor does not detect a malfunction on a drive cycle and the criteria of paragraph (d)(4)(ii) of this section has been met.

(2) These two separate criteria may be met on the same or different drive cycles provided the monitor never detects a malfunction during either drive cycle, and if criteria (b)(3)(iii)(C)(1)(i) happens first then no malfunction may be detected before criteria (b)(3)(iii)(C)(1)(ii) occurs. If a malfunction occurs after criteria (b)(3)(iii)(C)(1)(i) then criteria (b)(3)(iii)(C)(1)(i) must be satisfied again. For the second criterion, the manufacturer must exclude any temperature and/or elevation provisions of paragraph (d)(4)(ii) of this section. For this paragraph (b)(3)(iii)(C), monitors required to use “similar conditions” as defined in §86.010-2 to store and erase pending and MIL-on DTCs cannot require that the similar conditions be met prior to erasure of the permanent DTC.

(D) The Administrator shall allow monitors subject to paragraph (b)(3)(iii)(B) of this section to use the criteria of paragraph (b)(3)(iii)(C) of this section in lieu of paragraph (b)(3)(iii)(B). Further, manufacturers may request Administrator approval to use alternative criteria to erase the permanent DTC. The Administrator shall approve alternate criteria that will not likely require driving conditions that are longer and more difficult to meet than those required under paragraph (b)(3)(iii)(C) of this section and do not require access to enhanced scan tools to determine conditions necessary to erase the permanent DTC.

(4) *Exceptions to MIL and DTC requirements*. (i) If a limp-home mode of operation causes a overt indication (e.g., activation of a red engine shut-down warning light) such that the driver is certain to respond and have the problem corrected, a manufacturer may choose not to activate the MIL as required by paragraph (b)(2)(v) of this section. Additionally, if an auxiliary emission control device has been properly activated as approved by the Administrator, a manufacturer may choose not to activate the MIL.

(ii) For gasoline engines, a manufacturer may choose to meet the MIL and DTC requirements in §86.007-17 in lieu of meeting the requirements of paragraph (b) of this §86.010-18.

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(c) **Monitoring conditions.** The OBD system must monitor and detect the malfunctions specified in paragraphs (g), (h), and (i) of this section under the following general monitoring conditions. The more specific monitoring conditions of paragraph (d) of this section are sometimes required according to the provisions of paragraphs (g), (h), and (i) of this section.

(1) As specifically provided for in paragraphs (g), (h), and (i) of this section, the monitoring conditions for detecting malfunctions must be technically necessary to ensure robust detection of malfunctions (e.g., avoid false passes and false indications of malfunctions); designed to ensure monitoring will occur under conditions that may reasonably be expected to be encountered in normal vehicle operation and normal vehicle use; and, designed to ensure monitoring will occur during the FTP transient test cycle contained in appendix I paragraph (f), of this part, or similar drive cycle as approved by the Administrator.

(2) Monitoring must occur at least once per drive cycle in which the monitoring conditions are met.

(3) Manufacturers may define monitoring conditions that are not encountered during the FTP cycle as required in paragraph (c)(1) of this section. In doing so, the manufacturer would be expected to consider the degree to which the requirement to run during the FTP transient cycle restricts monitoring during in-use operation, the technical necessity for defining monitoring conditions that are not encountered during the FTP cycle, whether monitoring is otherwise not feasible during the FTP cycle, and/or the ability to demonstrate that the monitoring conditions satisfy the minimum acceptable in-use monitor performance ratio requirement as defined in paragraph (d) of this section.

(d) **In-use performance tracking.** As specifically required in paragraphs (g), (h), and (i) of this section, the OBD system must monitor and detect the malfunctions specified in paragraphs (g), (h), and (i) of this section according to the criteria of this paragraph (d). The OBD system is not required to track and report in-use performance for monitors other than those specifically identified in paragraph (d)(1) of this section, but all monitors on applicable model year engines are still required to meet the in-use performance ratio as specified in paragraph (d)(1)(ii) of this section.

(1) The manufacturer must implement software algorithms in the OBD system to individually track and report the in-use performance of the following monitors, if equipped, in the standardized format specified in paragraph (e) of this section: NMHC converting catalyst (paragraph (g)(5) of this section); NO_x converting catalyst (paragraph (g)(6) of this section); gasoline catalyst (paragraph (h)(6) of this section); exhaust gas sensor (paragraph (g)(9) of this section) or paragraph (h)(8) of this section; evaporative system (paragraph (h)(7) of this section); EGR system (paragraph (g)(3) of this section or (h)(3) of this section); VVT system (paragraph (g)(10) of this section or (h)(9) of this section); secondary air system (paragraph (h)(5) of this section); DPF system (paragraph (g)(8) of this section); boost pressure control system (paragraph (g)(4) of this section); and, NO_x adsorber system (paragraph (g)(7) of this section).

(i) The manufacturer shall not use the calculated ratio specified in paragraph (d)(2) of this section or any other indication of monitor frequency as a monitoring condition for a monitor (e.g., using a low ratio to enable more frequent monitoring through diagnostic executive priority or modification of other monitoring conditions, or using a high ratio to enable less frequent monitoring).

(ii) For model years 2013 and later, manufacturers must define monitoring conditions that, in addition to meeting the criteria in paragraphs (c)(1) and (d)(1) of this section, ensure that the monitor yields an in-use performance ratio (as defined in paragraph (d)(2) of this section) that meets or exceeds the minimum acceptable in-use monitor performance ratio of 0.100 for all monitors specifically required in paragraphs (g), (h), and (i) of this section to meet the monitoring condition requirements of this paragraph (d).

(iii) If the most reliable monitoring method developed requires a lower ratio for a specific monitor than that specified in paragraph (d)(1)(ii) of this section, the Administrator may lower the minimum acceptable in-use monitoring performance ratio.

(2) *In-use performance ratio definition.* For monitors required to meet the requirements of paragraph (d) of this section, the performance ratio must be calculated in accordance with the specifications of this paragraph (d)(2).

(i) The numerator of the performance ratio is defined as the number of times a vehicle has been operated such that all monitoring conditions have been encountered that are necessary for the specific monitor to detect a malfunction.

(ii) The denominator is defined as the number of times a vehicle has been operated in accordance with the provisions of paragraph (d)(4) of this section.

(iii) The performance ratio is defined as the numerator divided by the denominator.

(3) *Specifications for incrementing the numerator.* (i) Except as provided for in paragraph (d)(3)(v) of this section, the numerator, when incremented, must be incremented by an integer of one. The numerator shall not be incremented more than once per drive cycle.

(ii) The numerator for a specific monitor must be incremented within 10 seconds if and only if the following criteria are satisfied on a single drive cycle:

(A) Every monitoring condition has been satisfied that is necessary for the specific monitor to detect a malfunction and store a pending DTC, including applicable enable criteria, presence or absence of related DTCs, sufficient length of monitoring time, and diagnostic executive priority assignments (e.g., diagnostic "A" must execute prior to diagnostic "B"). For the purpose of incrementing the numerator, satisfying all the monitoring conditions necessary for a monitor to determine that the monitor is not malfunctioning shall not, by itself, be sufficient to meet this criteria.

(B) For monitors that require multiple stages or events in a single drive cycle to detect a malfunction, every monitoring condition necessary for all events to complete must be satisfied.

(C) For monitors that require intrusive operation of components to detect a malfunction, a manufacturer must

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request approval of the strategy used to determine that, had a malfunction been present, the monitor would have detected the malfunction. Administrator approval of the request will be based on the equivalence of the strategy to actual intrusive operation and the ability of the strategy to determine accurately if every monitoring condition was satisfied that was necessary for the intrusive event to occur.

(D) For the secondary air system monitor, the criteria in paragraphs (d)(3)(ii)(A) through (d)(3)(ii)(C) of this section are satisfied during normal operation of the secondary air system. Monitoring during intrusive operation of the secondary air system later in the same drive cycle for the sole purpose of monitoring shall not, by itself, be sufficient to meet these criteria.

(iii) For monitors that can generate results in a “gray zone” or “non-detection zone” (i.e., monitor results that indicate neither a properly operating system nor a malfunctioning system) or in a “non-decision zone” (e.g., monitors that increment and decrement counters until a pass or fail threshold is reached), the numerator, in general, shall not be incremented when the monitor indicates a result in the “non-detection zone” or prior to the monitor reaching a complete decision. When necessary, the Administrator will consider data and/or engineering analyses submitted by the manufacturer demonstrating the expected frequency of results in the “non-detection zone” and the ability of the monitor to determine accurately, had an actual malfunction been present, whether or not the monitor would have detected a malfunction instead of a result in the “non-detection zone.”

(iv) For monitors that run or complete their evaluation with the engine off, the numerator must be incremented either within 10 seconds of the monitor completing its evaluation in the engine off state, or during the first 10 seconds of engine start on the subsequent drive cycle.

(v) Manufacturers that use alternative statistical MIL activation protocols as allowed in paragraph (b)(2)(iii) of this section for any of the monitors requiring a numerator, are required to increment the numerator(s) appropriately. The manufacturer may be required to provide supporting data and/or engineering analyses demonstrating both the equivalence of their incrementing approach to the incrementing specified in this paragraph (d)(3) for monitors using the standard MIL activation protocol, and the overall equivalence of the incrementing approach in determining that the minimum acceptable in-use performance ratio of paragraph (d)(1)(ii) of this section, if applicable, has been satisfied.

(4) *Specifications for incrementing the denominator.* (i) The denominator, when incremented, must be incremented by an integer of one. The denominator shall not be incremented more than once per drive cycle.

(ii) The denominator for each monitor must be incremented within 10 seconds if and only if the following criteria are satisfied on a single drive cycle:

(A) Cumulative time since the start of the drive cycle is greater than or equal to 600 seconds while at an elevation of less than 8,000 feet (2,400 meters) above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit (–7 C);

(B) Cumulative gasoline engine operation at or above 25 miles per hour or diesel engine operation at or above 1,150 rotations per minute (diesel engines may use the gasoline criterion for 2010 through 2012 model years), either of which occurs for greater than or equal to 300 seconds while at an elevation of less than 8,000 feet (2,400 meters) above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit (–7 C); and,

(C) Continuous engine operation at idle (e.g., accelerator pedal released by driver and engine speed less than or equal to 200 rpm above normal warmed-up idle (as determined in the drive position for vehicles equipped with an automatic transmission) or vehicle speed less than or equal to one mile per hour) for greater than or equal to 30 seconds while at an elevation of less than 8,000 feet (2,400 meters) above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit (–7 C).

(iii) In addition to the requirements of paragraph (d)(4)(ii) of this section, the evaporative system monitor denominator(s) may be incremented if and only if:

(A) Cumulative time since the start of the drive cycle is greater than or equal to 600 seconds while at an ambient temperature of greater than or equal to 40 degrees Fahrenheit (4 C) but less than or equal to 95 degrees Fahrenheit (35 C); and,

(B) Engine cold start occurs with the engine coolant temperature greater than or equal to 40 degrees Fahrenheit (4 C) but less than or equal to 95 degrees Fahrenheit (35 C) and less than or equal to 12 degrees Fahrenheit (7 C) higher than the ambient temperature.

(iv) In addition to the requirements of paragraph (d)(4)(ii) of this section, the denominator(s) for the following monitors may be incremented if and only if the component or strategy is commanded “on” for a cumulative time greater than or equal to 10 seconds. For purposes of determining this commanded “on” time, the OBD system shall not include time during intrusive operation of any of the components or strategies that occurs later in the same drive cycle for the sole purpose of monitoring.

(A) Secondary air system (paragraph (h)(5) of this section).

(B) Cold start emission reduction strategy (paragraph (h)(4) of this section).

(C) Components or systems that operate only at engine start-up (e.g., glow plugs, intake air heaters) and are subject to monitoring under “other emission control systems” (paragraph (i)(4) of this section) or comprehensive component output components (paragraph (i)(3)(iii) of this section).

(v) In addition to the requirements of paragraph (d)(4)(ii) of this section, the denominator(s) for the following monitors of output components (except those operated only at engine start-up and subject to the requirements of paragraph (d)(4)(iv) of this section, may be incremented if and only if the component is commanded to function (e.g., commanded “on”, “opened”, “closed”, “locked”) on two or more occasions during the

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drive cycle or for a cumulative time greater than or equal to 10 seconds, whichever occurs first:

(A) Variable valve timing and/or control system (paragraph (g)(10) of this section or (h)(9) of this section).

(B) "Other emission control systems" (paragraph (i)(4) of this section).

(C) Comprehensive component output component (paragraph (i)(3) of this section) (e.g., turbocharger wastegates, variable length manifold runners).

(vi) For monitors of the following components, the manufacturer may use alternative or additional criteria for incrementing the denominator to that set forth in paragraph (d)(4)(ii) of this section. To do so, the alternative criteria must be based on equivalence to the criteria of paragraph (d)(4)(ii) of this section in measuring the frequency of monitor operation relative to the amount of engine operation:

(A) Engine cooling system input components (paragraph (i)(1) of this section).

(B) "Other emission control systems" (paragraph (i)(4) of this section).

(C) Comprehensive component input components that require extended monitoring evaluation (paragraph (i)(3) of this section) (e.g., stuck fuel level sensor rationality).

(D) Comprehensive component input component temperature sensor rationality monitors (paragraph (i)(3) of this section) (e.g., intake air temperature sensor, ambient temperature sensor, fuel temperature sensor).

(E) Diesel particulate filter (DPF) frequent regeneration (paragraph (g)(8)(ii)(B) of this section).

(vii) For monitors of the following components or other emission controls that experience infrequent regeneration events, the manufacturer may use alternative or additional criteria for incrementing the denominator to that set forth in paragraph (d)(4)(ii) of this section. To do so, the alternative criteria must be based on equivalence to the criteria of paragraph (d)(4)(ii) of this section in measuring the frequency of monitor operation relative to the amount of engine operation:

(A) NMHC converting catalyst (paragraph (g)(5) of this section).

(B) Diesel particulate filter (DPF) (paragraphs (g)(8)(ii)(A) and (g)(8)(ii)(D) of this section).

(viii) In addition to the requirements of paragraph (d)(4)(ii) of this section, the denominator(s) for the following monitors shall be incremented if and only if a regeneration event is commanded for a time greater than or equal to 10 seconds:

(A) DPF incomplete regeneration (paragraph (g)(8)(ii)(C) of this section).

(B) DPF active/intrusive injection (paragraph (g)(8)(ii)(E) of this section).

(ix) For hybrids that employ alternative engine start hardware or strategies (e.g., integrated starter and generators), or alternative fuel vehicles (e.g., dedicated, bi-fuel, or dual-fuel applications), the manufacturer may use alternative criteria for incrementing the denominator to that set forth in paragraph (d)(4)(ii) of this section. In general, the Administrator will not approve alternative criteria for those hybrids that employ engine shut

off only at or near idle and/or vehicle stop conditions. To use alternative criteria, the alternative criteria must be based on the equivalence to the criteria of paragraph (d)(4)(ii) of this section in measuring the amount of vehicle operation relative to the measure of conventional vehicle operation.

(5) *Disablement of numerators and denominators.* (i) Within 10 seconds of detecting a malfunction (i.e., a pending or a MIL-on DTC has been stored) that disables a monitor for which the monitoring conditions in paragraph (d) of this section must be met, the OBD system must stop incrementing the numerator and denominator for any monitor that may be disabled as a consequence of the detected malfunction. Within 10 seconds of the time at which the malfunction is no longer being detected (e.g., the pending DTC is erased through OBD system self-clearing or through a scan tool command), incrementing of all applicable numerators and denominators must resume.

(ii) Within 10 seconds of the start of a power take-off unit (e.g., dump bed, snow plow blade, or aerial bucket, etc.) that disables a monitor for which the monitoring conditions in paragraph (d) of this section must be met, the OBD system must stop incrementing the numerator and denominator for any monitor that may be disabled as a consequence of power take-off operation. Within 10 seconds of the time at which the power take-off operation ends, incrementing of all applicable numerators and denominators must resume.

(iii) Within 10 seconds of detecting a malfunction (i.e., a pending or a MIL-on DTC has been stored) of any component used to determine if the criteria of paragraphs (d)(4)(ii) and (d)(4)(iii) of this section are satisfied, the OBD system must stop incrementing all applicable numerators and denominators. Within 10 seconds of the time at which the malfunction is no longer being detected (e.g., the pending DTC is erased through OBD system self-clearing or through a scan tool command), incrementing of all applicable numerators and denominators must resume.

(e) **Standardized tracking and reporting of in-use monitor performance**—(1) General. For monitors required to track and report in-use monitor performance according to paragraph (d) of this section, the performance data must be tracked and reported in accordance with the specifications in paragraphs (d)(2), (e), and (k)(5) of this section. The OBD system must separately report an in-use monitor performance numerator and denominator for each of the following components:

(i) For diesel engines, NMHC catalyst bank 1, NMHC catalyst bank 2, NO_x catalyst bank 1, NO_x catalyst bank 2, exhaust gas sensor bank 1, exhaust gas sensor bank 2, EGR/VVT system, DPF, boost pressure control system, and NO_x adsorber. The OBD system must also report a general denominator and an ignition cycle counter in the standardized format specified in paragraphs (e)(5), (e)(6), and (k)(5) of this section.

(ii) For gasoline engines, catalyst bank 1, catalyst bank 2, exhaust gas sensor bank 1, exhaust gas sensor bank 2, evaporative leak detection system, EGR/VVT system, and secondary air system. The OBD system must also

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report a general denominator and an ignition cycle counter in the standardized format specified in paragraphs (e)(5), (e)(6), and (k)(5) of this section.

(iii) For specific components or systems that have multiple monitors that are required to be reported under paragraphs (g) and (h) of this section (e.g., exhaust gas sensor bank 1 may have multiple monitors for sensor response or other sensor characteristics), the OBD system must separately track numerators and denominators for each of the specific monitors and report only the corresponding numerator and denominator for the specific monitor that has the lowest numerical ratio. If two or more specific monitors have identical ratios, the corresponding numerator and denominator for the specific monitor that has the highest denominator must be reported for the specific component.

(2) *Numerator.* (i) The OBD system must report a separate numerator for each of the applicable components listed in paragraph (e)(1) of this section.

(ii) The numerator(s) must be reported in accordance with the specifications in paragraph (k)(5)(ii) of this section.

(3) *Denominator.* (i) The OBD system must report a separate denominator for each of the applicable components listed in paragraph (e)(1) of this section.

(ii) The denominator(s) must be reported in accordance with the specifications in paragraph (k)(5)(ii) of this section.

(4) *Monitor performance ratio.* For purposes of determining which corresponding numerator and denominator to report as required in paragraph (e)(1)(iii) of this section, the ratio must be calculated in accordance with the specifications in paragraph (k)(5)(iii) of this section.

(5) *Ignition cycle counter.* (i) The ignition cycle counter is defined as a counter that indicates the number of ignition cycles a vehicle has experienced according to the specifications of paragraph (e)(5)(ii)(B) of this section. The ignition cycle counter must be reported in accordance with the specifications in paragraph (k)(5)(ii) of this section.

(ii) The ignition cycle counter must be incremented as follows:

(A) The ignition cycle counter, when incremented, must be incremented by an integer of one. The ignition cycle counter shall not be incremented more than once per ignition cycle.

(B) The ignition cycle counter must be incremented within 10 seconds if and only if the engine exceeds an engine speed of 50 to 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for engines paired with an automatic transmission) for at least two seconds plus or minus one second.

(iii) Within 10 seconds of detecting a malfunction (i.e., a pending or a MIL-on DTC has been stored) of any component used to determine if the criteria in paragraph (e)(5)(ii)(B) of this section are satisfied (i.e., engine speed or time of operation), the OBD system must stop incrementing the ignition cycle counter. Incrementing of the ignition cycle counter shall not be stopped for any other condition. Within 10 seconds of the time at which the malfunction is no longer being detected (e.g., the

pending DTC is erased through OBD system self-clearing or through a scan tool command), incrementing of the ignition cycle counter must resume.

(6) *General denominator.* (i) The general denominator is defined as a measure of the number of times an engine has been operated according to the specifications of paragraph (e)(6)(ii)(B) of this section. The general denominator must be reported in accordance with the specifications in paragraph (k)(5)(ii) of this section.

(ii) The general denominator must be incremented as follows:

(A) The general denominator, when incremented, must be incremented by an integer of one. The general denominator shall not be incremented more than once per drive cycle.

(B) The general denominator must be incremented within 10 seconds if and only if the criteria identified in paragraph (d)(4)(ii) of this section are satisfied on a single drive cycle.

(C) Within 10 seconds of detecting a malfunction (i.e., a pending or a MIL-on DTC has been stored) of any component used to determine if the criteria in paragraph (d)(4)(ii) of this section are satisfied (i.e., vehicle speed/load, ambient temperature, elevation, idle operation, or time of operation), the OBD system must stop incrementing the general denominator. Incrementing of the general denominator shall not be stopped for any other condition (e.g., the disablement criteria in paragraphs (d)(5)(i) and (d)(5)(ii) of this section shall not disable the general denominator). Within 10 seconds of the time at which the malfunction is no longer being detected (e.g., the pending DTC is erased through OBD system self-clearing or through a scan tool command), incrementing of the general denominator must resume.

(f) **Malfunction criteria determination.** (1) In determining the malfunction criteria for the diesel engine monitors required under paragraphs (g) and (i) of this section that are required to indicate a malfunction before emissions exceed an emission threshold based on any applicable standard, the manufacturer must:

(i) Use the emission test cycle and standard (i.e., the transient FTP or the supplemental emissions test (SET)) determined by the manufacturer to provide the most effective monitoring conditions and robust monitor provided all other applicable requirements of this section are met.

(ii) Identify in the certification documentation required under paragraph (m) of this section, the test cycle and standard determined by the manufacturer to be the most stringent for each applicable monitor and the most effective and robust for each applicable monitor.

(iii) If the Administrator reasonably believes that a manufacturer has determined incorrectly the test cycle and standard that is most stringent or effective, the manufacturer must be able to provide emission data and/or engineering analysis supporting their choice of test cycle and standard.

(2) On engines equipped with emission controls that experience infrequent regeneration events, a manufacturer need not adjust the emission test results that are used to determine the malfunction criteria for monitors

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that are required to indicate a malfunction before emissions exceed a certain emission threshold. For each such monitor, should the manufacturer choose to adjust the emission test results, the manufacturer must adjust the emission result as done in accordance with the provisions of §86.004-28(i) with the component for which the malfunction criteria are being established having been deteriorated to the malfunction threshold. The adjusted emission value must be used for purposes of determining whether or not the applicable emission threshold is exceeded.

(i) For purposes of this paragraph (f)(2), regeneration means an event, by design, during which emissions levels change while the emission control performance is being restored.

(ii) For purposes of this paragraph (f)(2), infrequent means having an expected frequency of less than once per transient FTP cycle.

(3) For gasoline engines, rather than meeting the malfunction criteria specified under paragraphs (h) and (i) of this section, the manufacturer may request approval to use an OBD system certified to the requirements of §86.007-17. To do so, the manufacturer must demonstrate use of good engineering judgment in determining equivalent malfunction detection criteria to those required in this section.

(g) **OBD monitoring requirements for diesel-fueled/compression-ignition engines.** The following table shows the thresholds at which point certain components or systems, as specified in this paragraph (g), are considered malfunctioning.

TABLE 1—OBD EMISSIONS THRESHOLDS FOR DIESEL-FUELED/COMPRESSION-IGNITION ENGINES MEANT FOR PLACEMENT IN APPLICATIONS GREATER THAN 14,000 POUNDS GVWR (G/BHP-HR)

Component	§86.010-18 reference	NMHC	CO	NO _x	PM
Model years 2010-2012:					
NO _x aftertreatment system ...	(g)(6) (g)(7)	.....	.....	+0.6	
Diesel particulate filter (DPF) system ...	(g)(8)	2.5x	.....	.....	0.05/ +0.04
Air-fuel ratio sensors upstream of aftertreatment devices	(g)(9)	2.5x	2.5x	+0.3	0.03/ +0.02
Air-fuel ratio sensors downstream of aftertreatment devices	(g)(9)	2.5x	.....	+0.3	0.05/ +0.04

TABLE 1—OBD EMISSIONS THRESHOLDS FOR DIESEL-FUELED/COMPRESSION-IGNITION ENGINES MEANT FOR PLACEMENT IN APPLICATIONS GREATER THAN 14,000 POUNDS GVWR (G/BHP-HR), Continued

Component	§86.010-18 reference	NMHC	CO	NO _x	PM
NO _x sensors	(g)(9)	.....	.....	+0.6	0.05/ +0.04
"Other monitors" with emissions thresholds	(g)(1) (g)(3) (g)(4) (g)(10)	2.5x	2.5x	+0.3	0.03/ +0.02
Model years 2013 and later:					
NO _x aftertreatment system ...	(g)(6) (g)(7)	.....	.....	+0.3	
Diesel particulate filter (DPF) system ...	(g)(8)	2x	.....	.....	0.05/ +0.04
Air-fuel ratio sensors upstream of aftertreatment devices	(g)(9)	2x	2x	+0.3	0.03/ +0.02
Air-fuel ratio sensors downstream of aftertreatment devices	(g)(9)	2x	.....	+0.3	0.05/ +0.04
NO _x sensors	(g)(9)	.....	.....	+0.3	0.05/ +0.04
"Other monitors" with emissions thresholds	(g)(1) (g)(2) (g)(3) (g)(4) (g)(10)	2x	2x	+0.3	0.03/ +0.02

Notes: FEL = Family Emissions Limit; 2.5x std means a multiple of 2.5 times the applicable emissions standard; +0.3 means the standard or FEL plus 0.3; 0.05/+0.04 means an absolute level of 0.05 or an additive level of the standard or FEL plus 0.04, whichever level is higher; these emissions thresholds apply to the monitoring requirements of paragraph (g) of this §86.010-18.

(1) *Fuel system monitoring*—(i) *General.* The OBD system must monitor the fuel delivery system to verify that it is functioning properly. The individual electronic components (e.g., actuators, valves, sensors, pumps) that are used in the fuel system and are not specifically addressed in this paragraph (g)(1) must be monitored in accordance with the requirements of paragraph (i)(3) of this section.

(ii) *Fuel system malfunction criteria* —(A) *Fuel system pressure control.* The OBD system must monitor the fuel system's ability to control to the desired fuel pressure. This monitoring must be done continuously unless new hardware has to be added, in which case the monitoring must be done at least once per drive cycle. The OBD

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system must detect a malfunction of the fuel system's pressure control system when the pressure control system is unable to maintain an engine's emissions at or below the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the fuel system pressure control could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that the commanded fuel system pressure cannot be delivered. For model year 2010 to 2012 engines with a unit injector fuel system, this requirement may be met by conducting a functional check of the fuel system pressure control in lieu of monitoring for conditions that could cause an engine's emissions to exceed the applicable emissions thresholds.

(B) *Fuel system injection quantity.* The OBD system must detect a malfunction of the fuel injection system when the system is unable to deliver the commanded quantity of fuel necessary to maintain an engine's emissions at or below the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the fuel injection quantity could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that the commanded fuel quantity cannot be delivered. For model year 2010 to 2012 engines with a unit injector fuel system, this requirement may be met by conducting a functional check of the fuel system injection quantity in lieu of monitoring for conditions that could cause an engine's emissions to exceed the applicable emissions thresholds.

(C) *Fuel system injection timing.* The OBD system must detect a malfunction of the fuel injection system when the system is unable to deliver fuel at the proper crank angle/timing (e.g., injection timing too advanced or too retarded) necessary to maintain an engine's emissions at or below the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the fuel injection timing could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that the commanded fuel injection timing cannot be achieved. For model year 2010 to 2012 engines with a unit injector fuel system, this requirement may be met by conducting a functional check of the fuel system injection timing in lieu of monitoring for conditions that could cause an engine's emissions to exceed the applicable emissions thresholds.

(D) *Combined Monitoring.* For engines with a unit injector fuel system, the manufacturer may request Administrator approval to combine the malfunction criteria of paragraphs (g)(1)(ii)(A) through (g)(1)(ii)(C) of this section into one malfunction provided the manufacturer can demonstrate that the combined malfunction will satisfy the intent of each separate malfunction criteria. For engines with a common rail fuel system, the manufacturer may request Administrator approval to combine the malfunction criteria of paragraphs (g)(1)(ii)(B) through (g)(1)(ii)(C) of this section into one

malfunction provided the manufacturer can demonstrate that the combined malfunction will satisfy the intent of each separate malfunction criteria.

(E) *Fuel system feedback control.* See paragraph (i)(6) of this section.

(iii) *Fuel system monitoring conditions.* (A) With the exceptions noted in this paragraph for unit injector systems, the OBD system must monitor continuously for malfunctions identified in paragraphs (g)(1)(ii)(A) and (g)(1)(ii)(E) of this section. For 2010 through 2012 unit injector systems, where functional monitoring is done in lieu of emission threshold monitoring for malfunctions identified in paragraph (g)(1)(ii)(A) of this section, the manufacturer must define the monitoring conditions in accordance with paragraphs (c) and (d) of this section. For 2013 and later unit injector systems, the manufacturer must define the monitoring conditions for malfunctions identified in paragraph (g)(1)(ii)(A) of this section in accordance with paragraphs (c) and (d) of this section, with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section.

(B) For 2010 through 2012, the manufacturer must define the monitoring conditions for malfunctions identified in paragraphs (g)(1)(ii)(B), (g)(1)(ii)(C), and (g)(1)(ii)(D) of this section in accordance with paragraphs (c) and (d) of this section. For 2013 and later, the manufacturer must define the monitoring conditions in accordance with paragraphs (c) and (d) of this section, with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section.

(iv) *Fuel system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(2) *Engine misfire monitoring*—(i) *General.* The OBD system must monitor the engine for misfire causing excess emissions.

(ii) *Engine misfire malfunction criteria.* (A) The OBD system must be capable of detecting misfire occurring in one or more cylinders. To the extent possible without adding hardware for this specific purpose, the OBD system must also identify the specific misfiring cylinder. If more than one cylinder is misfiring continuously, or if more than one but less than half of the cylinders are misfiring continuously (if the manufacturer can demonstrate the robustness of their monitor to the approval of the Administrator), a separate DTC must be stored indicating that multiple cylinders are misfiring. When identifying multiple cylinder misfire, the OBD system is not required to identify individually through separate DTCs each of the continuously misfiring cylinders.

(B) For model years 2013 and later, on engines equipped with sensors that can detect combustion or combustion quality (e.g., for use in engines with homogeneous charge compression ignition (HCCI) control systems), the OBD system must detect a misfire malfunction causing emissions to exceed the applicable thresholds for "other monitors" shown in Table 1 of this paragraph (g). To determine what level of misfire would cause emissions to

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exceed the applicable emissions thresholds, the manufacturer must determine the percentage of misfire evaluated in 1,000 revolution increments that would cause emissions from an emission durability demonstration engine to exceed the emissions thresholds if the percentage of misfire were present from the beginning of the test. To establish this percentage of misfire, the manufacturer must use misfire events occurring at equally spaced, complete engine cycle intervals, across randomly selected cylinders throughout each 1,000-revolution increment. If this percentage of misfire is determined to be lower than one percent, the manufacturer may set the malfunction criteria at one percent. Any misfire malfunction must be detected if the percentage of misfire established via this testing is exceeded regardless of the pattern of misfire events (e.g., random, equally spaced, continuous). The manufacturer may employ other revolution increments besides the 1,000 revolution increment. To do so, the manufacturer must demonstrate that the strategy is equally effective and timely in detecting misfire.

(iii) *Engine misfire monitoring conditions.*

(A) The OBD system must monitor for engine misfire during engine idle conditions at least once per drive cycle in which the monitoring conditions for misfire are met. The manufacturer must be able to demonstrate via engineering analysis and/or data that the self-defined monitoring conditions: are technically necessary to ensure robust detection of malfunctions (e.g., avoid false passes and false detection of malfunctions); require no more than 1000 cumulative engine revolutions; and, do not require any single continuous idle operation of more than 15 seconds to make a determination that a malfunction is present (e.g., a decision can be made with data gathered during several idle operations of 15 seconds or less); or, satisfy the requirements of paragraph (c) of this section with alternative engine operating conditions.

(B) Manufacturers may employ alternative monitoring conditions (e.g., off-idle) provided the manufacturer is able to demonstrate that the alternative monitoring ensure equivalent robust detection of malfunctions and equivalent timeliness in detection of malfunctions.

(C) For model years 2013 and later, on engines equipped with sensors that can detect combustion or combustion quality the OBD system must monitor continuously for engine misfire under all positive torque engine speed and load conditions. If a monitoring system cannot detect all misfire patterns under all required engine speed and load conditions, the manufacturer may request that the Administrator approve the monitoring system nonetheless. In evaluating the manufacturer's request, the Administrator will consider the following factors: the magnitude of the region(s) in which misfire detection is limited; the degree to which misfire detection is limited in the region(s) (i.e., the probability of detection of misfire events); the frequency with which said region(s) are expected to be encountered in-use; the type of misfire patterns for which misfire detection is troublesome; and demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under required conditions (i.e., compliance can be achieved on other engines). The evaluation will be based on the fol-

lowing misfire patterns: equally spaced misfire occurring on randomly selected cylinders; single cylinder continuous misfire; and, paired cylinder (cylinders firing at the same crank angle) continuous misfire.

(iv) *Engine misfire MIL activation and DTC storage.*

(A) General requirements for MIL activation and DTC storage are set forth in paragraph (b) of this section.

(B) For model years 2013 and later, on engines equipped with sensors that can detect combustion or combustion quality, upon detection of the percentage of misfire specified in paragraph (g)(2)(ii)(B) of this section, the following criteria shall apply for MIL activation and DTC storage: A pending DTC must be stored no later than after the fourth exceedance of the percentage of misfire specified in paragraph (g)(2)(ii) of this section during a single drive cycle; if a pending fault code has been stored, the OBD system must activate the MIL and store a MIL-on DTC within 10 seconds if the percentage of misfire specified in paragraph (g)(2)(ii) of this section is again exceeded four times during the drive cycle immediately following storage of the pending DTC, regardless of the conditions encountered during the drive cycle, or on the next drive cycle in which similar conditions are encountered to those that were occurring when the pending DTC was stored. Similar conditions means an engine speed within 375 rpm, engine load within 20 percent, and the same warm up status (i.e., cold or hot). The Administrator may approve other definitions of similar conditions based on comparable timeliness and reliability in detecting similar engine operation. The pending DTC may be erased at the end of the next drive cycle in which similar conditions are encountered to those that were occurring when the pending DTC was stored provided the specified percentage of misfire was not again exceeded. The pending DTC may also be erased if similar conditions are not encountered during the 80 drive cycles immediately following initial detection of the malfunction.

(C) For model years 2013 and later, on engines equipped with sensors that can detect combustion or combustion quality, the OBD system must store and erase freeze frame conditions either in conjunction with storing and erasing a pending DTC or in conjunction with storing and erasing a MIL-on DTC. If freeze frame conditions are stored for a malfunction other than a misfire malfunction when a DTC is stored as specified in paragraph (g)(2)(iv)(B) of this section, the stored freeze frame information must be replaced with the freeze frame information regarding the misfire malfunction.

(D) For model years 2013 and later, on engines equipped with sensors that can detect combustion or combustion quality, upon detection of misfire according to paragraph (g)(2)(iv)(B) of this section, the OBD system must also store the following engine conditions: engine speed, load, and warm up status of the first misfire event that resulted in the storage of the pending DTC.

(E) For model years 2013 and later, on engines equipped with sensors that can detect combustion or combustion quality, the MIL may be deactivated after three sequential drive cycles in which similar conditions have been encountered without an exceedance of the specified percentage of misfire.

(3) *EGR system monitoring*

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(i) *General.* The OBD system must monitor the EGR system on engines so equipped for low flow rate, high flow rate, and slow response malfunctions. For engines equipped with EGR coolers (e.g., heat exchangers), the OBD system must monitor the cooler for insufficient cooling malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the EGR system must be monitored in accordance with the comprehensive component requirements in paragraph (i)(3) of this section.

(ii) *EGR system malfunction criteria*

(A) *EGR low flow.* The OBD system must detect a malfunction of the EGR system prior to a decrease from the manufacturer's specified EGR flow rate that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the EGR system that causes a decrease in flow could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that it cannot increase EGR flow to achieve the commanded flow rate.

(B) *EGR high flow.* The OBD system must detect a malfunction of the EGR system, including a leaking EGR valve (i.e., exhaust gas flowing through the valve when the valve is commanded closed) prior to an increase from the manufacturer's specified EGR flow rate that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the EGR system that causes an increase in flow could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that it cannot reduce EGR flow to achieve the commanded flow rate.

(C) *EGR slow response.* The OBD system must detect a malfunction of the EGR system prior to any failure or deterioration in the capability of the EGR system to achieve the commanded flow rate within a manufacturer-specified time that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). The OBD system must monitor both the capability of the EGR system to respond to a commanded increase in flow and the capability of the EGR system to respond to a commanded decrease in flow.

(D) *EGR system feedback control.* See paragraph (i)(6) of this section.

(E) *EGR cooler performance.* The OBD system must detect a malfunction of the EGR cooler prior to a reduction from the manufacturer's specified cooling performance that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the EGR cooler could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has no detectable amount of EGR cooling.

(iii) *EGR system monitoring conditions.*

(A) The OBD system must monitor continuously for malfunctions identified in paragraphs (g)(3)(ii)(A), (g)(3)(ii)(B), and (g)(3)(ii)(D) of this section.

(B) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (g)(3)(ii)(C) of this section in accordance with paragraphs (c) and (d) of this section, with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (g)(3)(ii)(C) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(C) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (g)(3)(ii)(E) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (g)(3)(ii)(E) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(D) The manufacturer may request Administrator approval to disable temporarily the EGR system monitor(s) under specific ambient conditions (e.g., when freezing may affect performance of the system) or during specific operating conditions (e.g., transients, extreme low or high flow conditions). The manufacturer must be able to demonstrate via data or engineering analysis that a reliable system monitor cannot be run when these conditions exist because it cannot robustly distinguish between a malfunctioning system and a properly operating system. The manufacturer is still required to maintain comprehensive component monitoring as required in paragraph (i)(3) of this section.

(iv) *EGR system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(4) *Turbo boost control system monitoring*

(i) *General.* The OBD system must monitor the boost pressure control system (e.g., turbocharger) on engines so equipped for under and over boost malfunctions. For engines equipped with variable geometry turbochargers (VGT), the OBD system must monitor the VGT system for slow response malfunctions. For engines equipped with charge air cooler systems, the OBD system must monitor the charge air cooler system for cooling system performance malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the boost pressure control system must be monitored in accordance with the comprehensive component requirements in paragraph (i)(3) of this section.

(ii) *Turbo boost control system malfunction criteria*

(A) *Turbo underboost.* The OBD system must detect a malfunction of the boost pressure control system prior to a decrease from the manufacturer's commanded boost pressure, or expected boost pressure on engines not equipped with a boost pressure control system, that would

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cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the boost pressure control system that causes a decrease in boost could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that it cannot increase boost to achieve the commanded boost pressure.

(B) *Turbo overboost*. The OBD system must detect a malfunction of the boost pressure control system on engines so equipped prior to an increase from the manufacturer's commanded boost pressure that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the boost pressure control system that causes an increase in boost could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that it cannot decrease boost to achieve the commanded boost pressure.

(C) *VGT slow response*. The OBD system must detect a malfunction prior to any failure or deterioration in the capability of the VGT system on engines so equipped to achieve the commanded turbocharger geometry within a manufacturer-specified time that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the VGT system response could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction of the VGT system when proper functional response of the system to computer commands does not occur.

(D) *Turbo boost feedback control*. See paragraph (i)(6) of this section.

(E) *Charge air undercooling*. The OBD system must detect a malfunction of the charge air cooling system prior to a decrease from the manufacturer's specified cooling rate that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g). For engines in which no failure or deterioration of the charge air cooling system that causes a decrease in cooling performance could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has no detectable amount of charge air cooling.

(iii) *Turbo boost monitoring conditions*.

(A) The OBD system must monitor continuously for malfunctions identified in paragraphs (g)(4)(ii)(A), (g)(4)(ii)(B), and (g)(4)(ii)(D) of this section.

(B) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (g)(4)(ii)(C) of this section in accordance with paragraphs (c) and (d) of this section, with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect

malfunctions identified in paragraph (g)(4)(ii)(C) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(C) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (g)(4)(ii)(E) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (g)(4)(ii)(E) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(D) The manufacturer may request Administrator approval to disable temporarily the turbo boost system monitor(s) during specific operating conditions (e.g., transients, extreme low or high flow conditions). The manufacturer must be able to demonstrate via data or engineering analysis that a reliable system monitor cannot be run when these conditions exist because it cannot robustly distinguish between a malfunctioning system and a properly operating system. The manufacturer is still required to maintain comprehensive component monitoring as required in paragraph (i)(3) of this section.

(iv) *Turbo boost system MIL activation and DTC storage*. The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(5) *NMHC converting catalyst monitoring*.

(i) *General*. The OBD system must monitor the NMHC converting catalyst(s) for proper NMHC conversion capability. For purposes of this paragraph (g)(5), each catalyst that converts NMHC must be monitored either individually or in combination with others. For purposes of this paragraph (g)(5), NMHC conversion that may occur over the DPF or other aftertreatment devices is not included.

(ii) *NMHC converting catalyst malfunction criteria*.

(A) *NMHC converting catalyst conversion efficiency*. The OBD system must detect a malfunction when the catalyst has no detectable amount of NMHC conversion capability.

(B) *NMHC converting catalyst aftertreatment assistance functions*. For catalysts used to generate an exotherm to assist DPF regeneration, the OBD system must detect a malfunction when the catalyst is unable to generate a sufficient exotherm to achieve DPF regeneration. In meeting this requirement, the OBD system must detect a malfunction when the DOC is unable to generate a temperature rise of 100 degrees C, or to reach the necessary DPF regeneration temperature, within 60 seconds of initiating an active DPF regeneration. Further, the OBD system must detect a malfunction when the DOC is unable to sustain the necessary regeneration temperature for the duration of the regeneration event. The OBD or control system must abort the regeneration if the regeneration temperature has not been reached within five minutes of initiating an active regeneration event, or if the regeneration temperature cannot be sustained for the duration of the regeneration event. As an alternative to these specific malfunction criteria, the manufacturer

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may employ different criteria. To do so, the manufacturer must submit a description with supporting data, subject to Administrator approval, of their DPF regeneration monitoring strategy. The Administrator will consider the strategy's equivalence to the specific criteria stated in this paragraph when considering the request. Also as an alternative to these specific malfunction criteria, the manufacturer may employ an OBD monitor that detects a catalyst malfunction when the catalyst conversion capability decreases to the point that NMHC emissions exceed 2.5 times the applicable NMHC emission standard but must adjust emission test results pursuant to paragraph (f)(2) of this section. For catalysts located downstream of a DPF and used to convert NMHC emissions during DPF regeneration, the OBD system must detect a malfunction when the catalyst has no detectable amount of NMHC conversion capability unless the manufacturer can demonstrate that deterioration or malfunction of the catalyst will not result in emissions that exceed the applicable NMHC standard.

(iii) *NMHC converting catalyst monitoring conditions.* The manufacturer must define the monitoring conditions for malfunctions identified in paragraphs (g)(5)(ii)(A) and (g)(5)(ii)(B) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraphs (g)(5)(ii)(A) and (g)(5)(ii)(B) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(iv) *NMHC converting catalyst MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section. The monitoring method for the NMHC converting catalyst(s) must be capable of detecting all instances, except diagnostic self-clearing, when a catalyst DTC has been erased but the catalyst has not been replaced (e.g., catalyst over-temperature histogram approaches are not acceptable).

(6) *Selective catalytic reduction (SCR) and lean NO_x catalyst monitoring.*

(i) *General.* The OBD system must monitor the SCR and/or the lean NO_x converting catalyst(s) for proper conversion capability. For engines equipped with SCR systems or other catalyst systems that use an active/intrusive reductant injection (e.g., active lean NO_x catalysts that use diesel fuel post-injection or in-exhaust injection), the OBD system must monitor the active/intrusive reductant injection system for proper performance. The individual electronic components (e.g., actuators, valves, sensors, heaters, pumps) in the active/intrusive reductant injection system must be monitored in accordance with the comprehensive component requirements in paragraph (i)(3) of this section. For purposes of this paragraph (g)(6), each catalyst that converts NO_x must be monitored either individually or in combination with others.

(ii) *SCR and lean NO_x catalyst malfunction criteria.*

(A) *SCR and lean NO_x catalyst conversion efficiency.* The OBD system must detect a catalyst malfunction when the catalyst conversion capability decreases to the point

that would cause an engine's emissions to exceed the emissions thresholds for NO_x aftertreatment systems as shown in Table 1 of this paragraph (g). If no failure or deterioration of the catalyst NO_x conversion capability could result in an engine's emissions exceeding any of the applicable emissions thresholds, the OBD system must detect a malfunction when the catalyst has no detectable amount of NO_x conversion capability.

(B) *SCR and lean NO_x catalyst active/intrusive reductant delivery performance.* The OBD system must detect a malfunction prior to any failure or deterioration of the system to properly regulate reductant delivery (e.g., urea injection, separate injector fuel injection, post injection of fuel, air assisted injection/mixing) that would cause an engine's emissions to exceed any of the applicable emissions thresholds for NO_x aftertreatment systems as shown in Table 1 of this paragraph (g). If no failure or deterioration of the reductant delivery system could result in an engine's emissions exceeding any of the applicable thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that it is no longer able to deliver the desired quantity of reductant.

(C) *SCR and lean NO_x catalyst active/intrusive reductant quantity.* If the SCR or lean NO_x catalyst system uses a reductant other than the fuel used for the engine, or uses a reservoir/tank for the reductant that is separate from the fuel tank used for the engine, the OBD system must detect a malfunction when there is no longer sufficient reductant available (e.g., the reductant tank is empty).

(D) *SCR and lean NO_x catalyst active/intrusive reductant quality.* If the SCR or lean NO_x catalyst system uses a reservoir/tank for the reductant that is separate from the fuel tank used for the engine, the OBD system must detect a malfunction when an improper reductant is used in the reductant reservoir/tank (e.g., the reductant tank is filled with something other than the reductant).

(E) *SCR and lean NO_x catalyst active/intrusive reductant feedback control.* See paragraph (i)(6) of this section.

(iii) *SCR and lean NO_x catalyst monitoring conditions.*

(A) The manufacturers must define the monitoring conditions for malfunctions identified in paragraphs (g)(6)(ii)(A) and (g)(6)(ii)(D) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (g)(6)(ii)(A) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(B) The OBD system must monitor continuously for malfunctions identified in paragraphs (g)(6)(ii)(B), (g)(6)(ii)(C), and (g)(6)(ii)(E) of this section.

(iv) *SCR and lean NO_x catalyst MIL activation and DTC storage.*

(A) For malfunctions identified in paragraph (g)(6)(ii)(A) of this section, the MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

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(B) For malfunctions identified in paragraphs (g)(6)(ii)(B), (g)(6)(ii)(C), and (g)(6)(ii)(D) of this section, the manufacturer may delay activating the MIL if the vehicle is equipped with an alternative indicator for notifying the vehicle operator of the malfunction. The alternative indicator must be of sufficient illumination and be located such that it is readily visible to the vehicle operator under all lighting conditions. If the vehicle is not equipped with such an alternative indicator and the OBD MIL activates, the MIL may be immediately deactivated and the corresponding DTC(s) erased once the OBD system has verified that the reductant tank has been refilled properly and the MIL has not been activated for any other malfunction. The Administrator may approve other strategies that provide equivalent assurance that a vehicle operator would be promptly notified and that corrective action would be taken.

(C) The monitoring method for the SCR and lean NO_x catalyst(s) must be capable of detecting all instances, except diagnostic self-clearing, when a catalyst DTC(s) has been erased but the catalyst has not been replaced (e.g., catalyst over-temperature histogram approaches are not acceptable).

(7) *NO_x adsorber system monitoring.*

(i) *General.* The OBD system must monitor the NO_x adsorber on engines so-equipped for proper performance. For engines equipped with active/intrusive injection (e.g., in-exhaust fuel and/or air injection) to achieve desorption of the NO_x adsorber, the OBD system must monitor the active/intrusive injection system for proper performance. The individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system must be monitored in accordance with the comprehensive component requirements in paragraph (i)(3) of this section.

(ii) *NO_x adsorber system malfunction criteria.*

(A) *NO_x adsorber system capability.* The OBD system must detect a NO_x adsorber malfunction when its capability (i.e., its combined adsorption and conversion capability) decreases to the point that would cause an engine's NO_x emissions to exceed the emissions thresholds for NO_x aftertreatment systems as shown in Table 1 of this paragraph (g). If no failure or deterioration of the NO_x adsorber capability could result in an engine's NO_x emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has no detectable amount of NO_x adsorber capability.

(B) *NO_x adsorber system active/intrusive reductant delivery performance.* For NO_x adsorber systems that use active/intrusive injection (e.g., in-cylinder post fuel injection, in-exhaust air-assisted fuel injection) to achieve desorption of the NO_x adsorber, the OBD system must detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate injection causes the system to be unable to achieve desorption of the NO_x adsorber.

(C) *NO_x adsorber system feedback control.* Malfunction criteria for the NO_x adsorber and the NO_x adsorber active/intrusive reductant delivery system are contained in paragraph (i)(6) of this section.

(iii) *NO_x adsorber system monitoring conditions.*

(A) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (g)(7)(ii)(A) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (g)(7)(ii)(A) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(B) The OBD system must monitor continuously for malfunctions identified in paragraphs (g)(7)(ii)(B) and (g)(7)(ii)(C) of this section.

(iv) *NO_x adsorber system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(8) *Diesel particulate filter (DPF) system monitoring*

(i) *General.* The OBD system must monitor the DPF on engines so-equipped for proper performance. For engines equipped with active regeneration systems that use an active/intrusive injection (e.g., in-exhaust fuel injection, in-exhaust fuel/air burner), the OBD system must monitor the active/intrusive injection system for proper performance. The individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system must be monitored in accordance with the comprehensive component requirements in paragraph (i)(3) of this section.

(ii) *DPF system malfunction criteria*

(A) *DPF filtering performance.* The OBD system must detect a malfunction prior to a decrease in the PM filtering capability of the DPF (e.g., cracking, melting, etc.) that would cause an engine's PM emissions to exceed the emissions thresholds for DPF systems as shown in Table 1 of this paragraph (g). If no failure or deterioration of the PM filtering performance could result in an engine's PM emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when no detectable amount of PM filtering occurs. As an alternative to a threshold monitor, the OBD system, on model year 2010 through 2012 engines only, can be designed to detect a malfunction based on a detectable decrease in the expected pressure drop across the DPF for a period of 5 seconds or more. The monitoring area for this alternative is determined using engine speed and load points defined in test cycles and procedures for the supplemental emissions test (SET) under §86.1360-2007. The monitoring area shall include all engine speed and load points greater than a region bounded by a line connecting mode numbers 2, 6, 3, and 13 (i.e. A100, A75, B50, and C50). At engine speeds greater than "speed C", the monitor shall run whenever engine load is greater than 50%. For purposes of this paragraph, the detectable change in pressure drop is determined by operating the engine at the B50 engine speed and load point (as described in the SET test procedures), observing the pressure drop on a clean, nominal DPF, and multiplying the observed pressure drop by 0.5 or other factor supported by data and approved by the Administrator. The detectable change in pressure drop shall be reported in units

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of kilopascals (kPa). At time of certification, manufacturers shall provide the detectable change in pressure drop value along with OBD data stream parameters recorded with a clean DPF under the following nine engine speed/load operating points of the SET: A50, A75, A100, B50, B75, B100, C50, C75, and C100. The OBD data stream parameters to be reported are described in (k)(4)(ii) of this section and shall include the following: Engine speed; calculated load; air flow rate from mass air flow sensor (if so equipped); fuel rate; and DPF delta pressure.

(B) *DPF regeneration frequency.* The OBD system must detect a malfunction when the DPF regeneration frequency increases from (i.e., occurs more often than) the manufacturer's specified regeneration frequency to a level such that it would cause an engine's NMHC emissions to exceed the emissions threshold for DPF systems as shown in Table 1 of this paragraph (g). If no such regeneration frequency exists that could cause NMHC emissions to exceed the applicable emission threshold, the OBD system must detect a malfunction when the DPF regeneration frequency exceeds the manufacturer's specified design limits for allowable regeneration frequency.

(C) *DPF incomplete regeneration.* The OBD system must detect a regeneration malfunction when the DPF does not properly regenerate under manufacturer-defined conditions where regeneration is designed to occur.

(D) *DPF missing substrate.* The OBD system must detect a malfunction if either the DPF substrate is completely destroyed, removed, or missing, or if the DPF assembly has been replaced with a muffler or straight pipe.

(E) *DPF system active/intrusive injection.* For DPF systems that use active/intrusive injection (e.g., in-cylinder post fuel injection, in-exhaust air-assisted fuel injection) to achieve regeneration of the DPF, the OBD system must detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate injection causes the system to be unable to achieve regeneration of the DPF.

(F) *DPF regeneration feedback control.* See paragraph (i)(6) of this section.

(iii) *DPF monitoring conditions.* The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (g)(8)(ii) of this section in accordance with paragraphs (c) and (d) of this section, with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section. For OBD systems designed to the alternative malfunction criteria of paragraph (g)(8)(ii)(A) of this section, the alternative DPF monitor shall run continuously whenever engine speed and load conditions are within the monitoring area described in paragraph (g)(8)(ii)(A). The OBD system may make a malfunction or potential malfunction determination during any successful monitoring event but shall include in the enable criteria of any subsequent monitoring events a confirmed successful and complete DPF regeneration. The subsequent monitoring events must be conducted within an operating period that ensures that the detected malfunction has not "healed" due to trapped particulates

in the compromised portion of the DPF substrate. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (g)(8)(ii) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(iv) *DPF system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(9) *Exhaust gas sensor and sensor heater monitoring.*

(i) *General.* The OBD system must monitor for proper output signal, activity, response rate, and any other parameter that can affect emissions, all exhaust gas sensors (e.g., oxygen, air-fuel ratio, NO_x) used for emission control system feedback (e.g., EGR control/feedback, SCR control/feedback, NO_x adsorber control/feedback) and/or as a monitoring device. For engines equipped with heated exhaust gas sensors, the OBD system must monitor the heater for proper performance.

(ii) *Malfunction criteria for air-fuel ratio sensors located upstream of aftertreatment devices.*

(A) *Sensor performance.* The OBD system must detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 1 of this paragraph (g).

(B) *Circuit integrity.* The OBD system must detect malfunctions of the sensor related to a lack of circuit continuity or signal out-of-range values.

(C) *Feedback function.* The OBD system must detect a malfunction of the sensor if the emission control system (e.g., EGR, SCR, or NO_x adsorber) is unable to use that sensor as a feedback input (e.g., causes limp-home or open-loop operation).

(D) *Monitoring function.* To the extent feasible, the OBD system must detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBD system monitoring device (e.g., for catalyst, EGR, SCR, or NO_x adsorber monitoring).

(iii) *Malfunction criteria for air-fuel ratio sensors located downstream of aftertreatment devices.*

(A) *Sensor performance.* The OBD system must detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's emissions to exceed the emissions thresholds for air-fuel ratio sensors downstream of aftertreatment devices as shown in Table 1 of this paragraph (g).

(B) *Circuit integrity.* The OBD system must detect malfunctions of the sensor related to a lack of circuit continuity or signal out-of-range values.

(C) *Feedback function.* The OBD system must detect a malfunction of the sensor if the emission control system (e.g., EGR, SCR, or NO_x adsorber) is unable to use that

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sensor as a feedback input (e.g., causes limp-home or open-loop operation).

(D) *Monitoring function.* To the extent feasible, the OBD system must detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBD system monitoring device (e.g., for catalyst, EGR, SCR, or NO_x adsorber monitoring).

(iv) *Malfunction criteria for NO_x sensors.*

(A) *Sensor performance.* The OBD system must detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's emissions to exceed the emissions thresholds for NO_x sensors as shown in Table 1 of this paragraph (g).

(B) *Circuit integrity.* The OBD system must detect malfunctions of the sensor related to a lack of circuit continuity or signal out-of-range values.

(C) *Feedback function.* The OBD system must detect a malfunction of the sensor if the emission control system (e.g., EGR, SCR, or NO_x adsorber) is unable to use that sensor as a feedback input (e.g., causes limp-home or open-loop operation).

(D) *Monitoring function.* To the extent feasible, the OBD system must detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBD system monitoring device (e.g., for catalyst, EGR, SCR, or NO_x adsorber monitoring).

(v) *Malfunction criteria for other exhaust gas sensors.* For other exhaust gas sensors, the manufacturer must submit a monitoring plan to the Administrator for approval. The plan must include data and/or engineering evaluations that demonstrate that the monitoring plan is as reliable and effective as the monitoring required in paragraphs (g)(9)(ii), (g)(9)(iii), (g)(9)(iv) of this section.

(vi) *Malfunction criteria for exhaust gas sensor heaters.*

(A) The OBD system must detect a malfunction of the heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (i.e., within the criteria required to be met by the component vendor for heater circuit performance at high mileage). The manufacturer may use other malfunction criteria for heater performance malfunctions. To do so, the manufacturer must be able to demonstrate via data and/or an engineering evaluation that the monitor is reliable and robust.

(B) The OBD system must detect malfunctions of the heater circuit including open or short circuits that conflict with the commanded state of the heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground)).

(vii) *Monitoring conditions for exhaust gas sensors.*

(A) The manufacturer must define the monitoring conditions for malfunctions identified in paragraphs (g)(9)(ii)(A), (g)(9)(iii)(A), and (g)(9)(iv)(A) of this section (i.e., sensor performance) in accordance with paragraphs

(c) and (d) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraphs (g)(9)(ii)(A), (g)(9)(iii)(A), and (g)(9)(iv)(A) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(B) The manufacturer must define the monitoring conditions for malfunctions identified in paragraphs (g)(9)(ii)(D), (g)(9)(iii)(D), and (g)(9)(iv)(D) of this section (i.e., monitoring function) in accordance with paragraphs (c) and (d) of this section with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section.

(C) Except as provided for in paragraph (g)(9)(vii)(D) of this section, the OBD system must monitor continuously for malfunctions identified in paragraphs (g)(9)(ii)(B), (g)(9)(ii)(C), (g)(9)(iii)(B), (g)(9)(iii)(C), (g)(9)(iv)(B), (g)(9)(iv)(C) of this section (i.e., circuit integrity and feedback function).

(D) A manufacturer may request approval to disable continuous exhaust gas sensor monitoring when an exhaust gas sensor malfunction cannot be distinguished from other effects (e.g., disable monitoring for out-of-range on the low side during fuel cut conditions). To do so, the manufacturer must demonstrate via data and/or engineering analyses that a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false malfunction detection.

(viii) *Monitoring conditions for exhaust gas sensor heaters*

(A) The manufacturer must define monitoring conditions for malfunctions identified in paragraph (g)(9)(vi)(A) of this section (i.e., sensor heater performance) in accordance with paragraphs (c) and (d) of this section.

(B) The OBD system must monitor continuously for malfunctions identified in paragraph (g)(9)(vi)(B) of this section (i.e., circuit malfunctions).

(ix) *Exhaust gas sensor and sensor heater MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(10) *Variable Valve Timing (VVT) system monitoring.*

(i) *General.* The OBD system must monitor the VVT system on engines so equipped for target error and slow response malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the VVT system must be monitored in accordance with the comprehensive components requirements in paragraph (i)(3) of this section.

(ii) *VVT system malfunction criteria*

(A) *VVT system target error.* The OBD system must detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a crank angle and/or lift tolerance that would cause an engine's emissions to exceed the emission thresholds for "other monitors" as shown in Table 1 of this paragraph (g).

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(B) *VVT slow response.* The OBD system must detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a manufacturer-specified time that would cause an engine's emissions to exceed the emission thresholds for "other monitors" as shown in Table 1 of this paragraph (g).

(C) For engines in which no failure or deterioration of the VVT system could result in an engine's emissions exceeding the applicable emissions thresholds of paragraphs (g)(10)(ii)(A) and (g)(10)(ii)(B) of this section, the OBD system must detect a malfunction of the VVT system when proper functional response of the system to computer commands does not occur.

(iii) *VVT system monitoring conditions.* Manufacturers must define the monitoring conditions for VVT system malfunctions identified in paragraph (g)(10)(ii) of this section in accordance with paragraphs (c) and (d) of this section, with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (g)(10)(ii) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(iv) *VVT MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(h) **OBD monitoring requirements for gasoline-fueled/spark-ignition engines.** The following table shows the thresholds at which point certain components or systems, as specified in this paragraph (h), are considered malfunctioning.

TABLE 2—OBD EMISSIONS THRESHOLDS FOR GASOLINE-FUELED/SPARK-IGNITION ENGINES MEANT FOR PLACEMENT IN APPLICATIONS GREATER THAN 14,000 POUNDS GVWR (G/BHP-HR)

Component	NO _x	NMHC	CO	§86.010-18 reference
Catalyst system	1.75x std.....	1.75x std....	.....	(h)(6)
Evaporative emissions control system	.....	0.150 inch leak .....	.....	(h)(7)
"Other monitors" with emissions thresholds	1.5x std	1.5x std	1.5x std	(h)(1), (h)(2), (h)(3), (h)(4), (h)(5), (h)(8), (h)(9)

Notes: 1.75x std means a multiple of 1.75 times the applicable emissions standard; these emissions thresholds apply to the monitoring requirements of paragraph (h) of this section; The evaporative emissions control system threshold is not, technically, an emissions threshold but rather a leak size that must be detected; nonetheless, for ease we refer to this as the threshold.

(1) *Fuel system monitoring.*

(i) *General.* The OBD system must monitor the fuel delivery system to determine its ability to provide compliance with emission standards.

(ii) *Fuel system malfunction criteria.*

(A) The OBD system must detect a malfunction of the fuel delivery system (including feedback control based on a secondary oxygen sensor) when the fuel delivery system is unable to maintain an engine's emissions at or below the emissions thresholds for "other monitors" as shown in Table 2 of this paragraph (h).

(B) Except as provided for in paragraph (h)(1)(ii)(C) of this section, if the engine is equipped with adaptive feedback control, the OBD system must detect a malfunction when the adaptive feedback control has used up all of the adjustment allowed by the manufacturer.

(C) If the engine is equipped with feedback control that is based on a secondary oxygen (or equivalent) sensor, the OBD system is not required to detect a malfunction of the fuel system solely when the feedback control based on a secondary oxygen sensor has used up all of the adjustment allowed by the manufacturer. However, if a failure or deterioration results in engine emissions that exceed the emissions thresholds for "other monitors" as shown in Table 2 of this paragraph (h), the OBD system is required to detect a malfunction.

(D) The OBD system must detect a malfunction whenever the fuel control system fails to enter closed loop operation following engine start within a manufacturer specified time interval. The specified time interval must be supported by data and/or engineering analyses submitted by the manufacturer.

(E) The manufacturer may adjust the malfunction criteria and/or monitoring conditions to compensate for changes in altitude, for temporary introduction of large amounts of purge vapor, or for other similar identifiable operating conditions when such conditions occur.

(iii) *Fuel system monitoring conditions.* The fuel system must be monitored continuously for the presence of a malfunction.

(iv) *Fuel system MIL activation and DTC storage.*

(A) A pending DTC must be stored immediately upon the fuel system exceeding the malfunction criteria established in paragraph (h)(1)(ii) of this section.

(B) Except as provided for in paragraph (h)(1)(iv)(C) of this section, if a pending DTC is stored, the OBD system must activate the MIL immediately and store a MIL-on DTC if a malfunction is again detected during either the drive cycle immediately following storage of the pending DTC regardless of the conditions encountered during that drive cycle, or on the next drive cycle in which similar conditions are encountered to those that occurred when the pending DTC was stored. Similar conditions means engine conditions having an engine speed within 375 rpm, load conditions within 20 percent, and the same warm-up status (i.e., cold or hot) as the engine conditions stored pursuant to paragraph (h)(1)(iv)(E) of this section. Other definitions of similar conditions may be used but must result in comparable timeliness and reliability in detecting similar engine operation.

(C) The pending DTC may be erased at the end of the next drive cycle in which similar conditions have been encountered without having again exceeded the specified fuel system malfunction criteria. The pending DTC

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may also be erased if similar conditions are not encountered during the 80 drive cycles immediately following detection of the potential malfunction for which the pending DTC was stored.

(D) *Storage of freeze frame conditions.* The OBD system must store and erase freeze frame conditions either in conjunction with storing and erasing a pending DTC or in conjunction with storing and erasing a MIL-on DTC. Freeze frame information associated with a fuel system malfunction shall be stored in preference to freeze frame information required elsewhere in paragraphs (h) or (i) of this section.

(E) *Storage of fuel system conditions for determining similar conditions of operation.* The OBD must store the engine speed, load, and warm-up status present at the time it first detects a potential malfunction meeting the criteria of paragraph (h)(1)(ii) of this section and stores a pending DTC.

(F) *Deactivating the MIL.* The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without detecting a malfunction of the fuel system.

(2) *Engine misfire monitoring.*

(i) *General.*

(A) The OBD system must monitor the engine for misfire causing catalyst damage and misfire causing excess emissions.

(B) The OBD system must identify the specific cylinder that is misfiring. The manufacturer may store a general misfire DTC instead of a cylinder specific DTC under certain operating conditions. To do so, the manufacturer must submit data and/or engineering analyses that demonstrate that the misfiring cylinder cannot be identified reliably when the conditions occur.

(C) If more than one cylinder is misfiring, a separate DTC must be stored to indicate that multiple cylinders are misfiring unless otherwise allowed by this paragraph (h)(2). When identifying multiple cylinder misfire, the OBD system is not required to also identify using separate DTCs each of the misfiring cylinders individually. If more than 90 percent of the detected misfires occur in a single cylinder, an appropriate DTC may be stored that indicates the specific misfiring cylinder rather than storing the multiple cylinder misfire DTC. If two or more cylinders individually have more than 10 percent of the total number of detected misfires, a multiple cylinder DTC must be stored.

(ii) *Engine misfire malfunction criteria.*

(A) *Misfire causing catalyst damage.* The manufacturer must determine the percentage of misfire evaluated in 200 revolution increments for each engine speed and load condition that would result in a temperature that causes catalyst damage. If this percentage of misfire is exceeded, it shall be considered a malfunction that must be detected. For every engine speed and load condition for which this percentage of misfire is determined to be lower than five percent, the manufacturer may set the malfunction criteria at five percent. The manufacturer may use a longer interval than 200 revolutions but only for determining, on a given drive cycle, the first misfire exceedance as provided in paragraph (h)(2)(iv)(A) of this section. To do

so, the manufacturer must demonstrate that the interval is not so long that catalyst damage would occur prior to the interval being elapsed.

(B) *Misfire causing emissions to exceed the applicable thresholds.* The manufacturer must determine the percentage of misfire evaluated in 1000 revolution increments that would cause emissions from an emissions durability demonstration engine to exceed the emissions thresholds for "other monitors" as shown in Table 2 of this paragraph (h) if that percentage of misfire were present from the beginning of the test. If this percentage of misfire is exceeded, regardless of the pattern of misfire events (e.g., random, equally spaced, continuous), it shall be considered a malfunction that must be detected. To establish this percentage of misfire, the manufacturer must use misfire events occurring at equally spaced, complete engine cycle intervals, across randomly selected cylinders throughout each 1000-revolution increment. If this percentage of misfire is determined to be lower than one percent, the manufacturer may set the malfunction criteria at one percent. The manufacturer may use a longer interval than 1000 revolutions. To do so, the manufacturer must demonstrate that the strategy would be equally effective and timely at detecting misfire.

(iii) *Engine misfire monitoring conditions.*

(A) The OBD system must monitor continuously for misfire under the following conditions: from no later than the end of the second crankshaft revolution after engine start; during the rise time and settling time for engine speed to reach the desired idle engine speed at engine start-up (i.e., "flare-up" and "flare-down"); and, under all positive torque engine speeds and load conditions except within the engine operating region bound by the positive torque line (i.e., engine load with the transmission in neutral), and the points represented by an engine speed of 3000 rpm with the engine load at the positive torque line and the redline engine speed with the engine's manifold vacuum at four inches of mercury lower than that at the positive torque line. For this purpose, redline engine speed is defined as either the recommended maximum engine speed as displayed on the instrument panel tachometer, or the engine speed at which fuel shutoff occurs.

(B) If an OBD monitor cannot detect all misfire patterns under all required engine speed and load conditions as required by paragraph (h)(2)(iii)(A) of this section, the OBD system may still be acceptable. The Administrator will evaluate the following factors in making a determination: The magnitude of the region(s) in which misfire detection is limited; the degree to which misfire detection is limited in the region(s) (i.e., the probability of detection of misfire events); the frequency with which said region(s) are expected to be encountered in-use; the type of misfire patterns for which misfire detection is troublesome; and demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under the required conditions (i.e., compliance can be achieved on other engines). The evaluation will be based on the following misfire patterns: equally spaced misfire occurring on randomly selected cylinders; single

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cylinder continuous misfire; and paired cylinder (cylinders firing at the same crank angle) continuous misfire.

(C) The manufacturer may use monitoring system that has reduced misfire detection capability during the portion of the first 1000 revolutions after engine start that a cold start emission reduction strategy is active that reduces engine torque (e.g., spark retard strategies). To do so, the manufacturer must demonstrate that the probability of detection is greater than or equal to 75 percent during the worst case condition (i.e., lowest generated torque) for a vehicle operated continuously at idle (park/neutral idle) on a cold start between 50 and 86 degrees Fahrenheit and that the technology cannot reliably detect a higher percentage of the misfire events during the conditions.

(D) The manufacturer may disable misfire monitoring or use an alternative malfunction criterion when misfire cannot be distinguished from other effects. To do so, the manufacturer must demonstrate that the disablement interval or the period of use of an alternative malfunction criterion is limited only to that necessary for avoiding false detection and for one or more of the following operating conditions: Rough road; fuel cut; gear changes for manual transmission vehicles; traction control or other vehicle stability control activation such as anti-lock braking or other engine torque modifications to enhance vehicle stability; off-board control or intrusive activation of vehicle components or monitors during service or assembly plant testing; portions of intrusive evaporative system or EGR monitors that can significantly affect engine stability (i.e., while the purge valve is open during the vacuum pull-down of an evaporative system leak check but not while the purge valve is closed and the evaporative system is sealed or while an EGR monitor causes the EGR valve to be cycled intrusively on and off during positive torque conditions); or, engine speed, load, or torque transients due to throttle movements more rapid than those that occur over the FTP cycle for the worst case engine within each engine family. In general, the Administrator will not approve disablement for conditions involving normal air conditioning compressor cycling from on-to-off or off-to-on, automatic transmission gear shifts (except for shifts occurring during wide open throttle operation), transitions from idle to off-idle, normal engine speed or load changes that occur during the engine speed rise time and settling time (i.e., “flare-up” and “flare-down”) immediately after engine starting without any vehicle operator-induced actions (e.g., throttle stabs), or excess acceleration (except for acceleration rates that exceed the maximum acceleration rate obtainable at wide open throttle while the vehicle is in gear due to abnormal conditions such as slipping of a clutch). The Administrator may approve misfire monitoring disablement or use of an alternate malfunction criterion for any other condition on a case by case basis upon determining that the manufacturer has demonstrated that the request is based on an unusual or unforeseen circumstance and that it is applying the best available computer and monitoring technology.

(E) For engines with more than eight cylinders that cannot meet the requirements of paragraph (h)(2)(iii)(A) of this section, a manufacturer may use alternative mis-

fire monitoring conditions. Such use must be based on data and/or an engineering evaluation submitted by the manufacturer that demonstrate that misfire detection throughout the required operating region cannot be achieved when employing proven monitoring technology (i.e., a technology that provides for compliance with these requirements on other engines) and provided misfire is detected to the fullest extent permitted by the technology. However, the misfire detection system must still monitor during all positive torque operating conditions encountered during an FTP cycle.

(iv) *MIL activation and DTC storage for engine misfire causing catalyst damage.*

(A) *Pending DTCs.* A pending DTC must be stored immediately if, during a single drive cycle, the specified misfire percentage described in paragraph (h)(2)(ii)(A) of this section is exceeded three times when operating in the positive torque region encountered during a FTP cycle or is exceeded on a single occasion when operating at any other engine speed and load condition in the positive torque region defined in paragraph (h)(2)(iii)(A) of this section. Immediately after a pending DTC is stored pursuant to this paragraph, the MIL must blink once per second at all times during the drive cycle that engine misfire is occurring. The MIL may be deactivated during those times that misfire is not occurring. If, at the time that a catalyst damaging misfire malfunction occurs, the MIL is already activated for a malfunction other than misfire, the MIL must still blink once per second at all times during the drive cycle that engine misfire is occurring. If misfire ceases, the MIL must stop blinking but remain activated as appropriate in accordance with the other malfunction.

(B) *MIL-on DTCs.* If a pending DTC is stored in accordance with paragraph (h)(2)(iv)(A) of this section, the OBD system must immediately store a MIL-on DTC if the percentage of misfire described in paragraph (h)(2)(ii)(A) of this section is again exceeded one or more times during either the drive cycle immediately following storage of the pending DTC, regardless of the conditions encountered during that drive cycle, or on the next drive cycle in which similar conditions are encountered to those that occurred when the pending DTC was stored. If, during a previous drive cycle, a pending DTC is stored in accordance with paragraph (h)(2)(iv)(A) of this section, a MIL-on DTC must be stored immediately upon exceeding the percentage misfire described in paragraph (h)(2)(ii)(A) of this section regardless of the conditions encountered. Upon storage of a MIL-on DTC, the MIL must blink once per second at all times during the drive cycle that engine misfire is occurring. If misfire ceases, the MIL must stop blinking but remain activated until the conditions are met for extinguishing the MIL.

(C) *Erase of pending DTCs.* Pending DTCs stored in accordance with paragraph (h)(2)(iv)(A) of this section must be erased at the end of the next drive cycle in which similar conditions are encountered to those that occurred when the pending DTC was stored provided no exceedances have been detected of the misfire percentage described in paragraph (h)(2)(ii)(A) of this section.

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The pending DTC may also be erased if similar conditions are not encountered during the next 80 drive cycles immediately following storage of the pending DTC.

(D) *Exemptions for engines with fuel shutoff and default fuel control.* In engines that provide for fuel shutoff and default fuel control to prevent over fueling during catalyst damaging misfire conditions, the MIL need not blink as required by paragraphs (h)(2)(iv)(A) and (h)(2)(iv)(B) of this section. Instead, the MIL may be activated continuously upon misfire detection provided that the fuel shutoff and default fuel control are activated immediately upon misfire detection. Fuel shutoff and default fuel control may be deactivated only when the engine is outside of the misfire range except that the manufacturer may periodically, but not more than once every 30 seconds, deactivate fuel shutoff and default fuel control to determine if the catalyst damaging misfire is still occurring. Normal fueling and fuel control may be resumed if the catalyst damaging misfire is no longer occurring.

(E) The manufacturer may use a strategy that activates the MIL continuously rather than blinking the MIL during extreme catalyst damage misfire conditions (i.e., catalyst damage misfire occurring at all engine speeds and loads). Use of such a strategy must be limited to catalyst damage misfire levels that cannot be avoided during reasonable driving conditions. To use such a strategy, the manufacturer must be able to demonstrate that the strategy will encourage operation of the vehicle in conditions that will minimize catalyst damage (e.g., at low engine speeds and loads).

(v) *MIL activation and DTC storage for engine misfire causing emissions to exceed applicable emissions thresholds.*

(A) Immediately upon detection, during the first 1000 revolutions after engine start of the misfire percentage described in paragraph (h)(2)(ii)(B) of this section, a pending DTC must be stored. If such a pending DTC is stored already and another such exceedance of the misfire percentage is detected within the first 1000 revolutions after engine start on any subsequent drive cycle, the MIL must activate and a MIL-on DTC must be stored. The pending DTC may be erased if, at the end of the next drive cycle in which similar conditions are encountered to those that occurred when the pending DTC was stored, there has been no exceedance of the misfire percentage described in paragraph (h)(2)(ii)(B) of this section. The pending DTC may also be erased if similar conditions are not encountered during the next 80 drive cycles immediately following storage of the pending DTC.

(B) No later than the fourth detection during a single drive cycle, following the first 1000 revolutions after engine start of the misfire percentage described in paragraph (h)(2)(ii)(B) of this section, a pending DTC must be stored. If such a pending DTC is stored already, then the MIL must activate and a MIL-on DTC must be stored within 10 seconds of the fourth detection of the misfire percentage described in paragraph (h)(2)(ii)(B) of this section during either the drive cycle immediately following storage of the pending DTC, regardless of the conditions encountered during that drive cycle excepting those conditions within the first 1000 revolutions after engine start, or on the next drive cycle in which similar

conditions are encountered to those that occurred when the pending DTC was stored excepting those conditions within the first 1000 revolutions after engine start. The pending DTC may be erased if, at the end of the next drive cycle in which similar conditions are encountered to those that occurred when the pending DTC was stored, there has been no exceedance of the misfire percentage described in paragraph (h)(2)(ii)(B) of this section. The pending DTC may also be erased if similar conditions are not encountered during the next 80 drive cycles immediately following storage of the pending DTC.

(vi) *Storage of freeze frame conditions for engine misfire.*

(A) The OBD system must store and erase freeze frame conditions (as defined in paragraph (k)(4)(iii) of this section) either in conjunction with storing and erasing a pending DTC or in conjunction with storing and erasing a MIL-on DTC.

(B) If, upon storage of a DTC as required by paragraphs (h)(2)(iv) and (h)(2)(v) of this section, there already exist stored freeze frame conditions for a malfunction other than a misfire or fuel system malfunction (see paragraph (h)(1) of this section) then the stored freeze frame information shall be replaced with freeze frame information associated with the misfire malfunction.

(vii) *Storage of engine conditions in association with engine misfire.* Upon detection of the misfire percentages described in paragraphs (h)(2)(ii)(A) and (h)(2)(ii)(B) of this section, the following engine conditions must be stored for use in determining similar conditions: Engine speed, load, and warm up status of the first misfire event that resulted in pending DTC storage.

(viii) *MIL deactivation in association with engine misfire.* The MIL may be deactivated after three sequential drive cycles in which similar conditions have been encountered without an exceedance of the misfire percentages described in paragraphs (h)(2)(ii)(A) and (h)(2)(ii)(B) of this section.

(3) *Exhaust gas recirculation system monitoring.*

(i) *General.* The OBD system must monitor the EGR system on engines so equipped for low and high flow rate malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the EGR system must be monitored in accordance with the comprehensive component requirements in paragraph (i)(3) of this section.

(ii) *EGR system malfunction criteria.*

(A) The OBD system must detect a malfunction of the EGR system prior to a decrease from the manufacturer's specified EGR flow rate that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 2 of this paragraph (h). For engines in which no failure or deterioration of the EGR system that causes a decrease in flow could result in an engine's emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has no detectable amount of EGR flow.

(B) The OBD system must detect a malfunction of the EGR system prior to an increase from the manufacturer's specified EGR flow rate that would cause an engine's emissions to exceed the emissions thresholds for "other

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monitors” as shown in Table 2 of this paragraph (h). For engines in which no failure or deterioration of the EGR system that causes an increase in flow could result in an engine’s emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when the system has reached its control limits such that it cannot reduce EGR flow.

(iii) *EGR system monitoring conditions.*

(A) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (h)(3)(ii) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required by paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (h)(3)(ii) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(B) The manufacturer may disable temporarily the EGR monitor under conditions when monitoring may not be reliable (e.g., when freezing may affect performance of the system). To do so, the manufacturer must be able to demonstrate that the monitor is unreliable when such conditions exist.

(iv) *EGR system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(4) *Cold start emission reduction strategy monitoring.*

(i) *General.* If an engine incorporates a specific engine control strategy to reduce cold start emissions, the OBD system must monitor the key components (e.g., idle air control valve), other than secondary air, while the control strategy is active to ensure proper operation of the control strategy.

(ii) *Cold start strategy malfunction criteria.*

(A) The OBD system must detect a malfunction prior to any failure or deterioration of the individual components associated with the cold start emission reduction control strategy that would cause an engine’s emissions to exceed the emissions thresholds for “other monitors” as shown in Table 2 of this paragraph (h). The manufacturer must establish the malfunction criteria based on data from one or more representative engine(s) and provide an engineering evaluation for establishing the malfunction criteria for the remainder of the manufacturer’s product line.

(B) Where no failure or deterioration of a component used for the cold start emission reduction strategy could result in an engine’s emissions exceeding the applicable emissions thresholds, the individual component must be monitored for proper functional response while the control strategy is active in accordance with the malfunction criteria in paragraphs (i)(3)(ii) and (i)(3)(iii) of this section.

(iii) *Cold start strategy monitoring conditions.* The manufacturer must define monitoring conditions for malfunctions identified in paragraph (h)(4)(ii) of this section in accordance with paragraphs (c) and (d) of this section.

(iv) *Cold start strategy MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(5) *Secondary air system monitoring.*

(i) *General.* The OBD system on engines equipped with any form of secondary air delivery system must monitor the proper functioning of the secondary air delivery system including all air switching valve(s). The individual electronic components (e.g., actuators, valves, sensors) that are used in the secondary air system must be monitored in accordance with the comprehensive component requirements in paragraph (i)(3) of this section. For purposes of this paragraph (h)(5), “air flow” is defined as the air flow delivered by the secondary air system to the exhaust system. For engines using secondary air systems with multiple air flow paths/distribution points, the air flow to each bank (i.e., a group of cylinders that share a common exhaust manifold, catalyst, and control sensor) must be monitored in accordance with the malfunction criteria in paragraph (h)(5)(ii) of this section. Also for purposes of this paragraph (h)(5), “normal operation” is defined as the condition when the secondary air system is activated during catalyst and/or engine warm-up following engine start. “Normal operation” does not include the condition when the secondary air system is turned on intrusively for the sole purpose of monitoring.

(ii) *Secondary air system malfunction criteria.*

(A) Except as provided in paragraph (h)(5)(ii)(C) of this section, the OBD system must detect a secondary air system malfunction prior to a decrease from the manufacturer’s specified air flow during normal operation that would cause an engine’s emissions to exceed the emissions thresholds for “other monitors” as shown in Table 2 of this paragraph (h).

(B) Except as provided in paragraph (h)(5)(ii)(C) of this section, the OBD system must detect a secondary air system malfunction prior to an increase from the manufacturer’s specified air flow during normal operation that would cause an engine’s emissions to exceed the emissions thresholds for “other monitors” as shown in Table 2 of this paragraph (h).

(C) For engines in which no deterioration or failure of the secondary air system would result in an engine’s emissions exceeding the applicable emissions thresholds, the OBD system must detect a malfunction when no detectable amount of air flow is delivered by the secondary air system during normal operation.

(iii) *Secondary air system monitoring conditions.* The manufacturer must define monitoring conditions for malfunctions identified in paragraph (h)(5)(ii) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required by paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (h)(5)(ii) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(iv) *Secondary air system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(6) *Catalyst system monitoring.*

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(i) *General.* The OBD system must monitor the catalyst system for proper conversion capability.

(ii) *Catalyst system malfunction criteria.* The OBD system must detect a catalyst system malfunction when the catalyst system's conversion capability decreases to the point that emissions exceed the emissions thresholds for the catalyst system as shown in Table 2 of this paragraph (h).

(iii) *Catalyst system monitoring conditions.* The manufacturer must define monitoring conditions for malfunctions identified in paragraph (h)(6)(ii) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required by paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (h)(6)(ii) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(iv) *Catalyst system MIL activation and DTC storage.*

(A) The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(B) The monitoring method for the catalyst system must be capable of detecting when a catalyst DTC has been erased (except OBD system self erasure), but the catalyst has not been replaced (e.g., catalyst overtemperature histogram approaches are not acceptable).

(7) *Evaporative system monitoring.*

(i) *General.* The OBD system must verify purge flow from the evaporative system and monitor the complete evaporative system, excluding the tubing and connections between the purge valve and the intake manifold, for vapor leaks to the atmosphere. Individual components of the evaporative system (e.g. valves, sensors) must be monitored in accordance with the comprehensive components requirements in paragraph (i)(3) of this section.

(ii) *Evaporative system malfunction criteria.*

(A) *Purge monitor.* The OBD system must detect an evaporative system malfunction when no purge flow from the evaporative system to the engine can be detected by the OBD system.

(B) *Leak monitor.* The OBD system must detect an evaporative system malfunction when the complete evaporative system contains a leak or leaks that cumulatively are greater than or equal to a leak caused by a 0.150 inch diameter hole.

(C) The manufacturer may demonstrate that detection of a larger hole is more appropriate than that specified in paragraph (h)(7)(ii)(B) of this section. To do so, the manufacturer must demonstrate through data and/or engineering analyses that holes smaller than the proposed detection size would not result in evaporative or running loss emissions that exceed 1.5 times the applicable evaporative emissions standards. Upon such a demonstration, the proposed detection size could be substituted for the requirement of paragraph (h)(7)(ii)(B) of this section.

(iii) *Evaporative system monitoring conditions.*

(A) The manufacturer must define monitoring conditions for malfunctions identified in paragraph (h)(7)(ii)(A) of this section in accordance with paragraphs (c) and (d) of this section.

(B) The manufacturer must define monitoring conditions for malfunctions identified in paragraph (h)(7)(ii)(B) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required by paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (h)(7)(ii)(B) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(C) The manufacturer may disable or abort an evaporative system monitor when the fuel tank level is over 85 percent of nominal tank capacity or during a refueling event.

(D) The manufacturer may request Administrator approval to run the evaporative system monitor during only those drive cycles characterized as cold starts provided such a condition is needed to ensure reliable monitoring. In making the request, the manufacturer must demonstrate through data and/or engineering analyses that a reliable monitor can only be run on drive cycles that begin with a specific set of cold start criteria. A set of cold start criteria based solely on ambient temperature exceeding engine coolant temperature will not be acceptable.

(E) The OBD system may disable temporarily the evaporative purge system to run an evaporative system leak monitor.

(iv) *Evaporative system MIL activation and DTC storage.*

(A) Except as provided for in paragraph (h)(7)(iv)(B) of this section, the MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(B) If the OBD system is capable of discerning that a system leak is being caused by a missing or improperly secured gas cap, the OBD system need not activate the MIL or store a DTC provided the vehicle is equipped with an alternative indicator for notifying the operator of the gas cap problem. The alternative indicator must be of sufficient illumination and location to be readily visible under all lighting conditions. If the vehicle is not equipped with such an alternative indicator, the MIL must activate and a DTC be stored as required in paragraph (h)(7)(iv)(A) of this section; however, these may be deactivated and erased, respectively, if the OBD system determines that the gas cap problem has been corrected and the MIL has not been activated for any other malfunction. The Administrator may approve other strategies that provide equivalent assurance that a vehicle operator will be notified promptly of a missing or improperly secured gas cap and that corrective action will be undertaken.

(8) *Exhaust gas sensor monitoring.*

(i) *General.*

(A) The OBD system must monitor for malfunctions the output signal, response rate, and any other parameter that can affect emissions of all primary (i.e., fuel

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control) exhaust gas sensors (e.g., oxygen, wide-range air/fuel). Both the lean-to-rich and rich-to-lean response rates must be monitored.

(B) The OBD system must also monitor all secondary exhaust gas sensors (those used for secondary fuel trim control or as a monitoring device) for proper output signal, activity, and response rate.

(C) For engines equipped with heated exhaust gas sensor, the OBD system must monitor the heater for proper performance.

(ii) *Primary exhaust gas sensor malfunction criteria.*

(A) The OBD system must detect a malfunction prior to any failure or deterioration of the exhaust gas sensor output voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) (including drift or bias corrected for by secondary sensors) that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 2 of this paragraph (h).

(B) The OBD system must detect malfunctions of the exhaust gas sensor caused by either a lack of circuit continuity or out-of-range values.

(C) The OBD system must detect a malfunction of the exhaust gas sensor when a sensor failure or deterioration causes the fuel system to stop using that sensor as a feedback input (e.g., causes default or open-loop operation).

(D) The OBD system must detect a malfunction of the exhaust gas sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, or other characteristics are no longer sufficient for use as an OBD system monitoring device (e.g., for catalyst monitoring).

(iii) *Secondary exhaust gas sensor malfunction criteria.*

(A) The OBD system must detect a malfunction prior to any failure or deterioration of the exhaust gas sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's emissions to exceed the emissions thresholds for "other monitors" as shown in Table 2 of this paragraph (h).

(B) The OBD system must detect malfunctions of the exhaust gas sensor caused by a lack of circuit continuity.

(C) To the extent feasible, the OBD system must detect a malfunction of the exhaust gas sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBD system monitoring device (e.g., for catalyst monitoring).

(D) The OBD system must detect malfunctions of the exhaust gas sensor caused by out-of-range values.

(E) The OBD system must detect a malfunction of the exhaust gas sensor when a sensor failure or deterioration causes the fuel system (e.g., fuel control) to stop using that sensor as a feedback input (e.g., causes default or open-loop operation).

(iv) *Exhaust gas sensor heater malfunction criteria.*

(A) The OBD system must detect a malfunction of the heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's

specified limits for normal operation (i.e., within the criteria required to be met by the component vendor for heater circuit performance at high mileage). Other malfunction criteria for heater performance malfunctions may be used upon demonstrating via data or engineering analyses that the monitoring reliability and timeliness is equivalent to the stated criteria in this paragraph (h)(8)(iv)(A).

(B) The OBD system must detect malfunctions of the heater circuit including open or short circuits that conflict with the commanded state of the heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground)).

(v) *Primary exhaust gas sensor monitoring conditions.*

(A) The manufacturer must define monitoring conditions for malfunctions identified in paragraphs (h)(8)(ii)(A) and (h)(8)(ii)(D) of this section in accordance with paragraphs (c) and (d) of this section. For purposes of tracking and reporting as required by paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraphs (h)(8)(ii)(A) and (h)(8)(ii)(D) of this section must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(B) Except as provided for in paragraph (h)(8)(v)(C) of this section, monitoring for malfunctions identified in paragraphs (h)(8)(ii)(B) and (h)(8)(ii)(C) of this section must be conducted continuously.

(C) The manufacturer may disable continuous primary exhaust gas sensor monitoring when a primary exhaust gas sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). To do so, the manufacturer must demonstrate via data or engineering analyses that a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(vi) *Secondary exhaust gas sensor monitoring conditions.*

(A) The manufacturer must define monitoring conditions for malfunctions identified in paragraphs (h)(8)(iii)(A) through (h)(8)(iii)(C) of this section in accordance with paragraphs (c) and (d) of this section.

(B) Except as provided for in paragraph (h)(8)(vi)(C) of this section, monitoring for malfunctions identified in paragraphs (h)(8)(iii)(D) and (h)(8)(iii)(E) of this section must be conducted continuously.

(C) The manufacturer may disable continuous secondary exhaust gas sensor monitoring when a secondary exhaust gas sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). To do so, the manufacturer must demonstrate via data or engineering analyses that a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(vii) *Exhaust gas sensor heater monitoring conditions.*

(A) The manufacturer must define monitoring conditions for malfunctions identified in paragraph (h)(8)(iv)(A)

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of this section in accordance with paragraphs (c) and (d) of this section.

(B) Monitoring for malfunctions identified in paragraph (h)(8)(iv)(B) of this section must be conducted continuously.

(viii) *Exhaust gas sensor MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(9) *Variable valve timing (VVT) system monitoring.*

(i) *General.* The OBD system must monitor the VVT system on engines so equipped for target error and slow response malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the VVT system must be monitored in accordance with the comprehensive components requirements in paragraph (i)(3).

(ii) *VVT system malfunction criteria.*

(A) *VVT system target error.* The OBD system must detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a crank angle and/or lift tolerance that would cause an engine's emissions to exceed the emission thresholds for "other monitors" as shown in Table 2 of this paragraph (h).

(B) *VVT slow response.* The OBD system must detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a manufacturer-specified time that would cause an engine's emissions to exceed the emission thresholds for "other monitors" as shown in Table 2 of this paragraph (h).

(C) For engines in which no failure or deterioration of the VVT system could result in an engine's emissions exceeding the applicable emissions thresholds of paragraphs (h)(9)(ii)(A) and (h)(9)(ii)(B) of this section, the OBD system must detect a malfunction of the VVT system when proper functional response of the system to computer commands does not occur.

(iii) *VVT system monitoring conditions.* Manufacturers must define the monitoring conditions for VVT system malfunctions identified in paragraph (h)(9)(ii) in accordance with paragraphs (c) and (d) of this section, with the exception that monitoring must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section. For purposes of tracking and reporting as required in paragraph (d)(1) of this section, all monitors used to detect malfunctions identified in paragraph (h)(9)(ii) must be tracked separately but reported as a single set of values as specified in paragraph (e)(1)(iii) of this section.

(iv) *VVT MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(i) **OBD monitoring requirements for all engines.**

(1) *Engine cooling system monitoring.*

(i) *General.*

(A) The OBD system must monitor the thermostat on engines so equipped for proper operation.

(B) The OBD system must monitor the engine coolant temperature (ECT) sensor for electrical circuit continuity, out-of-range values, and rationality malfunctions.

(C) For engines that use a system other than the cooling system and ECT sensor (e.g., oil temperature, cylinder head temperature) to determine engine operating temperature for emission control purposes (e.g., to modify spark or fuel injection timing or quantity), the manufacturer may forego cooling system monitoring and instead monitor the components or systems used in their approach. To do so, the manufacturer must submit data and/or engineering analyses that demonstrate that their monitoring plan is as reliable and effective as the monitoring required in this paragraph (i)(1).

(ii) *Malfunction criteria for the thermostat.*

(A) The OBD system must detect a thermostat malfunction if, within the manufacturer specified time interval following engine start, any of the following conditions occur: The coolant temperature does not reach the highest temperature required by the OBD system to enable other diagnostics; and, the coolant temperature does not reach a warmed-up temperature within 20 degrees Fahrenheit of the manufacturer's nominal thermostat regulating temperature. For the second of these two conditions, the manufacturer may use a lower temperature for this criterion if either the manufacturer can demonstrate that the fuel, spark timing, and/or other coolant temperature-based modification to the engine control strategies would not cause an emissions increase greater than or equal to 50 percent of any of the applicable emissions standards; or, ambient air temperature is between 20 degrees Fahrenheit and 50 degrees Fahrenheit in which case, upon Administrator approval, the minimum coolant temperature required to be reached may be decreased based on the ambient air temperature.

(B) With Administrator approval, the manufacturer may use alternative malfunction criteria to those of paragraph (i)(1)(ii)(A) of this section and/or alternative monitoring conditions to those of paragraph (i)(1)(iv) of this section that are a function of temperature at engine start on engines that do not reach the temperatures specified in the malfunction criteria when the thermostat is functioning properly. To do so, the manufacturer is required to submit data and/or engineering analyses that demonstrate that a properly operating system does not reach the specified temperatures and that the possibility is minimized for cooling system malfunctions to go undetected thus disabling other OBD monitors.

(C) The manufacturer may request Administrator approval to forego monitoring of the thermostat if the manufacturer can demonstrate that a malfunctioning thermostat cannot cause a measurable increase in emissions during any reasonable driving condition nor cause any disablement of other OBD monitors.

(iii) *Malfunction criteria for the ECT sensor.*

(A) *Circuit integrity.* The OBD system must detect malfunctions of the ECT sensor related to a lack of circuit continuity or out-of-range values.

(B) *Time to reach closed-loop / feedback enable temperature.* The OBD system must detect if, within the manufacturer specified time interval following engine

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start, the ECT sensor does not achieve the highest stabilized minimum temperature that is needed to initiate closed-loop/feedback control of all affected emission control systems (e.g., fuel system, EGR system). The manufacturer specified time interval must be a function of the engine coolant temperature and/or intake air temperature at startup. The manufacturer time interval must be supported by data and/or engineering analyses demonstrating that it provides robust monitoring and minimizes the likelihood of other OBD monitors being disabled. The manufacturer may forego the requirements of this paragraph (i)(1)(iii)(B) provided the manufacturer does not use engine coolant temperature or the ECT sensor to enable closed-loop/feedback control of any emission control systems.

(C) *Stuck in range below the highest minimum enable temperature.* To the extent feasible when using all available information, the OBD system must detect a malfunction if the ECT sensor inappropriately indicates a temperature below the highest minimum enable temperature required by the OBD system to enable other monitors (e.g., an OBD system that requires ECT to be greater than 140 degrees Fahrenheit to enable a diagnostic must detect malfunctions that cause the ECT sensor to inappropriately indicate a temperature below 140 degrees Fahrenheit). The manufacturer may forego this requirement for temperature regions in which the monitors required under paragraphs (i)(1)(ii) or (i)(1)(iii)(B) of this section will detect ECT sensor malfunctions as defined in this paragraph (i)(1)(iii)(C).

(D) *Stuck in range above the lowest maximum enable temperature.* The OBD system must detect a malfunction if the ECT sensor inappropriately indicates a temperature above the lowest maximum enable temperature required by the OBD system to enable other monitors (e.g., an OBD system that requires an engine coolant temperature less than 90 degrees Fahrenheit at startup prior to enabling an OBD monitor must detect malfunctions that cause the ECT sensor to indicate inappropriately a temperature above 90 degrees Fahrenheit). The manufacturer may forego this requirement within temperature regions in which the monitors required under paragraphs (i)(1)(ii), (i)(1)(iii)(B), (i)(1)(iii)(C) of this section will detect ECT sensor malfunctions as defined in this paragraph (i)(1)(iii)(D) or in which the MIL will be activated according to the provisions of paragraph (b)(2)(v) of this section. The manufacturer may also forego this monitoring within temperature regions where a temperature gauge on the instrument panel indicates a temperature in the “red zone” (engine overheating zone) and displays the same temperature information as used by the OBD system.

(iv) *Monitoring conditions for the thermostat.*

(A) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (i)(1)(ii)(A) of this section in accordance with paragraph (c) of this section. Additionally, except as provided for in paragraphs (i)(1)(iv)(B) and (i)(1)(iv)(C) of this section, monitoring for malfunctions identified in paragraph (i)(1)(ii)(A) of this section must be conducted once per drive cycle on every drive cycle in which the ECT sensor indicates, at engine start, a temperature lower than the

temperature established as the malfunction criteria in paragraph (i)(1)(ii)(A) of this section.

(B) The manufacturer may disable thermostat monitoring at ambient engine start temperatures below 20 degrees Fahrenheit.

(C) The manufacturers may request Administrator approval to suspend or disable thermostat monitoring if the engine is subjected to conditions that could lead to false diagnosis. To do so, the manufacturer must submit data and/or engineering analyses that demonstrate that the suspension or disablement is necessary. In general, the manufacturer will not be allowed to suspend or disable the thermostat monitor on engine starts where the engine coolant temperature at engine start is more than 35 degrees Fahrenheit lower than the thermostat malfunction threshold temperature determined under paragraph (i)(1)(ii)(A) of this section.

(v) *Monitoring conditions for the ECT sensor.*

(A) Except as provided for in paragraph (i)(1)(v)(D) of this section, the OBD system must monitor continuously for malfunctions identified in paragraph monitoring for malfunctions identified in paragraph (i)(1)(iii)(A) of this section (i.e., circuit integrity and out-of-range).

(B) The manufacturer must define the monitoring conditions for malfunctions identified in paragraph (i)(1)(iii)(B) of this section in accordance with paragraph (c) of this section. Additionally, except as provided for in paragraph (i)(1)(v)(D) of this section, monitoring for malfunctions identified in paragraph (i)(1)(iii)(B) of this section must be conducted once per drive cycle on every drive cycle in which the ECT sensor indicates a temperature lower than the closed-loop enable temperature at engine start (i.e., all engine start temperatures greater than the ECT sensor out-of-range low temperature and less than the closed-loop enable temperature).

(C) The manufacturer must define the monitoring conditions for malfunctions identified in paragraphs (i)(1)(iii)(C) and (i)(1)(iii)(D) of this section in accordance with paragraphs (c) and (d) of this section.

(D) The manufacturer may suspend or delay the monitor for the time to reach closed-loop enable temperature if the engine is subjected to conditions that could lead to false diagnosis (e.g., vehicle operation at idle for more than 50 to 75 percent of the warm-up time).

(E) The manufacturer may request Administrator approval to disable continuous ECT sensor monitoring when an ECT sensor malfunction cannot be distinguished from other effects. To do so, the manufacturer must submit data and/or engineering analyses that demonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(vi) *Engine cooling system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(2) *Crankcase ventilation (CV) system monitoring.*

(i) *General.* The OBD system must monitor the CV system on engines so equipped for system integrity. Engines not required to be equipped with CV systems

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are exempt from monitoring the CV system. For diesel engines, the manufacturer must submit a plan for Administrator approval prior to OBD certification. That plan must include descriptions of the monitoring strategy, malfunction criteria, and monitoring conditions for CV system monitoring. The plan must demonstrate that the CV system monitor is of equivalent effectiveness, to the extent feasible, to the malfunction criteria and the monitoring conditions of this paragraph (i)(2).

(ii) *Crankcase ventilation system malfunction criteria.*

(A) For the purposes of this paragraph (i)(2), "CV system" is defined as any form of crankcase ventilation system, regardless of whether it utilizes positive pressure. "CV valve" is defined as any form of valve or orifice used to restrict or control crankcase vapor flow. Further, any additional external CV system tubing or hoses used to equalize crankcase pressure or to provide a ventilation path between various areas of the engine (e.g., crankcase and valve cover) are considered part of the CV system "between the crankcase and the CV valve" and subject to the malfunction criteria in paragraph (i)(2)(ii)(B) of this section.

(B) Except as provided for in paragraphs (i)(2)(ii)(C) through (i)(2)(ii)(E) of this section, the OBD system must detect a malfunction of the CV system when a disconnection of the system occurs between either the crankcase and the CV valve, or between the CV valve and the intake manifold.

(C) The manufacturer may forego monitoring for a disconnection between the crankcase and the CV valve provided the CV system is designed such that the CV valve is fastened directly to the crankcase such that it is significantly more difficult to remove the CV valve from the crankcase than to disconnect the line between the CV valve and the intake manifold (taking aging effects into consideration). To do so, the manufacturer must be able to provide data and/or an engineering evaluation demonstrating that the CV system is so designed.

(D) The manufacturer may forego monitoring for a disconnection between the crankcase and the CV valve provided the CV system is designed such that it uses tubing connections between the CV valve and the crankcase that are: resistant to deterioration or accidental disconnection; significantly more difficult to disconnect than is the line between the CV valve and the intake manifold; and, not subject to disconnection per the manufacturer's repair procedures for any non-CV system repair. To do so, the manufacturer must be able to provide data and/or engineering evaluation demonstrating that the CV system is so designed.

(E) The manufacturer may forego monitoring for a disconnection between the CV valve and the intake manifold provided the CV system is designed such that any disconnection either causes the engine to stall immediately during idle operation, or is unlikely to occur due to a CV system design that is integral to the induction system (e.g., machined passages rather than tubing or hoses). To do so, the manufacturer must be able to provide data and/or an engineering evaluation demonstrating that the CV system is so designed.

(iii) *Crankcase ventilation system monitoring conditions.* The manufacturer must define the monitoring

conditions for malfunctions identified in paragraph (i)(2) of this section in accordance with paragraphs (c) and (d) of this section.

(iv) *Crankcase ventilation system MIL activation and DTC storage.* The MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section. The stored DTC need not identify specifically the CV system (e.g., a DTC for idle speed control or fuel system monitoring can be stored) if the manufacturer can demonstrate that additional monitoring hardware is necessary to make such an identification and provided the manufacturer's diagnostic and repair procedures for the detected malfunction include directions to check the integrity of the CV system.

(3) *Comprehensive component monitoring.*

(i) *General.* Except as provided for in paragraph (i)(4) of this section, the OBD system must detect a malfunction of any electronic engine component or system not otherwise described in paragraphs (g), (h), (i)(1), and (i)(2) of this section that either provides input to (directly or indirectly, such components may include the crank angle sensor, knock sensor, throttle position sensor, cam position sensor, intake air temperature sensor, boost pressure sensor, manifold pressure sensor, mass air flow sensor, exhaust temperature sensor, exhaust pressure sensor, fuel pressure sensor, fuel composition sensor of a flexible fuel vehicle, etc.) or receives commands from (such components or systems may include the idle speed control system, glow plug system, variable length intake manifold runner systems, supercharger or turbocharger electronic components, heated fuel preparation systems, the wait-to-start lamp on diesel applications, the MIL, etc.) the onboard computer(s) and meets either of the criteria described in paragraphs (i)(3)(i)(A) and/or (i)(3)(i)(B) of this section. Note that, for the purposes of this paragraph (i)(3), "electronic engine component or system" does not include components that are driven by the engine and are not related to the control of the fueling, air handling, or emissions of the engine (e.g., PTO components, air conditioning system components, and power steering components).

(A) It can cause emissions to exceed applicable emission standards. To preclude monitoring, the manufacturer must be able to provide emission data showing that the component or system, when malfunctioning and installed on a suitable test engine, does not cause emissions to exceed the emission standards.

(B) It is used as part of the monitoring strategy for any other monitored system or component.

(ii) *Comprehensive component malfunction criteria for input components.*

(A) The OBD system must detect malfunctions of input components caused by a lack of circuit continuity and out-of-range values. In addition, where feasible, rationality checks must also be done and shall verify that a sensor output is neither inappropriately high nor inappropriately low (i.e., "two-sided" monitoring).

(B) To the extent feasible, the OBD system must separately detect and store different DTCs that distinguish rationality malfunctions from lack of circuit continuity

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and out-of-range malfunctions. For lack of circuit continuity and out-of-range malfunctions, the OBD system must, to the extent feasible, separately detect and store different DTCs for each distinct malfunction (e.g., out-of-range low, out-of-range high, open circuit). The OBD system is not required to store separate DTCs for lack of circuit continuity malfunctions that cannot be distinguished from other out-of-range circuit malfunctions.

(C) For input components that are used to activate alternative strategies that can affect emissions (e.g., AECs, engine shutdown systems), the OBD system must conduct rationality checks to detect malfunctions that cause the system to activate erroneously or deactivate the alternative strategy. To the extent feasible when using all available information, the rationality check must detect a malfunction if the input component inappropriately indicates a value that activates or deactivates the alternative strategy. For example, for an alternative strategy that activates when the intake air temperature is greater than 120 degrees Fahrenheit, the OBD system must detect malfunctions that cause the intake air temperature sensor to indicate inappropriately a temperature above 120 degrees Fahrenheit.

(D) For engines that require precise alignment between the camshaft and the crankshaft, the OBD system must monitor the crankshaft position sensor(s) and camshaft position sensor(s) to verify proper alignment between the camshaft and crankshaft in addition to monitoring the sensors for circuit continuity and proper rationality. Proper alignment monitoring between a camshaft and a crankshaft is required only in cases where both are equipped with position sensors. For engines equipped with VVT systems and a timing belt or chain, the OBD system must detect a malfunction if the alignment between the camshaft and crankshaft is off by one or more cam/crank sprocket cogs (e.g., the timing belt/chain has slipped by one or more teeth/cogs). If a manufacturer demonstrates that a single tooth/cog misalignment cannot cause a measurable increase in emissions during any reasonable driving condition, the OBD system must detect a malfunction when the minimum number of teeth/cogs misalignment has occurred that does cause a measurable emission increase.

(iii) *Comprehensive component malfunction criteria for output components/systems.*

(A) The OBD system must detect a malfunction of an output component/system when proper functional response does not occur in response to computer commands. If such a functional check is not feasible, the OBD system must detect malfunctions of output components/systems caused by a lack of circuit continuity or circuit malfunction (e.g., short to ground or high voltage). For output component lack of circuit continuity malfunctions and circuit malfunctions, the OBD system is not required to store different DTCs for each distinct malfunction (e.g., open circuit, shorted low). Manufacturers are not required to activate an output component/system when it would not normally be active for the sole purpose of performing a functional check of it as required in this paragraph (i)(3).

(B) For gasoline engines, the idle control system must be monitored for proper functional response to computer

commands. For gasoline engines using monitoring strategies based on deviation from target idle speed, a malfunction must be detected when either of the following conditions occurs: The idle speed control system cannot achieve the target idle speed within 200 revolutions per minute (rpm) above the target speed or 100 rpm below the target speed; or, the idle speed control system cannot achieve the target idle speed within the smallest engine speed tolerance range required by the OBD system to enable any other monitors. Regarding the former of these conditions, the manufacturer may use larger engine speed tolerances. To do so, the manufacturer must be able to provide data and/or engineering analyses that demonstrate that the tolerances can be exceeded without a malfunction being present.

(C) For diesel engines, the idle control system must be monitored for proper functional response to computer commands. For diesel engines, a malfunction must be detected when either of the following conditions occurs: the idle fuel control system cannot achieve the target idle speed or fuel injection quantity within ± 50 percent of the manufacturer-specified fuel quantity and engine speed tolerances; or, the idle fuel control system cannot achieve the target idle speed or fueling quantity within the smallest engine speed or fueling quantity tolerance range required by the OBD system to enable any other monitors.

(D) For model years 2010 through 2012, glow plugs must be monitored for circuit continuity malfunctions. For model years 2010 and later, intake air heater systems and, for model years 2013 and later, glow plugs must be monitored for proper functional response to computer commands and for circuit continuity malfunctions. The glow plug/intake air heater circuit(s) must be monitored for proper current and voltage drop. The manufacturer may use other monitoring strategies but must be able to provide data and/or engineering analyses that demonstrate reliable and timely detection of malfunctions. The OBD system must also detect a malfunction when a single glow plug no longer operates within the manufacturer's specified limits for normal operation. If a manufacturer can demonstrate that a single glow plug malfunction cannot cause a measurable increase in emissions during any reasonable driving condition, the OBD system must instead detect a malfunction when the number of glow plugs needed to cause an emission increase is malfunctioning. To the extent feasible, the stored DTC must identify the specific malfunctioning glow plug(s).

(E) The wait-to-start lamp circuit and the MIL circuit must be monitored for malfunctions that cause either lamp to fail to activate when commanded to do so (e.g., burned out bulb). This monitoring of the wait-to-start lamp circuit and the MIL circuit is not required for wait-to-start lamps and MILs using light-emitting diodes (LEDs).

(iv) *Monitoring conditions for input components.*

(A) The OBD system must monitor input components continuously for out-of-range values and circuit continuity. The manufacturer may disable continuous monitoring for circuit continuity and out-of-range values when a malfunction cannot be distinguished from other

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effects. To do so, the manufacturer must be able to provide data and/or engineering analyses that demonstrate that a properly functioning input component cannot be distinguished from a malfunctioning input component and that the disablement interval is limited only to that necessary for avoiding false malfunction detection.

(B) For input component rationality checks (where applicable), the manufacturer must define the monitoring conditions for detecting malfunctions in accordance with paragraphs (c) and (d) of this section, with the exception that rationality checks must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section.

(v) *Monitoring conditions for output components/systems.*

(A) The OBD system must monitor output components/systems continuously for circuit continuity and circuit malfunctions. The manufacturer may disable continuous monitoring for circuit continuity and circuit malfunctions when a malfunction cannot be distinguished from other effects. To do so, the manufacturer must be able to provide data and/or engineering analyses that demonstrate that a properly functioning output component/system cannot be distinguished from a malfunctioning one and that the disablement interval is limited only to that necessary for avoiding false malfunction detection.

(B) For output component/system functional checks, the manufacturer must define the monitoring conditions for detecting malfunctions in accordance with paragraphs (c) and (d) of this section. Specifically for the idle control system, the manufacturer must define the monitoring conditions for detecting malfunctions in accordance with paragraphs (c) and (d) of this section, with the exception that functional checks must occur every time the monitoring conditions are met during the drive cycle rather than once per drive cycle as required in paragraph (c)(2) of this section.

(vi) *Comprehensive component MIL activation and DTC storage.*

(A) Except as provided for in paragraphs (i)(3)(vi)(B) and (i)(3)(vi)(C) of this section, the MIL must activate and DTCs must be stored according to the provisions of paragraph (b) of this section.

(B) The MIL need not be activated in conjunction with storing a MIL-on DTC for any comprehensive component if: the component or system, when malfunctioning, could not cause engine emissions to increase by 15 percent or more of the applicable FTP standard during any reasonable driving condition; or, the component or system is not used as part of the monitoring strategy for any other system or component that is required to be monitored.

(C) The MIL need not be activated if a malfunction has been detected in the MIL circuit that prevents the MIL from activating (e.g., burned out bulb or light-emitting diode, LED). Nonetheless, the electronic MIL status (see paragraph (k)(4)(ii) of this section) must be reported as MIL commanded-on and a MIL-on DTC must be stored.

(4) *Other emission control system monitoring.*

(i) *General.* For other emission control systems that are either not addressed in paragraphs (g) through (i)(3) of this section (e.g., hydrocarbon traps, homogeneous charge compression ignition control systems), or addressed in paragraph (i)(3) of this section but not corrected or compensated for by an adaptive control system (e.g., swirl control valves), the manufacturer must submit a plan for Administrator approval of the monitoring strategy, malfunction criteria, and monitoring conditions prior to introduction on a production engine. The plan must demonstrate the effectiveness of the monitoring strategy, the malfunction criteria used, the monitoring conditions required by the monitor, and, if applicable, the determination that the requirements of paragraph (i)(4)(ii) of this section are satisfied.

(ii) For engines that use emission control systems that alter intake air flow or cylinder charge characteristics by actuating valve(s), flap(s), etc., in the intake air delivery system (e.g., swirl control valve systems), the manufacturer, in addition to meeting the requirements of paragraph (i)(4)(i) of this section, may elect to have the OBD system monitor the shaft to which all valves in one intake bank are physically attached rather than performing a functional check of the intake air flow, cylinder charge, or individual valve(s)/flap(s). For non-metal shafts or segmented shafts, the monitor must verify all shaft segments for proper functional response (e.g., by verifying that the segment or portion of the shaft farthest from the actuator functions properly). For systems that have more than one shaft to operate valves in multiple intake banks, the manufacturer is not required to add more than one set of detection hardware (e.g., sensor, switch) per intake bank to meet this requirement.

(5) *Exceptions to OBD monitoring requirements.*

(i) The Administrator may revise the PM filtering performance malfunction criteria for DPFs to exclude detection of specific failure modes such as partially melted substrates, if the most reliable monitoring method developed requires it.

(ii) The manufacturer may disable an OBD system monitor at ambient engine start temperatures below 20 degrees Fahrenheit (low ambient temperature conditions may be determined based on intake air or engine coolant temperature at engine start) or at elevations higher than 8,000 feet above sea level. To do so, the manufacturer must submit data and/or engineering analyses that demonstrate that monitoring is unreliable during the disable conditions. A manufacturer may request that an OBD system monitor be disabled at other ambient engine start temperatures by submitting data and/or engineering analyses demonstrating that misdiagnosis would occur at the given ambient temperatures due to their effect on the component itself (e.g., component freezing).

(iii) The manufacturer may disable an OBD system monitor when the fuel level is 15 percent or less of the nominal fuel tank capacity for those monitors that can be affected by low fuel level or running out of fuel (e.g., misfire detection). To do so, the manufacturer must submit data and/or engineering analyses that demonstrate that monitoring at the given fuel levels is unreliable, and that the OBD system is still able to detect a malfunction if the component(s) used to determine fuel level

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indicates erroneously a fuel level that causes the disablement.

(iv) The manufacturer may disable OBD monitors that can be affected by engine battery or system voltage levels.

(A) For an OBD monitor affected by low vehicle battery or system voltages, manufacturers may disable monitoring when the battery or system voltage is below 11.0 Volts. The manufacturer may use a voltage threshold higher than 11.0 Volts to disable monitors but must submit data and/or engineering analyses that demonstrate that monitoring at those voltages is unreliable and that either operation of a vehicle below the disablement criteria for extended periods of time is unlikely or the OBD system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(B) For an OBD monitor affected by high engine battery or system voltages, the manufacturer may disable monitoring when the battery or system voltage exceeds a manufacturer-defined voltage. To do so, the manufacturer must submit data and/or engineering analyses that demonstrate that monitoring above the manufacturer-defined voltage is unreliable and that either the electrical charging system/alternator warning light will be activated (or voltage gauge would be in the “red zone”) or the OBD system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(v) The manufacturer may also disable affected OBD monitors in systems designed to accommodate the installation of power take off (PTO) units provided monitors are disabled only while the PTO unit is active and the OBD readiness status (see paragraph (k)(4)(i) of this section) is cleared by the onboard computer (i.e., all monitors set to indicate “not complete” or “not ready”) while the PTO unit is activated. If monitors are so disabled and when the disablement ends, the readiness status may be restored to its state prior to PTO activation.

(6) *Feedback control system monitoring.* If the engine is equipped with feedback control of any of the systems covered in paragraphs (g), (h) and (i) of this section, then the OBD system must detect as malfunctions the conditions specified in this paragraph (i)(6) for each of the individual feedback controls.

(i) The OBD system must detect when the system fails to begin feedback control within a manufacturer specified time interval.

(ii) When any malfunction or deterioration causes open loop or limp-home operation.

(iii) When feedback control has used up all of the adjustment allowed by the manufacturer.

(iv) A manufacturer may temporarily disable monitoring for malfunctions specified in paragraph (i)(6)(iii) of this section during conditions that the specific monitor cannot distinguish robustly between a malfunctioning system and a properly operating system. To do so, the manufacturer is required to submit data and/or engineering analyses demonstrating that the individual feedback control system, when operating as designed on an engine with all emission controls working properly,

routinely operates during these conditions while having used up all of the adjustment allowed by the manufacturer. In lieu of detecting, with a system specific monitor, the malfunctions specified in paragraphs (i)(6)(i) and (i)(6)(ii) of this section the OBD system may monitor the individual parameters or components that are used as inputs for individual feedback control systems provided that the monitors detect all malfunctions that meet the criteria of paragraphs (i)(6)(i) and (i)(6)(ii) of this section.

(j) Production evaluation testing.

(1) Verification of standardization requirements.

(i) For model years 2013 and later, the manufacturer must perform testing to verify that production vehicles meet the requirements of paragraphs (k)(3) and (k)(4) of this section relevant to the proper communication of required emissions-related messages to a SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool.

(ii) Selection of test vehicles.

(A) The manufacturer must perform this testing every model year on ten unique production vehicles (i.e., engine rating and chassis application combination) per engine family. If there are less than ten unique production vehicles for a certain engine family, the manufacturer must test each unique production vehicle in that engine family. The manufacturer must perform this testing within either three months of the start of engine production or one month of the start of vehicle production, whichever is later. The manufacturer may request approval to group multiple production vehicles together and test one representative vehicle per group. To do so, the software and hardware designed to comply with the standardization requirements of paragraph (k)(1) of this section (e.g., communication protocol message timing, number of supported data stream parameters, engine and vehicle communication network architecture) in the representative vehicle must be identical to all others in the group and any differences in the production vehicles cannot be relevant with respect to meeting the criteria of paragraph (j)(1)(iv) of this section.

(B) For 2016 and subsequent model years, the required number of vehicles to be tested shall be reduced to five per engine family provided zero vehicles fail the testing required by paragraph (j)(1) of this section for two consecutive years.

(C) For 2019 and subsequent model years, the required number of vehicles to be tested shall be reduced to three per engine family provided zero vehicles fail the testing required by paragraph (j)(1) of this section for three consecutive years.

(D) The requirement for submittal of data from one or more of the production vehicles shall be waived if data have been submitted previously for all of the production vehicles. The manufacturer may request approval to carry over data collected in previous model years. To do so, the software and hardware designed to comply with the standardization requirements of paragraph (k)(1) of this section must be identical to the previous model year and there must not have been other hardware or software

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changes that affect compliance with the standardization requirements.

(iii) *Test equipment.* For the testing required by paragraph (j)(1) of this section, the manufacturer shall use an off-board device to conduct the testing. The manufacturer must be able to show that the off-board device is able to verify that the vehicles tested using the device are able to perform all of the required functions in paragraph (j)(1)(iv) of this section with any other off-board device designed and built in accordance with the SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) generic scan tool specifications.

(iv) *Required testing.* The testing must verify that communication can be established properly between all emission-related on-board computers and a SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool designed to adhere strictly to the communication protocols allowed in paragraph (k)(3) of this section. The testing must also verify that all emission-related information is communicated properly between all emission-related on-board computers and a SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool in accordance with the requirements of paragraph (k)(1) of this section and the applicable ISO and SAE specifications including specifications for physical layer, network layer, message structure, and message content. The testing must also verify that the onboard computer(s) can properly respond to a SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool request to clear emissions-related DTCs and reset the ready status in accordance with paragraph (k)(4)(ix) of this section. The testing must further verify that the following information can be properly communicated to a SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool:

(A) The current ready status from all onboard computers required to support ready status in accordance with SAE J1978 or SAE J1939-73 (both as specified in paragraph (k)(1) of this section) and paragraph (k)(4)(i) of this section in the key-on, engine-off position and while the engine is running.

(B) The MIL command status while a deactivated MIL is commanded and while an activated MIL is commanded in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) and paragraph (k)(4)(ii) of this section in the key-on, engine-off position and while the engine is running, and in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) and paragraphs (b)(1)(ii) of this section during the MIL functional check, if applicable, and, if applicable, (k)(4)(i)(C) of this section during the MIL ready status check while the engine is off.

(C) All data stream parameters required in paragraph (k)(4)(ii) of this section in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) including, if applicable, the proper identification of each data stream parameter as supported in SAE J1979 (e.g., Mode/Service \$01, PID \$00).

(D) The CAL ID, CVN, and VIN as required by paragraphs (k)(4)(vi), (k)(4)(vii), and (k)(4)(viii) of this section

and in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section).

(E) An emissions-related DTC (permanent, pending, MIL-on, previous-MIL-on) in accordance with SAE J1979 or SAE J1939-73 (both as specified in paragraph (k)(1) of this section) including the correct indication of the number of stored DTCs (e.g., Mode/Service \$01, PID \$01, Data A for SAE J1979 (as specified in paragraph (k)(1) of this section)) and paragraph (k)(4)(iv) of this section.

(v) *Reporting of results.* The manufacturer must submit to the Administrator the following, based on the results of the testing required by paragraph (j)(1)(iv) of this section:

(A) If a variant meets all the requirements of paragraph (j)(1)(iv) of this section, a statement specifying that the variant passed all the tests. Upon request from the Administrator, the detailed results of any such testing may have to be submitted.

(B) If any variant does not meet the requirements paragraph (j)(1)(iv) of this section, a written report detailing the problem(s) identified and the manufacturer's proposed corrective action (if any) to remedy the problem(s). This report must be submitted within one month of testing the specific variant. The Administrator will consider the proposed remedy and, if in disagreement, will work with the manufacturer to propose an alternative remedy. Factors to be considered by the Administrator in considering the proposed remedy will include the severity of the problem(s), the ability of service technicians to access the required diagnostic information, the impact on equipment and tool manufacturers, and the amount of time prior to implementation of the proposed corrective action.

(vi) *Alternative testing protocols.* Manufacturers may request approval to use other testing protocols. To do so, the manufacturer must demonstrate that the alternative testing methods and equipment will provide an equivalent level of verification of compliance with the standardization requirements as is required by paragraph (j)(1) of this section.

(2) *Verification of monitoring requirements.*

(i) Within either the first six months of the start of engine production or the first three months of the start of vehicle production, whichever is later, the manufacturer must conduct a complete evaluation of the OBD system of one or more production vehicles (test vehicles) and submit the results of the evaluation to the Administrator.

(ii) *Selection of test vehicles.*

(A) For each engine selected for monitoring system demonstration in paragraph (l) of this section, the manufacturer must evaluate one production vehicle equipped with an engine from the same engine family and rating as the demonstration engine. The vehicle selection must be approved by the Administrator.

(B) If the manufacturer is required to test more than one test vehicle, the manufacturer may test an engine in lieu of a vehicle for all but one of the required test vehicles.

(C) The requirement for submittal of data from one or more of the test vehicles may be waived if data have

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been submitted previously for all of the engine ratings and variants.

(iii) *Evaluation requirements.*

(A) The evaluation must demonstrate the ability of the OBD system on the selected test vehicle to detect a malfunction, activate the MIL, and, where applicable, store an appropriate DTC readable by a scan tool when a malfunction is present and the monitoring conditions have been satisfied for each individual monitor required by this section. For model years 2013 and later, the evaluation must demonstrate the ability of the OBD system on the selected test vehicle to detect a malfunction, activate the MIL, and, where applicable, store an appropriate DTC readable by a SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool when a malfunction is present and the monitoring conditions have been satisfied for each individual monitor required by this section.

(B) The evaluation must verify that the malfunction of any component used to enable another OBD monitor but that does not itself result in MIL activation (e.g., fuel level sensor) will not inhibit the ability of other OBD monitors to detect malfunctions properly.

(C) The evaluation must verify that the software used to track the numerator and denominator for the purpose of determining in-use monitoring frequency increments as required by paragraph (d)(2) of this section.

(D) Malfunctions may be implanted mechanically or simulated electronically, but internal onboard computer hardware or software changes shall not be used to simulate malfunctions. For monitors that are required to indicate a malfunction before emissions exceed an emission threshold, manufacturers are not required to use malfunctioning components/systems set exactly at their malfunction criteria limits. Emission testing is not required to confirm that the malfunction is detected before the appropriate emission thresholds are exceeded.

(E) The manufacturer must submit a proposed test plan for approval prior to performing evaluation testing. The test plan must identify the method used to induce a malfunction for each monitor.

(F) If the demonstration of a specific monitor cannot be reasonably performed without causing physical damage to the test vehicle (e.g., onboard computer internal circuit malfunctions), the manufacturer may omit the specific demonstration.

(G) For evaluation of test vehicles selected in accordance with paragraph (j)(2)(ii) of this section, the manufacturer is not required to demonstrate monitors that were demonstrated prior to certification as required in paragraph (l) of this section.

(iv) The manufacturer must submit a report of the results of all testing conducted as required by paragraph (j)(2) of this section. The report must identify the method used to induce a malfunction in each monitor, the MIL activation status, and the DTC(s) stored.

(3) *Verification of in-use monitoring performance ratios.*

(i) The manufacturer must collect and report in-use monitoring performance data representative of production vehicles (i.e., engine rating and chassis application combination). The manufacturer must collect and report

the data to the Administrator within 12 months after the first production vehicle was first introduced into commerce.

(ii) The manufacturer must separate production vehicles into the monitoring performance groups and submit data that represents each of these groups. The groups shall be based on the following criteria:

(A) Emission control system architecture. All engines that use the same or similar emissions control system architecture (e.g., EGR with DPF and SCR; EGR with DPF and NO_x adsorber; EGR with DPF-only) and associated monitoring system would be in the same emission architecture category.

(B) Vehicle application type. Within an emission architecture category, engines shall be separated into one of three vehicle application types: Engines intended primarily for line-haul chassis applications, engines intended primarily for urban delivery chassis applications, and all other engines.

(iii) The manufacturer may use an alternative grouping method to collect representative data. To do so, the manufacturer must show that the alternative groups include production vehicles using similar emission controls, OBD strategies, monitoring condition calibrations, and vehicle application driving/usage patterns such that they are expected to have similar in-use monitoring performance. The manufacturer will still be required to submit one set of data for each of the alternative groups.

(iv) For each monitoring performance group, the data must include all of the in-use performance tracking data (i.e., all numerators, denominators, the general denominator, and the ignition cycle counter), the date the data were collected, the odometer reading, the VIN, and the calibration ID. For model years 2013 and later, for each monitoring performance group, the data must include all of the in-use performance tracking data reported through SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section; i.e., all numerators, denominators, the general denominator, and the ignition cycle counter), the date the data were collected, the odometer reading, the VIN, and the calibration ID.

(v) The manufacturer must submit a plan to the Administrator that details the types of production vehicles in each monitoring performance group, the number of vehicles per group to be sampled, the sampling method, the timeline to collect the data, and the reporting format. The plan must provide for effective collection of data from, at least, 15 vehicles per monitoring performance group and provide for data that represent a broad range of temperature conditions. The plan shall not, by design, exclude or include specific vehicles in an attempt to collect data only from vehicles expected to have the highest in-use performance ratios.

(vi) The 12 month deadline for reporting may be extended to 18 months if the manufacturer can show that the delay is justified. In such a case, an interim report of progress to date must be submitted within the 12 month deadline.

(k) **Standardization requirements.**

(1) *Reference materials.* The following documents are incorporated by reference, see §86.1. Anyone may inspect

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copies at the U.S. EPA or at the National Archives and Records Administration (NARA). For information on the availability of this material at U.S. EPA, NARA, or the standard making bodies directly, refer to §86.1.

- (i) SAE J1930, Revised April 2002.
- (ii) SAE J1939, Revised October 2007.
- (iii) SAE J1939-13, Revised March 2004, for model years 2013 and later.
- (iv) SAE J1939-73, Revised September 2006.
- (v) SAE J1962, Revised April 2002, for model years 2013 and later.
- (vi) SAE J1978, Revised April 2002.
- (vii) SAE J1979, Revised May 2007.
- (viii) SAE J2012, Revised April 2002.
- (ix) SAE J2403, Revised August 2007.
- (x) ISO 15765-4:2005(E), January 15, 2005.

(2) *Diagnostic connector.* For model years 2010 through 2012, the manufacturer defined data link connector must be accessible to a trained service technician. For model years 2013 and later, a standard data link connector conforming to SAE J1962 (as specified in paragraph (k)(1) of this section) or SAE J1939-13 (as specified in paragraph (k)(1) of this section) specifications (except as provided for in paragraph (k)(2)(iii) if this section) must be included in each vehicle.

(i) For model years 2013 and later, the connector must be located in the driver's side foot-well region of the vehicle interior in the area bound by the driver's side of the vehicle and the driver's side edge of the center console (or the vehicle centerline if the vehicle does not have a center console) and at a location no higher than the bottom of the steering wheel when in the lowest adjustable position. The connector shall not be located on or in the center console (i.e., neither on the horizontal faces near the floor-mounted gear selector, parking brake lever, or cup-holders nor on the vertical faces near the car stereo, climate system, or navigation system controls). The location of the connector shall be capable of being easily identified and accessed (e.g., to connect an off-board tool). For vehicles equipped with a driver's side door, the connector must be identified and accessed easily by someone standing (or "crouched") on the ground outside the driver's side of the vehicle with the driver's side door open. The Administrator may approve an alternative location upon request from the manufacturer. In all cases, the installation position of the connector must be both identified and accessed easily by someone standing outside the vehicle and protected from accidental damage during normal vehicle use.

(ii) For model years 2013 and later, if the connector is covered, the cover must be removable by hand without the use of any tools and be labeled "OBD" to aid technicians in identifying the location of the connector. Access to the diagnostic connector shall not require opening or the removal of any storage accessory (e.g., ashtray, coinbox). The label must clearly identify that the connector is located behind the cover and is consistent with language and/or symbols commonly used in the automobile and/or heavy truck industry.

(iii) For model years 2013 and later, if the ISO 15765-4:2005(E) (as specified in paragraph (k)(1) of this section) communication protocol is used for the required OBD standardized functions, the connector must meet the "Type A" specifications of SAE J1962 (as specified in paragraph (k)(1) of this section). Any pins in the connector that provide electrical power must be properly fused to protect the integrity and usefulness of the connector for diagnostic purposes and shall not exceed 20.0 Volts DC regardless of the nominal vehicle system or battery voltage (e.g., 12V, 24V, 42V).

(iv) For model years 2013 and later, if the SAE J1939 (as specified in paragraph (k)(1) of this section) protocol is used for the required OBD standardized functions, the connector must meet the specifications of SAE J1939-13 (as specified in paragraph (k)(1) of this section). Any pins in the connector that provide electrical power must be properly fused to protect the integrity and usefulness of the connector for diagnostic purposes.

(v) For model years 2013 and later, the manufacturer may equip engines/vehicles with additional diagnostic connectors for manufacturer-specific purposes (i.e., purposes other than the required OBD functions). However, if the additional connector conforms to the "Type A" specifications of SAE J1962 (as specified in paragraph (k)(1) of this section) or the specifications of SAE J1939-13 (as specified in paragraph (k)(1) of this section) and is located in the vehicle interior near the required connector as described in this paragraph (k)(2), the connector(s) must be labeled clearly to identify which connector is used to access the standardized OBD information required by paragraph (k) of this section.

(3) *Communications to a scan tool.* For model years 2013 and later, all OBD control modules (e.g., engine, auxiliary emission control module) on a single vehicle must use the same protocol for communication of required emission-related messages from on-board to off-board network communications to a scan tool meeting SAE J1978 (as specified in paragraph (k)(1) of this section) specifications or designed to communicate with an SAE J1939 (as specified in paragraph (k)(1) of this section) network. Engine manufacturers shall not alter normal operation of the engine emission control system due to the presence of off-board test equipment accessing information required by this paragraph (k). The OBD system must use one of the following standardized protocols:

(i) ISO 15765-4:2005(E) (as specified in paragraph (k)(1) of this section). All required emission-related messages using this protocol must use a 500 kbps baud rate.

(ii) SAE J1939 (as specified in paragraph (k)(1) of this section). This protocol may only be used on vehicles with diesel engines.

(4) *Required emission related functions.* The following functions must be implemented and must be accessible by, at a minimum, a manufacturer scan tool. For model years 2013 and later, the following standardized functions must be implemented in accordance with the specifications in SAE J1979 (as specified in paragraph (k)(1) of this section) or SAE J1939 (as specified in paragraph (k)(1) of this section) to allow for access to the required information by a scan tool meeting SAE J1978

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(as specified in paragraph (k)(1) of this section) specifications or designed to communicate with an SAE J1939 (as specified in paragraph (k)(1) of this section) network:

(i) *Ready status.* The OBD system must indicate, in accordance with SAE J1979 or SAE J1939-73 (both as specified in paragraph (k)(1) of this section) specifications for model years 2013 and later, “complete” or “not complete” for each of the installed monitored components and systems identified in paragraphs (g), (h) with the exception of (h)(4), and (i)(3) of this section. All components or systems identified in paragraphs (h)(1), (h)(2), or (i)(3) of this section that are monitored continuously must always indicate “complete.” Components or systems that are not subject to being monitored continuously must immediately indicate “complete” upon the respective monitor(s) being executed fully and determining that the component or system is not malfunctioning. A component or system must also indicate “complete” if, after the requisite number of decisions necessary for determining MIL status has been executed fully, the monitor indicates a malfunction of the component or system. The status for each of the monitored components or systems must indicate “not complete” whenever diagnostic memory has been cleared or erased by a means other than that allowed in paragraph (b) of this section. Normal vehicle shut down (i.e., key-off/engine-off) shall not cause the status to indicate “not complete.”

(A) The manufacturer may request that the ready status for a monitor be set to indicate “complete” without the monitor having completed if monitoring is disabled for a multiple number of drive cycles due to the continued presence of extreme operating conditions (e.g., cold ambient temperatures, high altitudes). Any such request must specify the conditions for monitoring system disablement and the number of drive cycles that would pass without monitor completion before ready status would be indicated as “complete.”

(B) For the evaporative system monitor, the ready status must be set in accordance with this paragraph (k)(4)(i) when both the functional check of the purge valve and, if applicable, the leak detection monitor of the hole size specified in paragraph (h)(7)(ii)(B) of this section indicate that they are complete.

(C) If the manufacturer elects to indicate ready status through the MIL in the key-on/engine-off position as provided for in paragraph (b)(1)(iii) of this section, the ready status must be indicated in the following manner: If the ready status for all monitored components or systems is “complete,” the MIL shall remain continuously activated in the key-on/engine-off position for at least 10-20 seconds. If the ready status for one or more of the monitored components or systems is “not complete,” after at least 5 seconds of operation in the key-on/engine-off position with the MIL activated continuously, the MIL shall blink once per second for 5-10 seconds. The data stream value for MIL status as required in paragraph (k)(4)(ii) of this section must indicate “commanded off” during this sequence unless the MIL has also been “commanded on” for a detected malfunction.

(ii) *Data stream.* For model years 2010 through 2012, the following signals must be made available on demand through the data link connector. For model years 2013

and later, the following signals must be made available on demand through the standardized data link connector in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications. The actual signal value must always be used instead of a limp home value. Data link signals may report an error state or other predefined status indicator if they are defined for those signals in the SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications.

(A) *For gasoline engines.*

(1) Calculated load value, engine coolant temperature, engine speed, vehicle speed, and time elapsed since engine start.

(2) Absolute load, fuel level (if used to enable or disable any other monitors), barometric pressure (directly measured or estimated), engine control module system voltage, and commanded equivalence ratio.

(3) Number of stored MIL-on DTCs, catalyst temperature (if directly measured or estimated for purposes of enabling the catalyst monitor(s)), monitor status (i.e., disabled for the rest of this drive cycle, complete this drive cycle, or not complete this drive cycle) since last engine shut-off for each monitor used for ready status, distance traveled (or engine run time for engines not using vehicle speed information) while MIL activated, distance traveled (or engine run time for engines not using vehicle speed information) since DTC memory last erased, and number of warm-up cycles since DTC memory last erased, OBD requirements to which the engine is certified (e.g., California OBD, EPA OBD, European OBD, non-OBD) and MIL status (i.e., commanded-on or commanded-off).

(B) *For diesel engines.*

(1) Calculated load (engine torque as a percentage of maximum torque available at the current engine speed), driver's demand engine torque (as a percentage of maximum engine torque), actual engine torque (as a percentage of maximum engine torque), reference engine maximum torque, reference maximum engine torque as a function of engine speed (suspect parameter numbers (SPN) 539 through 543 defined by SAE J1939 (as specified in paragraph (k)(1) of this section) within parameter group number (PGN) 65251 for engine configuration), engine coolant temperature, engine oil temperature (if used for emission control or any OBD monitors), engine speed, and time elapsed since engine start.

(2) Fuel level (if used to enable or disable any other monitors), vehicle speed (if used for emission control or any OBD monitors), barometric pressure (directly measured or estimated), and engine control module system voltage.

(3) Number of stored MIL-on DTCs, monitor status (i.e., disabled for the rest of this drive cycle, complete this drive cycle, or not complete this drive cycle) since last engine shut-off for each monitor used for ready status, distance traveled (or engine run time for engines not using vehicle speed information) while MIL activated, distance traveled (or engine run time for engines not using vehicle speed information) since DTC memory last erased, number of warm-up cycles since DTC memory

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last erased, OBD requirements to which the engine is certified (e.g., California OBD, EPA OBD, European OBD, non-OBD), and MIL status (i.e., commanded-on or commanded-off).

(4) NO_x NTE control area status (i.e., inside control area, outside control area, inside manufacturer-specific Data stream, NO_x NTE carve-out area, or deficiency active area) and PM NTE control area status (i.e., inside control area, outside control area, inside manufacturer-specific PM NTE carve-out area, or deficiency active area).

(5) For purposes of the calculated load and torque parameters in paragraph (k)(4)(ii)(B)(1) of this section, manufacturers must report the most accurate values that are calculated within the applicable electronic control unit (e.g., the engine control module). Most accurate, in this context, must be of sufficient accuracy, resolution, and filtering to be used for the purposes of in-use emission testing with the engine still in a vehicle (e.g., using portable emission measurement equipment).

(C) *For all engines so equipped.*

(1) Absolute throttle position, relative throttle position, fuel control system status (e.g., open loop, closed loop), fuel trim, fuel pressure, ignition timing advance, fuel injection timing, intake air/manifold temperature, engine intercooler temperature, manifold absolute pressure, air flow rate from mass air flow sensor, secondary air status (upstream, downstream, or atmosphere), ambient air temperature, commanded purge valve duty cycle/position, commanded EGR valve duty cycle/position, actual EGR valve duty cycle/position, EGR error between actual and commanded, PTO status (active or not active), redundant absolute throttle position (for electronic throttle or other systems that utilize two or more sensors), absolute pedal position, redundant absolute pedal position, commanded throttle motor position, fuel rate, boost pressure, commanded/target boost pressure, turbo inlet air temperature, fuel rail pressure, commanded fuel rail pressure, DPF inlet pressure, DPF inlet temperature, DPF outlet pressure, DPF outlet temperature, DPF delta pressure, exhaust pressure sensor output, exhaust gas temperature sensor output, injection control pressure, commanded injection control pressure, turbocharger/turbine speed, variable geometry turbo position, commanded variable geometry turbo position, turbocharger compressor inlet temperature, turbocharger compressor inlet pressure, turbocharger turbine inlet temperature, turbocharger turbine outlet temperature, waste gate valve position, and glow plug lamp status.

(2) Oxygen sensor output, air/fuel ratio sensor output, NO_x sensor output, and evaporative system vapor pressure.

(iii) *Freeze frame.*

(A) For model years 2010 through 2012, "Freeze frame" information required to be stored pursuant to paragraphs (b)(2)(iv), (h)(1)(iv)(D), and (h)(2)(vi) of this section must be made available on demand through the data link connector. For model years 2013 and later, "Freeze frame" information required to be stored pursuant to paragraphs (b)(2)(iv), (h)(1)(iv)(D), and (h)(2)(vi) of this section must be made available on demand through the standardized data link connector in accordance with SAE J1979 or

SAE J1939-73 (both as specified in paragraph (k)(1) of this section) specifications.

(B) "Freeze frame" conditions must include the DTC that caused the data to be stored along with all of the signals required in paragraphs (k)(4)(ii)(A)(1) and (k)(4)(ii)(B)(1) of this section. Freeze frame conditions must also include all of the signals required on the engine in paragraphs (k)(4)(ii)(A)(2) and (k)(4)(ii)(B)(2) of this section, and paragraph (k)(4)(ii)(C)(1) of this section that are used for diagnostic or control purposes in the specific monitor or emission-critical powertrain control unit that stored the DTC.

(C) Only one frame of data is required to be recorded. For model years 2010 through 2012, the manufacturer may choose to store additional frames provided that at least the required frame can be read by, at a minimum, a manufacturer scan tool. For model years 2013 and later, the manufacturer may choose to store additional frames provided that at least the required frame can be read by a scan tool meeting SAE J1978 (as specified in paragraph (k)(1) of this section) specifications or designed to communicate with an SAE J1939 (as specified in paragraph (k)(1) of this section) network.

(iv) *Diagnostic trouble codes.*

(A) For model years 2010 through 2012, For all monitored components and systems, any stored pending, MIL-on, and previous-MIL-on DTCs must be made available through the diagnostic connector. For model years 2013 and later, all monitored components and systems, any stored pending, MIL-on, and previous-MIL-on DTCs must be made available through the diagnostic connector in a standardized format in accordance with SAE J1939 (as specified in paragraph (k)(1) of this section) or ISO 15765-4:2005(E) (as specified in paragraph (k)(1) of this section) specifications; standardized DTCs conforming to the applicable standardized specifications must be employed.

(B) The stored DTC must, to the extent possible, pinpoint the probable cause of the malfunction or potential malfunction. To the extent feasible, the manufacturer must use separate DTCs for every monitor where the monitor and repair procedure or probable cause of the malfunction is different. In general, rationality and functional checks must use different DTCs than the respective circuit integrity checks. Additionally, to the extent possible, input component circuit integrity checks must use different DTCs for distinct malfunctions (e.g., out-of-range low, out-of-range high, open circuit).

(C) The manufacturer must use appropriate standard-defined DTCs whenever possible. With Administrator approval, the manufacturer may use manufacturer-defined DTCs in accordance with the applicable standard's specifications. To do so, the manufacturer must be able to show a lack of available standard-defined DTCs, uniqueness of the monitor or monitored component, expected future usage of the monitor or component, and estimated usefulness in providing additional diagnostic and repair information to service technicians. Manufacturer-defined DTCs must be used in a consistent manner (i.e., the same DTC shall not be used to represent two different failure modes) across a manufacturer's entire product line.

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(D) For model years 2010 through 2012, a pending or MIL-on DTC (as required in paragraphs (g) through (i) of this section) must be stored and available to, at a minimum, a manufacturer scan tool within 10 seconds after a monitor has determined that a malfunction or potential malfunction has occurred. A permanent DTC must be stored and available to, at a minimum, a manufacturer scan tool no later than the end of an ignition cycle in which the corresponding MIL-on DTC that caused MIL activation has been stored. For model years 2013 and later, a pending or MIL-on DTC (as required in paragraphs (g) through (i) of this section) must be stored and available to an SAE J1978 (as specified in paragraph (k)(1) of this section) or SAE J1939 (as specified in paragraph (k)(1) of this section) scan tool within 10 seconds after a monitor has determined that a malfunction or potential malfunction has occurred. A permanent DTC must be stored and available to an SAE J1978 (as specified in paragraph (k)(1) of this section) or SAE J1939 (as specified in paragraph (k)(1) of this section) scan tool no later than the end of an ignition cycle in which the corresponding MIL-on DTC that caused MIL activation has been stored.

(E) For model years 2010 through 2012, pending DTCs for all components and systems (including those monitored continuously and non-continuously) must be made available through the diagnostic connector. For model years 2013 and later, pending DTCs for all components and systems (including those monitored continuously and non-continuously) must be made available through the diagnostic connector in accordance with the applicable standard's specifications. For all model years, a manufacturer using alternative statistical protocols for MIL activation as allowed in paragraph (b)(2)(iii) of this section must submit the details of their protocol for setting pending DTCs. The protocol must be, overall, equivalent to the requirements of this paragraph (k)(4)(iv)(E) and provide service technicians with a quick and accurate indication of a potential malfunction.

(F) For model years 2010 through 2012, permanent DTC for all components and systems must be made available through the diagnostic connector in a format that distinguishes permanent DTCs from pending DTCs, MIL-on DTCs, and previous-MIL-on DTCs. A MIL-on DTC must be stored as a permanent DTC no later than the end of the ignition cycle and subsequently at all times that the MIL-on DTC is commanding the MIL on. For model years 2013 and later, permanent DTC for all components and systems must be made available through the diagnostic connector in a standardized format that distinguishes permanent DTCs from pending DTCs, MIL-on DTCs, and previous-MIL-on DTCs. A MIL-on DTC must be stored as a permanent DTC no later than the end of the ignition cycle and subsequently at all times that the MIL-on DTC is commanding the MIL on. For all model years, permanent DTCs must be stored in non-volatile random access memory (NVRAM) and shall not be erasable by any scan tool command or by disconnecting power to the on-board computer. Permanent DTCs must be erasable if the engine control module is reprogrammed and the ready status described in paragraph (k)(4)(i) of this section for all monitored components and systems are set to "not complete." The OBD system must

have the ability to store a minimum of four current MIL-on DTCs as permanent DTCs in NVRAM. If the number of MIL-on DTCs currently commanding activation of the MIL exceeds the maximum number of permanent DTCs that can be stored, the OBD system must store the earliest detected MIL-on DTC as permanent DTC. If additional MIL-on DTCs are stored when the maximum number of permanent DTCs is already stored in NVRAM, the OBD system shall not replace any existing permanent DTC with the additional MIL-on DTCs.

(v) *Test results.*

(A) For model years 2010 through 2012 and except as provided for in paragraph (k)(4)(v)(G) of this section, for all monitored components and systems identified in paragraphs (g) and (h) of this section, results of the most recent monitoring of the components and systems and the test limits established for monitoring the respective components and systems must be stored and available through the data link. For model years 2013 and later and except as provided for in paragraph (k)(4)(v)(G) of this section, for all monitored components and systems identified in paragraphs (g) and (h) of this section, results of the most recent monitoring of the components and systems and the test limits established for monitoring the respective components and systems must be stored and available through the data link in accordance with the standardized format specified in SAE J1979 (as specified in paragraph (k)(1) of this section) for engines using the ISO 15765-4:2005(E) (as specified in paragraph (k)(1) of this section) protocol or SAE J1939 (as specified in paragraph (k)(1) of this section).

(B) The test results must be reported such that properly functioning components and systems (e.g., "passing" systems) do not store test values outside of the established test limits. Test limits must include both minimum and maximum acceptable values and must be defined so that a test result equal to either test limit is a "passing" value, not a "failing" value.

(C) For model years 2013 and later, the test results must be standardized such that the name of the monitored component (e.g., catalyst bank 1) can be identified by a generic scan tool and the test results and limits can be scaled and reported by a generic scan tool with the appropriate engineering units.

(D) The test results must be stored until updated by a more recent valid test result or the DTC memory of the OBD system computer is cleared. Upon DTC memory being cleared, test results reported for monitors that have not yet completed with valid test results since the last time the fault memory was cleared must report values of zero for the test result and test limits.

(E) All test results and test limits must always be reported and the test results must be stored until updated by a more recent valid test result or the DTC memory of the OBD system computer is cleared.

(F) The OBD system must store and report unique test results for each separate monitor.

(G) The requirements of this paragraph (k)(4)(v) do not apply to continuous fuel system monitoring, cold start

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emission reduction strategy monitoring, and continuous circuit monitoring.

(vi) *Software calibration identification (CAL ID)*. On all engines, a single software calibration identification number (CAL ID) for each monitor or emission critical control unit(s) must be made available through, for model years 2010 through 2012, the data link connector or, for model years 2013 and later, the standardized data link connector in accordance with the SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications. A unique CAL ID must be used for every emission-related calibration and/or software set having at least one bit of different data from any other emission-related calibration and/or software set. Control units coded with multiple emission or diagnostic calibrations and/or software sets must indicate a unique CAL ID for each variant in a manner that enables an off-board device to determine which variant is being used by the engine. Control units that use a strategy that will result in MIL activation if the incorrect variant is used (e.g., control units that contain variants for manual and automatic transmissions but will activate the MIL if the selected variant does not match the type of transmission mated to the engine) are not required to use unique CAL IDs. Manufacturers may request Administrator approval to respond with more than one CAL ID per diagnostic or emission critical control unit. Administrator approval of the request shall be based on the method used by the manufacturer to ensure each control unit will respond to a scan tool with the CAL IDs in order of highest to lowest priority with regards to areas of the software most critical to emission and OBD system performance.

(vii) *Software calibration verification number (CVN)*.

(A) All engines must use an algorithm to calculate a single calibration verification number (CVN) that verifies the on-board computer software integrity for each monitor or emission critical control unit that is electronically reprogrammable. The CVN must be made available through, for model years 2010 through 2012, the data link connector or, for model years 2013 and later, the standardized data link connector in accordance with the SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications. The CVN must indicate whether the emission-related software and/or calibration data are valid and applicable for the given vehicle and CAL ID. For systems having more than one CAL ID as allowed under paragraph (k)(4)(vi) of this section, one CVN must be made available for each CAL ID and must be output to a scan tool in the same order as the corresponding CAL IDs. For 2010 through 2012, manufacturers may use a default value for the CVN if their emissions critical powertrain control modules are not programmable in the field. For all years, manufacturers may use a default value for the CVN if their emissions critical powertrain control modules are one-time programmable or masked read-only memory. Any default CVN shall be 00000000 for systems designed in accordance with the SAE J1979 (as specified in paragraph (k)(1) of this section) specifications, and FFFFFFFFh for systems designed in accordance with the SAE J1939 (as specified in paragraph (k)(1) of this section) specifications.

(B) The CVN algorithm used to calculate the CVN must be of sufficient complexity that the same CVN is difficult to achieve with modified calibration values.

(C) The CVN must be calculated at least once per ignition cycle and stored until the CVN is subsequently updated. Except for immediately after a reprogramming event or a non-volatile memory clear or for the first 30 seconds of engine operation after a volatile memory clear or battery disconnect, the stored value must be made available through, for model years 2010 through 2012, the data link connector to, at a minimum, a manufacturer scan tool or, for model years 2013 and later, the data link connector to a generic scan tool in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications. For model years 2010 through 2012, the stored CVN value shall not be erased when DTC memory is erased or during normal vehicle shut down (i.e., key-off/engine-off). For model years 2013 and later, the stored CVN value shall not be erased when DTC memory is erased by a generic scan tool in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications or during normal vehicle shut down (i.e., key-off/engine-off).

(D) For model years 2013 and later, the CVN and CAL ID combination information must be available for all engines/vehicles in a standardized electronic format that allows for off-board verification that the CVN is valid and appropriate for a specific vehicle and CAL ID.

(viii) *Vehicle identification number (VIN)*.

(A) For model years 2010 through 2012, all vehicles must have the vehicle identification number (VIN) available through the data link connector to, at a minimum, a manufacturer scan tool. Only one electronic control unit per vehicle may report the VIN to a scan tool. For model years 2013 and later, all vehicles must have the vehicle identification number (VIN) available in a standardized format through the standardized data link connector in accordance with SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications. Only one electronic control unit per vehicle may report the VIN to an SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool.

(B) If the VIN is reprogrammable, all emission-related diagnostic information identified in paragraph (k)(4)(ix)(A) of this section must be erased in conjunction with reprogramming of the VIN.

(ix) *Erasure of diagnostic information*.

(A) For purposes of this paragraph (k)(4)(ix), "emission-related diagnostic information" includes all of the following: ready status as required by paragraph (k)(4)(i) of this section; data stream information as required by paragraph (k)(4)(ii) of this section including the number of stored MIL-on DTCs, distance traveled while MIL activated, number of warm-up cycles since DTC memory last erased, and distance traveled since DTC memory last erased; freeze frame information as required by paragraph (k)(4)(iii) of this section; pending, MIL-on, and previous-MIL-on DTCs as required by paragraph (k)(4)(iv) of this section; and, test results as required by paragraph (k)(4)(v) of this section.

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(B) For all engines, the emission-related diagnostic information must be erased if commanded by any scan tool and may be erased if the power to the on-board computer is disconnected. If any of the emission-related diagnostic information is commanded to be erased by any scan tool, all emission-related diagnostic information must be erased from all diagnostic or emission critical control units. The OBD system shall not allow a scan tool to erase a subset of the emission-related diagnostic information (e.g., the OBD system shall not allow a scan tool to erase only one of three stored DTCs or only information from one control unit without erasing information from the other control unit(s)).

(5) In-use performance ratio tracking requirements.

(i) For each monitor required in paragraphs (g) through (i) of this section to separately report an in-use performance ratio, manufacturers must implement software algorithms to, for model years 2010 through 2012, report a numerator and denominator or, for model years 2013 and later, report a numerator and denominator in the standardized format specified in this paragraph (k)(5) in accordance with the SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications.

(ii) For the numerator, denominator, general denominator, and ignition cycle counters required by paragraph (e) of this section, the following numerical value specifications apply:

(A) Each number shall have a minimum value of zero and a maximum value of 65,535 with a resolution of one.

(B) Each number shall be reset to zero only when a non-volatile random access memory (NVRAM) reset occurs (e.g., reprogramming event) or, if the numbers are stored in keep-alive memory (KAM), when KAM is lost due to an interruption in electrical power to the control unit (e.g., battery disconnect). Numbers shall not be reset to zero under any other circumstances including when a scan tool command to clear DTCs or reset KAM is received.

(C) To avoid overflow problems, if either the numerator or denominator for a specific component reaches the maximum value of 65,535 ± 2 , both numbers shall be divided by two before either is incremented again.

(D) To avoid overflow problems, if the ignition cycle counter reaches the maximum value of 65,535 ± 2 , the ignition cycle counter shall rollover and increment to zero on the next ignition cycle.

(E) To avoid overflow problems, if the general denominator reaches the maximum value of 65,535 ± 2 , the general denominator shall rollover and increment to zero on the next drive cycle that meets the general denominator definition.

(F) If a vehicle is not equipped with a component (e.g., oxygen sensor bank 2, secondary air system), the corresponding numerator and denominator for that specific component shall always be reported as zero.

(iii) For the ratio required by paragraph (e) of this section, the following numerical value specifications apply:

(A) The ratio shall have a minimum value of zero and a maximum value of 7.99527 with a resolution of 0.000122.

(B) The ratio for a specific component shall be considered to be zero whenever the corresponding numerator is equal to zero and the corresponding denominator is not zero.

(C) The ratio for a specific component shall be considered to be the maximum value of 7.99527 if the corresponding denominator is zero or if the actual value of the numerator divided by the denominator exceeds the maximum value of 7.99527.

(6) Engine run time tracking requirements.

(i) For all gasoline and diesel engines, the manufacturer must implement software algorithms to, for model years 2010 through 2012, track and report individually or, for model years 2013 and later, track and report individually in a standardized format the amount of time the engine has been operated in the following conditions:

(A) Total engine run time.

(B) Total idle run time (with "idle" defined as accelerator pedal released by the driver, engine speed less than or equal to 200 rpm above normal warmed-up idle (as determined in the drive position for vehicles equipped with an automatic transmission) or vehicle speed less than or equal to one mile per hour, and power take-off not active).

(C) Total run time with power take off active.

(ii) For each counter specified in paragraph (k)(6)(i) of this section, the following numerical value specifications apply:

(A) Each number shall be a four-byte value with a minimum value of zero, a resolution of one second per bit, and an accuracy of $\pm$ ten seconds per drive cycle.

(B) Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event). Numbers shall not be reset to zero under any other circumstances including when a scan tool (generic or enhanced) command to clear fault codes or reset KAM is received.

(C) To avoid overflow problems, if any of the individual counters reach the maximum value, all counters shall be divided by two before any are incremented again.

(D) For model years 2010 through 2012, the counters shall be made available to, at a minimum, a manufacturer scan tool and may be rescaled when transmitted from a resolution of one second per bit to no more than three minutes per bit. For model years 2013 and later, the counters shall be made available to a generic scan tool in accordance with the SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section) specifications and may be rescaled when transmitted, if required by the SAE specifications, from a resolution of one second per bit to no more than three minutes per bit.

(7) For 2019 and subsequent model year alternative-fueled engines derived from a diesel-cycle engine, a manufacturer may meet the standardization requirements of paragraph (k) of this section that are applicable to diesel engines rather than the requirements applicable to gasoline engines.

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(1) **Monitoring system demonstration requirements for certification.**

(1) *General.*

(i) The manufacturer must submit emissions test data from one or more durability demonstration test engines (test engines).

(ii) The Administrator may approve other demonstration protocols if the manufacturer can provide comparable assurance that the malfunction criteria are chosen based on meeting the malfunction criteria requirements and that the timeliness of malfunction detection is within the constraints of the applicable monitoring requirements.

(iii) For flexible fuel engines capable of operating on more than one fuel or fuel combinations, the manufacturer must submit a plan for providing emission test data. The plan must demonstrate that testing will represent properly the expected in-use fuel or fuel combinations.

(2) *Selection of test engines.*

(i) Prior to submitting any applications for certification for a model year, the manufacturer must notify the Administrator regarding the planned engine families and engine ratings within each family for that model year. The Administrator will select the engine family(ies) and the specific engine rating within the engine family(ies) that the manufacturer shall use as demonstration test engines. The selection of test vehicles for production evaluation testing as specified in paragraph (j)(2) of this section may take place during this selection process.

(ii) *For model years 2010 through 2012.* The manufacturer must provide emissions test data from the OBD parent rating as defined in paragraph (o)(1) of this section.

(iii) *For model years 2013 and later.*

(A) A manufacturer certifying one to five engine families in a given model year must provide emissions test data for a single test engine from one engine rating. A manufacturer certifying six to ten engine families in a given model year must provide emissions test data for a single test engine from two different engine ratings. A manufacturer certifying eleven or more engine families in a given model year must provide emissions test data for a single test engine from three different engine ratings. A manufacturer may forego submittal of test data for one or more of these test engines if data have been submitted previously for all of the engine ratings and/or if all requirements for certification carry-over from one model year to the next are satisfied.

(B) For a given model year, a manufacturer may elect to provide emissions data for test engines from more engine ratings than required by paragraph (1)(2)(iii)(A) of this section. For each additional engine rating tested in that given model year, the number of engine ratings required for testing in one future model year will be reduced by one.

(iv) For the test engine, the manufacturer must use an engine (excluding aftertreatment devices) aged for a minimum of 125 hours fitted with exhaust aftertreatment emission controls aged to be representative of useful life aging. In the event that an accelerated aging procedure

is used, the manufacturer is required to submit a description of the accelerated aging process and/or supporting data or use the accelerated aging procedure used for emission certification deterioration factor generation. The process and/or data must demonstrate that deterioration of the exhaust aftertreatment emission controls is stabilized sufficiently such that it represents emission control performance at the end of the useful life.

(3) *Required testing.* Except as otherwise described in this paragraph (1)(3), the manufacturer must perform single malfunction testing based on the applicable test with the components/ systems set at their malfunction criteria limits as determined by the manufacturer for meeting the emissions thresholds required in paragraphs (g), (h), and (i) of this section.

(i) *Required testing for diesel-fueled /compression ignition engines.*

(A) *Fuel system.* The manufacturer must perform a separate test for each malfunction limit established by the manufacturer for the fuel system parameters (e.g., fuel pressure, injection timing) specified in paragraphs (g)(1)(ii)(A) through (g)(1)(ii)(C) and/or (g)(1)(ii)(D) of this section, if applicable, of this section. When performing a test for a specific parameter, the fuel system must be operating at the malfunction criteria limit for the applicable parameter only. All other parameters must be operating with normal characteristics. In conducting the fuel system demonstration tests, the manufacturer may use computer modifications to cause the fuel system to operate at the malfunction limit if the manufacturer can demonstrate that the computer modifications produce test results equivalent to an induced hardware malfunction.

(B) *Engine misfire.* For model years 2013 and later, the manufacturer must perform a test at the malfunction limit established by the manufacturer for the monitoring required by paragraph (g)(2)(ii)(B) of this section.

(C) *EGR system.* The manufacturer must perform a separate test for each malfunction limit established by the manufacturer for the EGR system parameters (e.g., low flow, high flow, slow response) specified in paragraphs (g)(3)(ii)(A) through (g)(3)(ii)(C) and in (g)(3)(ii)(E) of this section. In conducting the EGR system slow response demonstration tests, the manufacturer may use computer modifications to cause the EGR system to operate at the malfunction limit if the manufacturer can demonstrate that the computer modifications produce test results equivalent to an induced hardware malfunction.

(D) *Turbo boost control system.* The manufacturer must perform a separate test for each malfunction limit established by the manufacturer for the turbo boost control system parameters (e.g., underboost, overboost, response) specified in paragraphs (g)(4)(ii)(A) through (g)(4)(ii)(C) and in (g)(4)(ii)(E) of this section.

(E) *NMHC catalyst.* The manufacturer must perform a separate test for each monitored NMHC catalyst(s). The catalyst(s) being evaluated must be deteriorated to the applicable malfunction limit established by the manufacturer for the monitoring required by paragraph (g)(5)(ii)(A) of this section and using methods established by the manufacturer in accordance with paragraph (1)(7) of this section. For each monitored NMHC catalyst(s),

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the manufacturer must also demonstrate that the OBD system will detect a catalyst malfunction with the catalyst at its maximum level of deterioration (i.e., the substrate(s) completely removed from the catalyst container or “empty” can). Emissions data are not required for the empty can demonstration.

(F) NO_x catalyst. The manufacturer must perform a separate test for each monitored NO_x catalyst(s) (e.g., SCR catalyst). The catalyst(s) being evaluated must be deteriorated to the applicable malfunction criteria established by the manufacturer for the monitoring required by paragraphs (g)(6)(ii)(A) and (g)(6)(ii)(B) of this section and using methods established by the manufacturer in accordance with paragraph (1)(7) of this section. For each monitored NO_x catalyst(s), the manufacturer must also demonstrate that the OBD system will detect a catalyst malfunction with the catalyst at its maximum level of deterioration (i.e., the substrate(s) completely removed from the catalyst container or “empty” can). Emissions data are not required for the empty can demonstration.

(G) NO_x adsorber. The manufacturer must perform a test using a NO_x adsorber(s) deteriorated to the applicable malfunction limit established by the manufacturer for the monitoring required by paragraph (g)(7)(ii)(A) of this section. The manufacturer must also demonstrate that the OBD system will detect a NO_x adsorber malfunction with the NO_x adsorber at its maximum level of deterioration (i.e., the substrate(s) completely removed from the container or “empty” can). Emissions data are not required for the empty can demonstration.

(H) Diesel particulate filter. The manufacturer must perform a separate test using a DPF deteriorated to the applicable malfunction limits established by the manufacturer for the monitoring required by paragraph (g)(8)(ii)(A) and (g)(8)(ii)(B) of this section. For systems using the optional DPF monitoring provision of paragraph (g)(8)(ii)(A) of this section, the manufacturer must perform a separate test using a DPF modified in a manner approved by the Administrator (e.g., drilling of wallflow channel end plugs, drilling of through holes, etc.) and testing at each of the nine test points specified in paragraph (g)(8)(ii)(A) of this section. The manufacturer must also demonstrate that the OBD system will detect a DPF malfunction with the DPF at its maximum level of deterioration (i.e., the filter(s) completely removed from the filter container or “empty” can). Emissions data are not required for the empty can demonstration.

(I) *Exhaust gas sensor*. The manufacturer must perform a separate test for each malfunction limit established by the manufacturer for the monitoring required in paragraphs (g)(9)(ii)(A), (g)(9)(iii)(A), and (g)(9)(iv)(A) of this section. When performing a test, all exhaust gas sensors used for the same purpose (e.g., for the same feedback control loop, for the same control feature on parallel exhaust banks) must be operating at the malfunction criteria limit for the applicable parameter only. All other exhaust gas sensor parameters must be operating with normal characteristics.

(J) *VVT system*. The manufacturer must perform a separate test for each malfunction limit established by the manufacturer for the monitoring required in paragraphs (g)(10)(ii)(A) and (g)(10)(ii)(B) of this section. In

conducting the VVT system demonstration tests, the manufacturer may use computer modifications to cause the VVT system to operate at the malfunction limit if the manufacturer can demonstrate that the computer modifications produce test results equivalent to an induced hardware malfunction.

(K) For each of the testing requirements of this paragraph (1)(3)(i) of this section, if the manufacturer has established that only a functional check is required because no failure or deterioration of the specific tested system could result in an engine's emissions exceeding the applicable emissions thresholds, the manufacturer is not required to perform a demonstration test; however, the manufacturer is required to provide the data and/or engineering analysis used to determine that only a functional test of the system(s) is required.

(ii) *Required testing for gasoline-fueled / spark-ignition engines*.

(A) *Fuel system*. For engines with adaptive feedback based on the primary fuel control sensor(s), the manufacturer must perform a test with the adaptive feedback based on the primary fuel control sensor(s) at the rich limit(s) and a test at the lean limit(s) established by the manufacturer as required by paragraph (h)(1)(ii)(A) of this section to detect a malfunction before emissions exceed applicable emissions thresholds. For engines with feedback based on a secondary fuel control sensor(s) and subject to the malfunction criteria in paragraph (h)(1)(ii)(A) of this section, the manufacturer must perform a test with the feedback based on the secondary fuel control sensor(s) at the rich limit(s) and a test at the lean limit(s) established by the manufacturer as required by paragraph (h)(1)(ii)(A) of this section to detect a malfunction before emissions exceed the applicable emissions thresholds. For other fuel metering or control systems, the manufacturer must perform a test at the criteria limit(s). For purposes of fuel system testing as required by this paragraph (1)(3)(ii)(A), the malfunction(s) induced may result in a uniform distribution of fuel and air among the cylinders. Non uniform distribution of fuel and air used to induce a malfunction shall not cause misfire. In conducting the fuel system demonstration tests, the manufacturer may use computer modifications to cause the fuel system to operate at the malfunction limit. To do so, the manufacturer must be able to demonstrate that the computer modifications produce test results equivalent to an induced hardware malfunction.

(B) *Misfire*. The manufacturer must perform a test at the malfunction criteria limit specified in paragraph (h)(2)(ii)(B) of this section.

(C) *EGR system*. The manufacturer must perform a test at each flow limit calibrated to the malfunction criteria specified in paragraphs (h)(3)(ii)(A) and (h)(3)(ii)(B) of this section.

(D) *Cold start emission reduction strategy*. The manufacturer must perform a test at the malfunction criteria for each component monitored according to paragraph (h)(4)(ii)(A) of this section.

(E) *Secondary air system*. The manufacturer must perform a test at each flow limit calibrated to the malfunction criteria specified in paragraphs (h)(5)(ii)(A) and (h)(5)(ii)(B) of this section.

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(F) *Catalyst*. The manufacturer must perform a test using a catalyst system deteriorated to the malfunction criteria specified in paragraph (h)(6)(ii) of this section using methods established by the manufacturer in accordance with paragraph (l)(7)(ii) of this section. The manufacturer must also demonstrate that the OBD system will detect a catalyst system malfunction with the catalyst system at its maximum level of deterioration (i.e., the substrate(s) completely removed from the catalyst container or “empty” can). Emission data are not required for the empty can demonstration.

(G) *Exhaust gas sensor*. The manufacturer must perform a test with all primary exhaust gas sensors used for fuel control simultaneously possessing a response rate deteriorated to the malfunction criteria limit specified in paragraph (h)(8)(ii)(A) of this section. The manufacturer must also perform a test for any other primary or secondary exhaust gas sensor parameter under paragraphs (h)(8)(ii)(A) and (h)(8)(iii)(A) of this section that can cause engine emissions to exceed the applicable emissions thresholds (e.g., shift in air/fuel ratio at which oxygen sensor switches, decreased amplitude). When performing additional test(s), all primary and secondary (if applicable) exhaust gas sensors used for emission control must be operating at the malfunction criteria limit for the applicable parameter only. All other primary and secondary exhaust gas sensor parameters must be operating with normal characteristics.

(H) *VVT system*. The manufacturer must perform a test at each target error limit and slow response limit calibrated to the malfunction criteria specified in paragraphs (h)(9)(ii)(A) and (h)(9)(ii)(B) of this section. In conducting the VVT system demonstration tests, the manufacturer may use computer modifications to cause the VVT system to operate at the malfunction limit. To do so, the manufacturer must be able to demonstrate that the computer modifications produce test results equivalent to an induced hardware malfunction.

(I) For each of the testing requirements of this paragraph (l)(3)(ii), if the manufacturer has established that only a functional check is required because no failure or deterioration of the specific tested system could cause an engine's emissions to exceed the applicable emissions thresholds, the manufacturer is not required to perform a demonstration test; however the manufacturer is required to provide the data and/or engineering analyses used to determine that only a functional test of the system(s) is required.

(iii) *Required testing for all engines*.

(A) Other emission control systems. The manufacturer must conduct demonstration tests for all other emission control components (e.g., hydrocarbon traps, adsorbers) designed and calibrated to a malfunction limit based on an emissions threshold based on the requirements of paragraph (i)(4) of this section.

(B) For each of the testing requirements of paragraph (l)(3)(iii)(A) of this section, if the manufacturer has established that only a functional check is required because no failure or deterioration of the specific tested system could result in an engine's emissions exceeding the applicable emissions thresholds, the manufacturer is not required to perform a demonstration test; however, the

manufacturer is required to provide the data and/or engineering analysis used to determine that only a functional test of the system(s) is required.

(iv) The manufacturer may electronically simulate deteriorated components but shall not make any engine control unit modifications when performing demonstration tests unless approved by the Administrator. All equipment necessary to duplicate the demonstration test must be made available to the Administrator upon request.

(4) *Testing protocol*.

(i) *Preconditioning*. The manufacturer must use an applicable cycle for preconditioning test engines prior to conducting each of the emission tests required by paragraph (l)(3) of this section. The manufacturer may perform a single additional preconditioning cycle, identical to the initial one, after a 20-minute hot soak but must demonstrate that such an additional cycle is necessary to stabilize the emissions control system. A practice of requiring a cold soak prior to conducting preconditioning cycles is not permitted.

(ii) *Test sequence*.

(A) The manufacturer must set individually each system or component on the test engine at the malfunction criteria limit prior to conducting the applicable preconditioning cycle(s). If a second preconditioning cycle is permitted in accordance with paragraph (l)(4)(i) of this section, the manufacturer may adjust the system or component to be tested before conducting the second preconditioning cycle. The manufacturer shall not replace, modify, or adjust the system or component after the last preconditioning cycle has been completed.

(B) After preconditioning, the test engine must be operated over the applicable cycle to allow for the initial detection of the tested system or component malfunction. This test cycle may be omitted from the testing protocol if it is unnecessary. If required by the monitoring strategy being tested, a cold soak may be performed prior to conducting this test cycle.

(C) The test engine must then be operated over the applicable exhaust emissions test.

(iii) A manufacturer required to test more than one test engine according to paragraph (l)(2)(iii) of this section may use internal calibration sign-off test procedures (e.g., forced cool downs, less frequently calibrated emission analyzers) instead of official test procedures to obtain the emission test data required by this paragraph (l) of this section for all but one of the required test engines. The manufacturer may elect this option if the data from the alternative test procedure are representative of official emissions test results. A manufacturer using this option is still responsible for meeting the malfunction criteria specified in paragraphs (g) through (i) of this section if and when emissions tests are performed in accordance with official test procedures.

(iv) The manufacturer may request approval to use an alternative testing protocol for demonstration of MIL activation if the engine dynamometer emission test cycle does not allow all of a given monitor's enable conditions to be satisfied. The manufacturer may request the use of an alternative engine dynamometer test cycle or the use

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of chassis testing to demonstrate proper MIL activation. To do so, the manufacturer must demonstrate the technical necessity for using an alternative test cycle and the degree to which the alternative test cycle demonstrates that in-use operation with the malfunctioning component will result in proper MIL activation.

(5) *Evaluation protocol.* Full OBD engine ratings, as defined by paragraph (o)(1) of this section, shall be evaluated according to the following protocol:

(i) For all tests conducted as required by paragraph (1) of this section, the MIL must activate before the end of the first engine start portion of the applicable test.

(ii) If the MIL activates prior to emissions exceeding the applicable malfunction criteria limits specified in paragraphs (g) through (i), no further demonstration is required. With respect to the misfire monitor demonstration test, if the manufacturer has elected to use the minimum misfire malfunction criteria of one percent as allowed in paragraphs (g)(2)(ii)(B), if applicable, and (h)(2)(ii)(B) of this section, no further demonstration is required provided the MIL activates with engine misfire occurring at the malfunction criteria limit.

(iii) If the MIL does not activate when the system or component is set at its malfunction criteria limit(s), the criteria limit(s) or the OBD system is not acceptable.

(A) Except for testing of the catalyst or DPF system, if the MIL first activates after emissions exceed the applicable malfunction criteria specified in paragraphs (g) through (i) of this section, the test engine shall be retested with the tested system or component adjusted so that the MIL will activate before emissions exceed the applicable malfunction criteria specified in paragraphs (g) through (i) of this section. If the component cannot be so adjusted because an alternative fuel or emission control strategy is used when a malfunction is detected (e.g., open loop fuel control used after an oxygen sensor malfunction is detected), the test engine shall be retested with the component adjusted to the worst acceptable limit (i.e., the applicable OBD monitor indicates that the component is performing at or slightly better than the malfunction criteria limit). When tested with the component so adjusted, the MIL must not activate during the test and the engine emissions must be below the applicable malfunction criteria specified in paragraphs (g) through (i) of this section.

(B) In testing the catalyst or DPF system, if the MIL first activates after emissions exceed the applicable emissions threshold(s) specified in paragraphs (g) and (h), the tested engine shall be retested with a less deteriorated catalyst or DPF system (i.e., more of the applicable engine out pollutants are converted or trapped). For the OBD system to be approved, testing shall be continued until the MIL activates with emissions below the applicable thresholds of paragraphs (g) and (h) of this section, or the MIL activates with emissions within a range no more than 20 percent below the applicable emissions thresholds and 10 percent or less above those emissions thresholds.

(iv) If an OBD system is determined to be unacceptable by the criteria of this paragraph (1)(5) of this section, the manufacturer may recalibrate and retest the system on the same test engine. In such a case, the manufac-

turer must confirm, by retesting, that all systems and components that were tested prior to the recalibration and are affected by it still function properly with the recalibrated OBD system.

(6) *Confirmatory testing.*

(i) The Administrator may perform confirmatory testing to verify the emission test data submitted by the manufacturer as required by this paragraph (1) of this section comply with its requirements and the malfunction criteria set forth in paragraphs (g) through (i) of this section. Such confirmatory testing is limited to the test engine(s) required by paragraph (1)(2) of this section.

(ii) To conduct this confirmatory testing, the Administrator may install appropriately deteriorated or malfunctioning components (or simulate them) in an otherwise properly functioning test engine of an engine rating represented by the demonstration test engine in order to test any of the components or systems required to be tested by paragraph (1) of this section. The manufacturer shall make available, if requested, an engine and all test equipment (e.g., malfunction simulators, deteriorated components) necessary to duplicate the manufacturer's testing. Such a request from the Administrator shall occur within six months of reviewing and approving the demonstration test engine data submitted by the manufacturer for the specific engine rating.

(7) *Catalyst aging.*

(i) *Diesel catalysts.* For purposes of determining the catalyst malfunction limits for the monitoring required by paragraphs (g)(5)(ii)(A), (g)(5)(ii)(B), and (g)(6)(ii)(A) of this section, where those catalysts are monitored individually, the manufacturer must use a catalyst deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning engine operating conditions. For purposes of determining the catalyst malfunction limits for the monitoring required by paragraphs (g)(5)(ii)(A), (g)(5)(ii)(B), and (g)(6)(ii)(A) of this section, where those catalysts are monitored in combination with other catalysts, the manufacturer must submit their catalyst system aging and monitoring plan to the Administrator as part of their certification documentation package. The plan must include the description, emission control purpose, and location of each component, the monitoring strategy for each component and/or combination of components, and the method for determining the applicable malfunction criteria including the deterioration/aging process.

(ii) *Gasoline catalysts.* For the purposes of determining the catalyst system malfunction criteria in paragraph (h)(6)(ii) of this section, the manufacturer must use a catalyst system deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning operating conditions. The malfunction criteria must be established by using a catalyst system with all monitored and unmonitored (downstream of the sensor utilized for catalyst monitoring) catalysts simultaneously deteriorated to the malfunction criteria except for those engines that use fuel shutoff to prevent over-fueling during engine misfire conditions. For such engines, the malfunction criteria must be established by

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using a catalyst system with all monitored catalysts simultaneously deteriorated to the malfunction criteria while unmonitored catalysts shall be deteriorated to the end of the engine's useful life.

(m) Certification documentation requirements.

(1) When submitting an application for certification of an engine, the manufacturer must submit the following documentation. If any of the items listed here are standardized for all of the manufacturer's engines, the manufacturer may, for each model year, submit one set of documents covering the standardized items for all of its engines.

(i) For the required documentation that is not standardized across all engines, the manufacturer may be allowed to submit documentation for certification from one engine that is representative of other engines. All such engines shall be considered to be part of an OBD certification documentation group. To represent the OBD group, the chosen engine must be certified to the most stringent emissions standards and OBD monitoring requirements and cover all of the emissions control devices for the engines in the group and covered by the submitted documentation. Such OBD groups must be approved in advance of certification.

(ii) Upon approval, one or more of the documentation requirements of this paragraph (m) of this section may be waived or modified if the information required is redundant or unnecessarily burdensome to generate.

(iii) To the extent possible, the certification documentation must use SAE J1930 (as specified in paragraph (k)(1) of this section) or SAE J2403 (as specified in paragraph (k)(1) of this section) terms, abbreviations, and acronyms as specified in paragraph (k)(1) of this section.

(2) Unless otherwise specified, the following information must be submitted as part of the certification application and prior to receiving a certificate.

(i) A description of the functional operation of the OBD system including a complete written description for each monitoring strategy that outlines every step in the decision-making process of the monitor. Algorithms, diagrams, samples of data, and/or other graphical representations of the monitoring strategy shall be included where necessary to adequately describe the information.

(ii) A table including the following information for each monitored component or system (either computer-sensed or computer-controlled) of the emissions control system:

- (A) Corresponding diagnostic trouble code.
- (B) Monitoring method or procedure for malfunction detection.
- (C) Primary malfunction detection parameter and its type of output signal.
- (D) Malfunction criteria limits used to evaluate output signal of primary parameter.
- (E) Other monitored secondary parameters and conditions (in engineering units) necessary for malfunction detection.
- (F) Monitoring time length and frequency of monitoring events.
- (G) Criteria for storing a diagnostic trouble code.

(H) Criteria for activating a malfunction indicator light.

(I) Criteria used for determining out-of-range values and input component rationality checks.

(iii) Whenever possible, the table required by paragraph (m)(2)(ii) of this section shall use the following engineering units:

- (A) Degrees Celsius for all temperature criteria.
- (B) KiloPascals (KPa) for all pressure criteria related to manifold or atmospheric pressure.
- (C) Grams (g) for all intake air mass criteria.
- (D) Pascals (Pa) for all pressure criteria related to evaporative system vapor pressure.
- (E) Miles per hour (mph) for all vehicle speed criteria.
- (F) Relative percent (%) for all relative throttle position criteria (as defined in SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section)).
- (G) Voltage (V) for all absolute throttle position criteria (as defined in SAE J1979 or SAE J1939 (both as specified in paragraph (k)(1) of this section)).
- (H) Per crankshaft revolution (/rev) for all changes per ignition event based criteria (e.g., g/rev instead of g/stroke or g/firing).
- (I) Per second (/sec) for all changes per time based criteria (e.g., g/sec).
- (J) Percent of nominal tank volume (%) for all fuel tank level criteria.

(iv) A logic flowchart describing the step-by-step evaluation of the enable criteria and malfunction criteria for each monitored emission related component or system.

(v) Emissions test data, a description of the testing sequence (e.g., the number and types of preconditioning cycles), approximate time (in seconds) of MIL activation during the test, diagnostic trouble code(s) and freeze frame information stored at the time of detection, corresponding test results (e.g. SAE J1979 (as specified in paragraph (k)(1) of this section) Mode/Service \$06, SAE J1939 (as specified in paragraph (k)(1) of this section) Diagnostic Message 8 (DM8)) stored during the test, and a description of the modified or deteriorated components used for malfunction simulation with respect to the demonstration tests specified in paragraph (l) of this section. The freeze frame data are not required for engines termed "Extrapolated OBD" engines.

(vi) For gasoline engines, data supporting the misfire monitor, including:

(A) The established percentage of misfire that can be tolerated without damaging the catalyst over the full range of engine speed and load conditions.

(B) Data demonstrating the probability of detection of misfire events by the misfire monitoring system over the full engine speed and load operating range for the following misfire patterns: random cylinders misfiring at the malfunction criteria established in paragraph (h)(2)(ii)(B) of this section, one cylinder continuously misfiring, and paired cylinders continuously misfiring.

(C) Data identifying all disablement of misfire monitoring that occurs during the FTP. For every disablement that occurs during the cycles, the data shall identify: when the disablement occurred relative to the driver's

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trace, the number of engine revolutions during which each disablement was present, and which disable condition documented in the certification application caused the disablement.

(D) Manufacturers are not required to use the durability demonstration engine to collect the misfire data required by paragraph (m)(2)(vi) of this section.

(vii) Data supporting the limit for the time between engine starting and attaining the designated heating temperature for after-start heated catalyst systems.

(viii) Data supporting the criteria used to detect a malfunction of the fuel system, EGR system, boost pressure control system, catalyst, NO_x adsorber, DPF, cold start emission reduction strategy, secondary air, evaporative system, VVT system, exhaust gas sensors, and other emission controls that causes emissions to exceed the applicable malfunction criteria specified in paragraphs (g) through (i) of this section. For diesel engine monitors required by paragraphs (g) and (i) of this section that are required to indicate a malfunction before emissions exceed an emission threshold based on any applicable standard (e.g., 2.5 times any of the applicable standards), the test cycle and standard determined by the manufacturer to be the most stringent for each applicable monitor in accordance with paragraph (f)(1) of this section.

(ix) A list of all electronic powertrain input and output signals (including those not monitored by the OBD system) that identifies which signals are monitored by the OBD system. For input and output signals that are monitored as comprehensive components, the listing shall also identify the specific diagnostic trouble code for each malfunction criteria (e.g., out-of-range low, out-of-range high, open circuit, rationality low, rationality high).

(x) A written description of all parameters and conditions necessary to begin closed-loop/feedback control of emission control systems (e.g., fuel system, boost pressure, EGR flow, SCR reductant delivery, DPF regeneration, fuel system pressure).

(xi) A written identification of the communication protocol utilized by each engine for communication with a scan tool (model years 2010 through 2012) or an SAE J1978 or SAE J1939 (both as specified in paragraph (k)(1) of this section) scan tool (model years 2013 and later).

(xii) For model years 2013 and later, a pictorial representation or written description of the diagnostic connector location including any covers or labels.

(xiii) A written description of the method used by the manufacturer to meet the requirements of paragraph (i)(2) of this section (crankcase ventilation system monitoring) including diagrams or pictures of valve and/or hose connections.

(xiv) Build specifications provided to engine purchasers or chassis manufacturers detailing all specifications or limitations imposed on the engine purchaser relevant to OBD requirements or emissions compliance (e.g., cooling system heat rejection rates, allowable MIL locations, connector location specifications). A description of the method or copies of agreements used to ensure engine purchasers or chassis manufacturers will comply with the OBD and emissions relevant build specifications (e.g.,

signed agreements, required audit/evaluation procedures).

(xv) Any other information determined by the Administrator to be necessary to demonstrate compliance with the requirements of this section.

(3) In addition to the documentation required by paragraphs (m)(1) and (m)(2) of this section, a manufacturer making use of paragraph (a)(5) of this section must submit the following information with their application for certification.

(i) A detailed description of how the OBD system meets the intent of §86.010-18.

(ii) A detailed description of why the manufacturer has chosen not to design the OBD system to meet the requirements of §86.010-18 and has instead designed the OBD system to meet the applicable California OBD requirements.

(iii) A detailed description of any deficiencies granted by the California staff and any concerns raised by California staff. A copy of a California Executive Order alone will not be considered acceptable toward meeting this requirement. This description shall also include, to the extent feasible, a plan with timelines for resolving deficiencies and/or concerns.

(n) Deficiencies.

(1) Upon application by the manufacturer, the Administrator may accept an OBD system as compliant even though specific requirements are not fully met. Such compliances without meeting specific requirements, or deficiencies, will be granted only if compliance is infeasible or unreasonable considering such factors as, but not limited to: Technical feasibility of the given monitor and lead time and production cycles including phase-in or phase-out of engines or vehicle designs and programmed upgrades of computers. Unmet requirements shall not be carried over from the previous model year except where unreasonable hardware or software modifications are necessary to correct the deficiency, and the manufacturer has demonstrated an acceptable level of effort toward compliance as determined by the Administrator. Furthermore, EPA will not accept any deficiency requests that include the complete lack of a major diagnostic monitor ("major" diagnostic monitors being those for exhaust aftertreatment devices, oxygen sensor, air-fuel ratio sensor, NO_x sensor, engine misfire, evaporative leaks, and diesel EGR, if equipped), with the possible exception of the special provisions for alternative fueled engines. For alternative fueled heavy-duty engines (e.g., natural gas, liquefied petroleum gas, methanol, ethanol), manufacturers may request the Administrator to waive specific monitoring requirements of this section for which monitoring may not be reliable with respect to the use of the alternative fuel. At a minimum, alternative fuel engines must be equipped with an OBD system meeting OBD requirements to the extent feasible as approved by the Administrator.

(2) In the event the manufacturer seeks to carry-over a deficiency from a past model year to the current model year, the manufacturer must re-apply for approval to do so. In considering the request to carry-over a deficiency,

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the Administrator shall consider the manufacturer's progress towards correcting the deficiency. The Administrator may not allow manufacturers to carry over monitoring system deficiencies for more than two model years unless it can be demonstrated that substantial engine hardware modifications and additional lead time beyond two years are necessary to correct the deficiency.

(3) A deficiency shall not be granted retroactively (i.e., after the engine has been certified).

(o) **Implementation schedule.** Except as specifically provided for in this paragraph (o) for small volume manufacturers and alternative fueled engines, the requirements of this section must be met according to the following provisions:

(1) *For model years 2010 through 2012.*

(i) *Full OBD.* The manufacturer must implement an OBD system meeting the applicable requirements of §86.010-18 on one engine rating within one engine family of the manufacturer's product line. This "Full OBD" rating will be known as the "OBD parent" rating. The OBD parent rating must be chosen, unless otherwise approved by the Administrator, as the rating having the highest weighted projected U.S. sales within the engine family having the highest weighted projected U.S. sales, with U.S. sales being weighted by the useful life of the engine rating.

(ii) *Extrapolated OBD.* For all other engine ratings within the engine family from which the OBD parent rating has been selected, the manufacturer must implement an OBD system meeting the applicable requirements of §86.010-18 except that the OBD system is not required to detect a malfunction prior to exceeding the emission thresholds shown in Table 1 of paragraph (g) and Table 2 of paragraph (h) of this section. These "Extrapolated OBD" engines will be known as the "OBD child" ratings. On these OBD child ratings, rather than detecting a malfunction prior to exceeding the emission thresholds, the manufacturer must submit a plan for Administrator review and approval that details the engineering evaluation the manufacturer will use to establish the malfunction criteria for the OBD child ratings. The plan must demonstrate both the use of good engineering judgment in establishing the malfunction criteria, and robust detection of malfunctions, including consideration of differences of base engine, calibration, emission control components, and emission control strategies.

(iii) Engine families other than those from which the parent and child ratings have been selected, are not subject to the requirements of this section.

(iv) Small volume manufacturers, as defined in §86.094-14(b)(1) and (2) and as determined using 2010 model year sales, are exempt from the requirements of this §86.010-18, unless model year 2011 or model year 2012 sales exceed 20,000 units.

(v) Engines certified as alternative fueled engines are exempt from the requirements of this §86.010-18.

(2) *For model years 2013 through 2015.*

(i) *OBD groups.* The manufacturer shall define one or more OBD groups to cover all engine ratings in all engine families. The manufacturer must submit a grouping plan for Administrator review and approval detailing the OBD

groups and the engine families and engine ratings within each group for a given model year.

(ii) *Full OBD.*

(A) For all model year 2010 through 2012 "Full OBD" and "Extrapolated OBD" engine ratings, the manufacturer must implement an OBD system meeting the applicable requirements of this section.

(B) On one engine rating within each of the manufacturer's OBD groups, the manufacturer must implement an OBD system meeting the applicable requirements of this section. These "Full OBD" ratings will be known as the "OBD parent" ratings. The OBD parent rating for each OBD group shall be chosen, unless otherwise approved by the Administrator, as the rating having the highest weighted projected U.S. sales within the OBD group, with U.S. sales being weighted by the useful life of the engine rating.

(iii) *Extrapolated OBD.* For all other engine ratings within each OBD group, the manufacturer must implement an OBD system meeting the requirements of this section except that the OBD system is not required to detect a malfunction prior to exceeding the emission thresholds shown in Table 1 of paragraph (g) and Table 2 of paragraph (h) of this section. These extrapolated OBD engines will be known as the "OBD child" ratings. On these OBD child ratings, rather than detecting a malfunction prior to exceeding the emission thresholds, the manufacturer must submit a plan for Administrator review and approval that details the engineering evaluation the manufacturer will use to establish the malfunction criteria for the OBD child ratings. The plan must demonstrate both the use of good engineering judgment in establishing the malfunction criteria, and robust detection of malfunctions, including consideration of differences of base engine, calibration, emission control components, and emission control strategies.

(iv) Engines certified as alternative fueled engines shall meet, to the extent feasible, the requirements specified in paragraph (i)(3) of this §86.010-18. Additionally, such engines shall monitor the NO_x aftertreatment system on engines so equipped and detect a malfunction if:

(A) The NO_x aftertreatment system has no detectable amount of NO_x aftertreatment capability (i.e., NO_x catalyst conversion or NO_x adsorption).

(B) The NO_x aftertreatment substrate is completely destroyed, removed, or missing.

(C) The NO_x aftertreatment assembly is replaced with a straight pipe.

(3) *For model years 2016 through 2018.*

(i) *OBD groups.* The manufacturer shall define one or more OBD groups to cover all engine ratings in all engine families. The manufacturer must submit a grouping plan for Administrator review and approval detailing the OBD groups and the engine families and engine ratings within each group for a given model year.

(ii) *Full OBD.* The manufacturer must implement an OBD system meeting the applicable requirements of this section on all engine ratings in all engine families.

(iii) Engines certified as alternative fueled engines shall meet, to the extent feasible, the requirements specified in paragraph (i)(3) of this §86.010-18. Additionally, such

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engines shall monitor the NO_x aftertreatment system on engines so equipped and detect a malfunction if:

(A) The NO_x aftertreatment system has no detectable amount of NO_x aftertreatment capability (i.e., NO_x catalyst conversion or NO_x adsorption).

(B) The NO_x aftertreatment substrate is completely destroyed, removed, or missing.

(C) The NO_x aftertreatment assembly is replaced with a straight pipe.

(4) *For model years 2019 and later.*

(i) The manufacturer must implement an OBD system meeting the applicable requirements of §86.010-18 on all engines.

(p) **In-use compliance standards.** For monitors required to indicate a malfunction before emissions exceed a certain emission threshold (e.g., 2.5 times any of the applicable standards):

(1) *For model years 2010 through 2012.*

(i) On the full OBD rating (i.e., the parent rating) as defined in paragraph (o)(1) of this section, separate in-use emissions thresholds shall apply. These thresholds are determined by doubling the applicable thresholds as shown in Table 1 of paragraph (g) and Table 2 of paragraph (h) of this section. The resultant thresholds apply only in-use and do not apply for certification or selective enforcement auditing.

(ii) The extrapolated OBD ratings (i.e., the child ratings) as defined in paragraph (o)(1) of this section shall not be evaluated against emissions levels for purposes of OBD compliance in-use.

(iii) Only the test cycle and standard determined and identified by the manufacturer at the time of certification in accordance with paragraph (f) of this section as the most stringent shall be used for the purpose of determining OBD system noncompliance in-use.

(iv) An OBD system shall not be considered noncompliant solely due to a failure or deterioration mode of a monitored component or system that could not have been reasonably foreseen to occur by the manufacturer.

(2) *For model years 2013 through 2015.*

(i) On the full OBD ratings as defined in paragraph (o)(2) of this section, separate in-use emissions thresholds shall apply. These thresholds are determined by doubling the applicable thresholds as shown in Table 1 of paragraph (g) and Table 2 of paragraph (h) of this section. The resultant thresholds apply only in-use and do not apply for certification or selective enforcement auditing.

(ii) The extrapolated OBD ratings as defined in paragraph (o)(2) of this section shall not be evaluated against emissions levels for purposes of OBD compliance in-use.

(iii) Only the test cycle and standard determined and identified by the manufacturer at the time of certification in accordance with paragraph (f) of this section as the most stringent shall be used for the purpose of determining OBD system noncompliance in-use.

(iv) For monitors subject to meeting the minimum in-use monitor performance ratio of 0.100 in paragraph (d)(1)(ii), the OBD system shall not be considered non-

compliant unless a representative sample indicates the in-use ratio is below 0.050.

(v) An OBD system shall not be considered noncompliant solely due to a failure or deterioration mode of a monitored component or system that could not have been reasonably foreseen to occur by the manufacturer.

(3) *For model years 2016 through 2018.*

(i) On the engine ratings tested according to (1)(2)(iii) of this section, the certification emissions thresholds shall apply in-use.

(ii) On the manufacturer's remaining engine ratings, separate in-use emissions thresholds shall apply. These thresholds are determined by doubling the applicable thresholds as shown in Table 1 of paragraph (g) and Table 2 of paragraph (h) of this section. The resultant thresholds apply only in-use and do not apply for certification or selective enforcement auditing.

(iii) An OBD system shall not be considered noncompliant solely due to a failure or deterioration mode of a monitored component or system that could not have been reasonably foreseen to occur by the manufacturer.

(4) *For model years 2019 and later.*

(i) On all engine ratings, the certification emissions thresholds shall apply in-use.

(ii) An OBD system shall not be considered noncompliant solely due to a failure or deterioration mode of a monitored component or system that could not have been reasonably foreseen to occur by the manufacturer.

§86.096-11 Emission standards for 1996 and later model year diesel heavy-duty engines and vehicles.

(a) Exhaust emissions from new 1996 and later model year diesel heavy-duty engines shall not exceed the following (optional for 1996 model year gaseous-fueled diesel heavy-duty engines):

(i) Hydrocarbons (for diesel engines fueled with either petroleum-fuel or liquefied petroleum gas). 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(ii) Total Hydrocarbon Equivalent (for methanol-fueled diesel engines). 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(iii) Nonmethane hydrocarbons (for natural gas-fueled diesel engines). 1.2 grams per brake horsepower-hour (0.45 gram per megajoule), as measured under transient operating conditions.

(2) Carbon monoxide. (i) 15.5 grams per brake horsepower-hour (5.77 grams per megajoule), as measured under transient operating conditions.

(ii) 0.50 percent of exhaust gas flow at curb idle (methanol-, natural gas-, and liquefied petroleum gas-fueled diesel only).

(3) Oxides of Nitrogen. (i) 5.0 grams per brake horsepower-hour (1.9 grams per megajoule), as measured under transient operating conditions.

(ii) A manufacturer may elect to include any or all of its diesel heavy-duty engine families in any or all of the

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NO_x averaging, trading, or banking programs for heavy-duty engines, within the restrictions described in §86.094. If the manufacturer elects to include engine families in any of these programs, the NO_x FELs may not exceed 6.0 grams per brake horsepower-hour (2.2 grams per megajoule). This ceiling value applies whether credits for the family are derived from averaging, trading or banking programs.

(4) Particulate. (i) For diesel engines to be used in urban buses, 0.05 gram per brake horsepower-hour (0.019 gram per megajoule) for certification testing and selective enforcement audit testing, and 0.07 gram per brake horsepower-hour (0.026 gram per megajoule) for in-use testing, as measured under transient operating conditions.

(ii) For all other diesel engines only, 0.10 gram per brake horsepower-hour (0.037 gram per megajoule), as measured under transient operating conditions.

(iii) A manufacturer may elect to include any or all of its diesel heavy-duty engine families in any or all of the particulate averaging, trading, or banking programs for heavy-duty engines, within the restrictions described in §86.094. If the manufacturer elects to include engine families in any of these programs, the particulate FEL may not exceed:

(A) For engine families intended for use in urban buses, 0.25 gram per brake horsepower-hour (0.093 gram per megajoule).

(B) For engine families not intended for use in urban buses, 0.60 gram per brake horsepower-hour (0.22 gram per megajoule).

(C) The ceiling values in paragraphs (a)(4)(iii)(A) and (B) of this section apply whether credits for the family are derived from averaging, trading or banking programs.

(1) The opacity of smoke emission from new 1996 and later model year diesel heavy-duty engine shall not exceed:

(i) 20 percent during the engine acceleration mode.

(ii) 15 percent during the engine lugging mode.

(iii) 50 percent during the peaks in either mode.

(2) The standards set forth in paragraph (b)(1) of this section refer to exhaust smoke emissions generated under the conditions set forth in subpart I of this part and measured and calculated in accordance with these procedures.

(3) Evaporative emissions (total of non-oxygenated hydrocarbons plus methanol) from 1996 and later model year heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed:

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs, 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs, 4.0 grams per test.

(4) Evaporative emissions from 1996 and later model year heavy-duty vehicles equipped with natural gas-fueled or liquefied petroleum gas-fueled heavy-duty engines shall not exceed the following standards. The standards apply equally to certification and in-use vehicles.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds for the full three-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 pounds for the full three-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 4.0 grams per test.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraphs (b)(3) and (b)(4) of this section refer to a composite sample of evaporative emissions collected under the conditions and measured in accordance with the procedures set forth in subpart M of this part. For certification vehicles only, manufacturers may conduct testing to quantify a level of nonfuel background emissions for an individual test vehicle. Such a demonstration must include a description of the source(s) of emissions and an estimated decay rate. The demonstrated level of non-fuel background emissions may be subtracted from emission test results from certification vehicles if approved in advance by the Administrator.

(ii) For vehicles with a Gross Vehicle Weight Rating greater than 26,000 pounds, the standards set forth in paragraphs (b)(3)(ii) and (b)(4)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in §86.091).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1996 or later model year methanol- or gaseous-fueled diesel, or any naturally aspirated diesel heavy-duty engine. For petroleum-fueled engines only, this provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction. This provision is optional for all 1996 model year gaseous-fueled diesel heavy-duty engines, and for 1997 model year gaseous-fueled diesel heavy-duty engines using turbochargers, pumps, blowers or superchargers for air induction.

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in subpart I or N of this part to ascertain that such test engines meet the requirements of paragraphs (a), 86.096(b), 86.096(c), and (d) of this section.

§86.098-11 Emission standards for 1998 and later model year diesel heavy-duty engines and vehicles.

(a) Exhaust emissions from new 1998 and later model year diesel heavy-duty engines shall not exceed the following:

(i) Hydrocarbons (for diesel engines fueled with either petroleum-fuel or liquefied petroleum gas). 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(ii) Total Hydrocarbon Equivalent (for methanol-fueled diesel engines). 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

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(iii) Nonmethane hydrocarbons (for natural gas-fueled diesel engines). 1.2 grams per brake horsepower-hour (0.45 gram per megajoule), as measured under transient operating conditions.

(2) Carbon monoxide. (i) 15.5 grams per brake horsepower-hour (5.77 grams per megajoule), as measured under transient operating conditions.

(ii) 0.50 percent of exhaust gas flow at curb idle (methanol-, natural gas-, and liquefied petroleum gas-fueled diesel only).

(3) Oxides of Nitrogen. (i) 4.0 grams per brake horsepower-hour (1.49 grams per megajoule), as measured under transient operating conditions.

(ii) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the NO_x or NO_xplus NMHC ABTprograms for HDEs, within the restrictions described in §76.098-15 as applicable. If the manufacturer elects to include engine families in any of these programs, the NO_x FELs may not exceed 5.0 grams per brake horsepower-hour (1.9 grams per megajoule). This ceiling value applies whether credits for the family are derived from averaging, trading or banking programs.

(4) Particulate. (i) For diesel engines to be used in urban buses, 0.05 gram per brake horsepower-hour (0.019 gram per megajoule) for certification testing and selective enforcement audit testing, and 0.07 gram per brake horsepower-hour (0.026 gram per megajoule) for in-use testing, as measured under transient operating conditions.

(ii) For all other diesel engines only, 0.10 gram per brake horsepower-hour (0.037 gram per megajoule), as measured under transient operating conditions.

(iii) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the NO_x or NO_x plus NMHC ABTprograms for HDEs, within the restrictions described in §76.098-15 as applicable. If the manufacturer elects to include engine families in any of these programs, the particulate FEL may not exceed:

(A) For engine families intended for use in urban buses, 0.25 gram per brake horsepower-hour (0.093 gram per megajoule).

(B) For engine families not intended for use in urban buses, 0.60 gram per brake horsepower-hour (0.22 gram per megajoule).

(C) The ceiling values in paragraphs (a)(4)(iii)(A) and (B) of this section apply whether credits for the family are derived from averaging, trading or banking programs.

(1) The opacity of smoke emission from new 1998 and later model year diesel heavy-duty engine shall not exceed:

- (i) 20 percent during the engine acceleration mode.
- (ii) 15 percent during the engine lugging mode.
- (iii) 50 percent during the peaks in either mode.

(2) The standards set forth in paragraph (b)(1) of this section refer to exhaust smoke emissions generated under the conditions set forth in subpart I of this part and measured and calculated in accordance with those procedures.

(3) Evaporative emissions (total of non-oxygenated hydrocarbons plus methanol) from heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed the following standards. The standards apply equally to certification and in-use vehicles. The spitback standard also applies to newly assembled vehicles.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs:

(1) For the full three-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 3.0 grams per test.

(2) For the supplemental two-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 3.5 grams per test.

(B) Running loss test: 0.05 grams per mile.

(C) Fuel dispensing spitback test: 1.0 gram per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs:

(1) For the full three-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 4.0 grams per test.

(2) For the supplemental two-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 4.5 grams per test.

(B) Running loss test: 0.05 grams per mile.

(A) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraph (b)(3) of this section refer to a composite sample of evaporative emissions collected under the conditions and measured in accordance with the procedures set forth in subpart M of this part. For certification vehicles only, manufacturers may conduct testing to quantify a level of nonfuel background emissions for an individual test vehicle. Such a demonstration must include a description of the source(s) of emissions and an estimated decay rate. The demonstrated level of nonfuel background emissions may be subtracted from emission test results from certification vehicles if approved in advance by the Administrator.

(B) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs., the standards set forth in paragraph (b)(3)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in §86.091).

(iv) All fuel vapor generated during in-use operations shall be routed exclusively to the evaporative control system (e.g., either canister or engine purge). The only exception to this requirement shall be for emergencies.

(A) At least 90 percent of a manufacturer's sales of 1998 model year heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed the standards described in paragraph (b)(3) of this section. The remaining vehicles shall be subject to the standards described in §86.094. All 1999 model year and later heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed the standards described in paragraph (b)(3) of this section.

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(B) Optionally, 90 percent of a manufacturer's combined sales of 1998 model year gasoline- and methanol-fueled light-duty vehicles, light-duty trucks, and heavy-duty vehicles shall not exceed the applicable standards.

(C) Small volume manufacturers, as defined in §86.092 and (2), are exempt from the phase-in described in paragraph (b)(3)(A) of this section. For small volume manufacturers, the standards of §86.094, and the associated test procedures, apply for the 1998 model year. Beginning in the 1999 model year, 100 percent compliance with the standards of this section is required. This exemption does not apply to small volume engine families as defined in §86.092.

(4) Evaporative emissions from 1998 and later model year heavy-duty vehicles equipped with natural gas-fueled or liquefied petroleum gas-fueled heavy-duty engines shall not exceed the following standards. The standards apply equally to certification and in-use vehicles.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds for the full three-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 pounds for the full three-diurnal test sequence described in §86.1230, diurnal plus hot soak measurements: 4.0 grams per test.

(A) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 pounds, the standards set forth in paragraph (b)(4) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in subpart M of this part and measured in accordance with those procedures.

(B) For vehicles with a Gross Vehicle Weight Rating greater than 26,000 lbs, the standards set forth in paragraphs (b)(3)(ii) and (b)(4)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in §86.091).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1998 or later model year methanol-, natural gas-, or liquefied petroleum gas-fueled diesel, or any naturally-aspirated diesel heavy-duty engine. For petroleum-fueled engines only, this provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction.

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in subpart I or N of this part to ascertain that such test engines meet the requirements of paragraphs (a), 86.098(b), 86.098(c), and (d) of this section.

§86.099-11 Emission standards for 1999 and later model year diesel heavy-duty engines and vehicles.

(a) Exhaust emissions from new 1999 and later model year diesel heavy-duty engines shall not exceed the following:

(1)(i) *Hydrocarbons (for diesel engines fueled with either petroleum-fuel or liquefied petroleum gas)*. 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(ii) *Total Hydrocarbon Equivalent (for methanol-fueled diesel engines)*. 1.3 grams per brake horsepower-hour (0.48 gram per megajoule), as measured under transient operating conditions.

(iii) *Nonmethane hydrocarbons (for natural gas-fueled diesel engines)*. 1.2 grams per brake horsepower-hour (0.45 gram per megajoule), as measured under transient operating conditions.

(2) *Carbon monoxide*. (i) 15.5 grams per brake horsepower-hour (5.77 grams per megajoule), as measured under transient operating conditions.

(ii) 0.50 percent of exhaust gas flow at curb idle (methanol-, natural gas-, and liquefied petroleum gas-fueled diesel only).

(3) *Oxides of Nitrogen*. (i) 4.0 grams per brake horsepower-hour (1.49 grams per megajoule), as measured under transient operating conditions.

(ii) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the NO_x or NO_x plus NMHC ABT programs for HDEs, within the restrictions described in §86.098–15 as applicable. If the manufacturer elects to include engine families in any of these programs, the NO_x FELs may not exceed 5.0 grams per brake horsepower-hour (1.9 grams per megajoule). This ceiling value applies whether credits for the family are derived from averaging, trading or banking programs.

(4) *Particulate*. (i) For diesel engines to be used in urban buses, 0.05 gram per brake horsepower-hour (0.019 gram per megajoule) for certification testing and selective enforcement audit testing, and 0.07 grams per brake horsepower-hour (0.026 gram per megajoule) for in-use testing, as measured under transient operating conditions.

(ii) For all other diesel engines only, 0.10 gram per brake horsepower-hour (0.037 gram per megajoule), as measured under transient operating conditions.

(iii) A manufacturer may elect to include any or all of its diesel HDE families in any or all of the particulate ABT programs for HDEs, within the restrictions described in §86.098–15 as applicable. If the manufacturer elects to include engine families in any of these programs, the particulate FEL may not exceed:

(A) For engine families intended for use in urban buses, 0.25 gram per brake horsepower-hour (0.093 gram per megajoule);

(B) For engine families *not* intended for use in urban buses, 0.60 gram per brake horsepower-hour (0.22 gram per megajoule). This ceiling value applies whether credits for the family are derived from averaging, trading or banking programs.

(b)(1) The opacity of smoke emission from new 1999 and later model year diesel heavy-duty engine shall not exceed:

(i) 20 percent during the engine acceleration mode.

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(ii) 15 percent during the engine lugging mode.

(iii) 50 percent during the peaks in either mode

(2) The standards set forth in paragraph (b)(1) of this section refer to exhaust smoke emissions generated under the conditions set forth in subpart I of this part and measured and calculated in accordance with those procedures.

(3) Evaporative emissions (total of non-oxygenated hydrocarbons plus methanol) from heavy-duty vehicles equipped with methanol-fueled diesel engines shall not exceed the following standards. The standards apply equally to certification and in-use vehicles. The spitback standard also applies to newly assembled vehicles.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 lbs:

(A)(1) For the full three-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 3.0 grams per test.

(2) For the supplemental two-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 3.5 grams per test.

(B) *Running loss test*: 0.05 grams per mile.

(C) *Fuel dispensing spitback test*: 1.0 gram per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 lbs:

(A)(1) For the full three-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 4.0 grams per test.

(2) For the supplemental two-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 4.5 grams per test.

(B) *Running loss test*: 0.05 grams per mile.

(iii)(A) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 lbs, the standards set forth in paragraph (b)(3) of this section refer to a composite sample of evaporative emissions collected under the conditions and measured in accordance with the procedures set forth in subpart M of this part. For certification vehicles only, manufacturers may conduct testing to quantify a level of nonfuel background emissions for an individual test vehicle. Such a demonstration must include a description of the source(s) of emissions and an estimated decay rate. The demonstrated level of nonfuel background emissions may be subtracted from emission test results from certification vehicles if approved in advance by the Administrator.

(B) For vehicles with a Gross Vehicle Weight Rating of greater than 26,000 lbs., the standards set forth in paragraph (b)(3)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in §86.091–23(b)(4)(ii)).

(iv) All fuel vapor generated during in-use operations shall be routed exclusively to the evaporative control system (e.g., either canister or engine purge). The only exception to this requirement shall be for emergencies.

(4) *Evaporative emissions* from 1999 and later model year heavy-duty vehicles equipped with natural gas-fueled or liquefied petroleum gas-fueled heavy-duty engines shall not exceed the following standards. The

standards apply equally to certification and in-use vehicles.

(i) For vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds for the full three-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 3.0 grams per test.

(ii) For vehicles with a Gross Vehicle Weight Rating of greater than 14,000 pounds for the full three-diurnal test sequence described in §86.1230–96, diurnal plus hot soak measurements: 4.0 grams per test.

(iii)(A) For vehicles with a Gross Vehicle Weight Rating of up to 26,000 pounds, the standards set forth in paragraph (b)(4) of this section refer to a composite sample of evaporative emissions collected under the conditions set forth in subpart M of this part and measured in accordance with those procedures.

(B) For vehicles with a Gross Vehicle Weight Rating greater than 26,000 pounds, the standards set forth in paragraphs (b)(3)(ii) and (b)(4)(ii) of this section refer to the manufacturer's engineering design evaluation using good engineering practice (a statement of which is required in §86.091–23(b)(4)(ii)).

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1999 or later model year methanol-, natural gas-, or liquefied petroleum gas-fueled diesel, or any naturally-aspirated diesel heavy-duty engine. For petroleum-fueled engines only, this provision does not apply to engines using turbochargers, pumps, blowers, or superchargers for air induction.

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in subpart I or N of this part to ascertain that such test engines meet the requirements of paragraphs (a), (b), (c), and (d) of this section.

Part 122—EPA administered permit programs: The national pollutant discharge elimination system

§122.21 Application for a permit (applicable to State programs, see §123.25).

(c) *Time to apply*. (1) Any person proposing a new discharge, shall submit an application at least 180 days before the date on which the discharge is to commence, unless permission for a later date has been granted by the Director. Facilities proposing a new discharge of storm water associated with industrial activity shall submit an application 180 days before that facility commences industrial activity which may result in a discharge of storm water associated with that industrial activity. Facilities described under §122.26(b)(14)(x) or (b)(15)(i) shall submit applications at least 90 days before the date on which construction is to commence. Different submittal dates may be required under the terms of applicable general permits. Persons proposing a new discharge are encouraged to submit their applications well in advance of the

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90 or 180 day requirements to avoid delay. See also paragraph (k) of this section and §122.26(c)(1)(i)(G) and (c)(1)(ii).

* * * * *

(3) *Average flows and treatment.* A narrative identification of each type of process, operation, or production area which contributes wastewater to the effluent for each outfall, including process wastewater, cooling water, and stormwater runoff; the average flow which each process contributes; and a description of the treatment the wastewater receives, including the ultimate disposal of any solid or fluid wastes other than by discharge. Processes, operations, or production areas may be described in general terms (for example, “dye-making reactor”, “distillation tower”). For a privately owned treatment works, this information shall include the identity of each user of the treatment works. The average flow of point sources composed of storm water may be estimated. The basis for the rainfall event and the method of estimation must be indicated.

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(7) *Effluent characteristics.* (i) Information on the discharge of pollutants specified in this paragraph (g)(7) (except information on storm water discharges which is to be provided as specified in §122.26). When “quantitative data” for a pollutant are required, the applicant must collect a sample of effluent and analyze it for the pollutant in accordance with analytical methods approved under part 136 of this chapter. When no analytical method is approved the applicant may use any suitable method but must provide a description of the method. When an applicant has two or more outfalls with substantially identical effluents, the Director may allow the applicant to test only one outfall and report that the quantitative data also apply to the substantially identical outfall. The requirements in paragraphs (g)(7) (vi) and (vii) of this section that an applicant must provide quantitative data for certain pollutants known or believed to be present do not apply to pollutants

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present in a discharge solely as the result of their presence in intake water; however, an applicant must report such pollutants as present. Grab samples must be used for pH, temperature, cyanide, total phenols, residual chlorine, oil and grease, fecal coliform and fecal streptococcus. For all other pollutants, 24-hour composite samples must be used. However, a minimum of one grab sample may be taken for effluents from holding ponds or other impoundments with a retention period greater than 24 hours. In addition, for discharges other than storm water discharges, the Director may waive composite sampling for any outfall for which the applicant demonstrates that the use of an automatic sampler is infeasible and that the minimum of four (4) grab samples will be a representative sample of the effluent being discharged.

(ii) *Storm water discharges.* For storm water discharges, all samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inch and at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where feasible, the variance in the duration of the event and the total rainfall of the event should not exceed 50 percent from the average or median rainfall event in that area. For all applicants, a flow-weighted composite shall be taken for either the entire discharge or for the first three hours of the discharge. The flow-weighted composite sample for a storm water discharge may be taken with a continuous sampler or as a combination of a minimum of three sample aliquots taken in each hour of discharge for the entire discharge or for the first three hours of the discharge, with each aliquot being separated by a minimum period of fifteen minutes (applicants submitting permit applications for storm water discharges under §122.26(d) may collect flow-weighted composite samples using different protocols with respect to the time duration between the collection of sample aliquots, subject to the approval of the Director). However, a minimum of one grab sample may be taken for storm water discharges from holding ponds or other impoundments with a retention period greater than 24 hours. For a flow-weighted composite sample, only one analysis of the composite of aliquots is required. For storm water discharge samples taken from discharges associated with industrial activities, quantitative data must be reported for the grab sample taken during the first thirty minutes (or as soon thereafter as practicable) of the discharge for all pollutants specified in §122.26(c)(1). For all storm water permit applicants taking flow-weighted composites, quantitative data must be reported for all pollutants specified in §122.26 except pH, temperature, cyanide, total phenols, residual chlorine, oil and grease, fecal coliform, and fecal streptococcus. The Director may allow or establish appropriate site-specific sampling procedures or requirements, including sampling locations, the season in which the sampling takes place, the minimum duration between the previous measurable storm event and the storm event sampled, the minimum or maximum level of precipitation required for an appropriate storm event, the form of precipitation sampled (snow melt or rain fall), protocols for collecting samples under part 136 of this chapter, and additional time for submitting

data on a case-by-case basis. An applicant is expected to “know or have reason to believe” that a pollutant is present in an effluent based on an evaluation of the expected use, production, or storage of the pollutant, or on any previous analyses for the pollutant. (For example, any pesticide manufactured by a facility may be expected to be present in contaminated storm water runoff from the facility.)

(iii) *Reporting requirements.* Every applicant must report quantitative data for every outfall for the following pollutants:

- Biochemical Oxygen Demand (BOD5)
- Chemical Oxygen Demand
- Total Organic Carbon
- Total Suspended Solids
- Ammonia (as N)
- Temperature (both winter and summer)
- pH

(iv) The Director may waive the reporting requirements for individual point sources or for a particular industry category for one or more of the pollutants listed in paragraph (g)(7)(iii) of this section if the applicant has demonstrated that such a waiver is appropriate because information adequate to support issuance of a permit can be obtained with less stringent requirements.

(v) Each applicant with processes in one or more primary industry category (see appendix A of this part) contributing to a discharge must report quantitative data for the following pollutants in each outfall containing process wastewater:

(A) The organic toxic pollutants in the fractions designated in table I of appendix D of this part for the applicant's industrial category or categories unless the applicant qualifies as a small business under paragraph (g)(8) of this section. Table II of appendix D of this part lists the organic toxic pollutants in each fraction. The fractions result from the sample preparation required by the analytical procedure which uses gas chromatography/mass spectrometry. A determination that an applicant falls within a particular industrial category for the purposes of selecting fractions for testing is not conclusive as to the applicant's inclusion in that category for any other purposes. See Notes 2, 3, and 4 of this section.

(B) The pollutants listed in table III of appendix D of this part (the toxic metals, cyanide, and total phenols).

(vi)(A) Each applicant must indicate whether it knows or has reason to believe that any of the pollutants in table IV of appendix D of this part (certain conventional and nonconventional pollutants) is discharged from each outfall. If an applicable effluent limitations guideline either directly limits the pollutant or, by its express terms, indirectly limits the pollutant through limitations on an indicator, the applicant must report quantitative data. For every pollutant discharged which is not so limited in an effluent limitations guideline, the applicant must either report quantitative data or briefly describe the reasons the pollutant is expected to be discharged.

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(B) Each applicant must indicate whether it knows or has reason to believe that any of the pollutants listed in table II or table III of appendix D of this part (the toxic pollutants and total phenols) for which quantitative data are not otherwise required under paragraph (g)(7)(v) of this section are discharged from each outfall. For every pollutant expected to be discharged in concentrations of 10 ppb or greater the applicant must report quantitative data. For acrolein, acrylonitrile, 2,4 dinitrophenol, and 2-methyl-4, 6 dinitrophenol, where any of these four pollutants are expected to be discharged in concentrations of 100 ppb or greater the applicant must report quantitative data. For every pollutant expected to be discharged in concentrations less than 10 ppb, or in the case of acrolein, acrylonitrile, 2,4 dinitrophenol, and 2-methyl-4, 6 dinitrophenol, in concentrations less than 100 ppb, the applicant must either submit quantitative data or briefly describe the reasons the pollutant is expected to be discharged. An applicant qualifying as a small business under paragraph (g)(8) of this section is not required to analyze for pollutants listed in table II of appendix D of this part (the organic toxic pollutants).

(vii) Each applicant must indicate whether it knows or has reason to believe that any of the pollutants in table V of appendix D of this part (certain hazardous substances and asbestos) are discharged from each outfall. For every pollutant expected to be discharged, the applicant must briefly describe the reasons the pollutant is expected to be discharged, and report any quantitative data it has for any pollutant.

(viii) Each applicant must report qualitative data, generated using a screening procedure not calibrated with analytical standards, for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) if it:

(A) Uses or manufactures 2,4,5-trichlorophenoxy acetic acid (2,4,5,-T); 2-(2,4,5-trichlorophenoxy) propanoic acid (Silvex, 2,4,5,-TP); 2-(2,4,5-trichlorophenoxy) ethyl, 2,2-dichloropropionate (Erbon); O,O-dimethyl O-(2,4,5-trichlorophenyl) phosphorothioate (Ronnell); 2,4,5-trichlorophenol (TCP); or hexachlorophene (HCP); or

(B) Knows or has reason to believe that TCDD is or may be present in an effluent.

* * * * *

(k) *Application requirements for new sources and new discharges.* New manufacturing, commercial, mining and silvicultural dischargers applying for NPDES permits (except for new discharges of facilities subject to the requirements of paragraph (h) of this section or new discharges of storm water associated with industrial activity which are subject to the requirements of §122.26(c)(1) and this section (except as provided by §122.26(c)(1)(ii)) shall provide the following information to the Director, using the application forms provided by the Director:

* * * * *

§122.22 Signatories to permit applications and reports (applicable to State programs, see §123.25).

* * * * *

(b) All reports required by permits, and other information requested by the Director shall be signed by a person described in paragraph (a) of this section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in paragraph (a) of this section;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company, (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) and,

(3) The written authorization is submitted to the Director.

* * * * *

§122.26 Storm water discharges (applicable to State NPDES programs, see §123.25)

(a) *Permit requirement.* (1) Prior to October 1, 1994, discharges composed entirely of storm water shall not be required to obtain a NPDES permit except:

(i) A discharge with respect to which a permit has been issued prior to February 4, 1987;

(ii) A discharge associated with industrial activity (see §122.26(a)(4));

(iii) A discharge from a large municipal separate storm sewer system;

(iv) A discharge from a medium municipal separate storm sewer system;

(v) A discharge which the Director, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator, determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. This designation may include a discharge from any conveyance or system of conveyances used for collecting and conveying storm water runoff or a system of discharges from municipal separate storm sewers, except for those discharges from conveyances which do not require a permit under paragraph (a)(2) of this section or agricultural storm water runoff which is exempted from the definition of point source at §122.2.

The Director may designate discharges from municipal separate storm sewers on a system-wide or jurisdiction-wide basis. In making this determination the Director may consider the following factors:

(A) The location of the discharge with respect to waters of the United States as defined at 40 CFR 122.2.

(B) The size of the discharge;

(C) The quantity and nature of the pollutants discharged to waters of the United States; and

(D) Other relevant factors.

(2) The Director may not require a permit for discharges of storm water runoff from the following:

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(i) Mining operations composed entirely of flows which are from conveyances or systems of conveyances (including but not limited to pipes, conduits, ditches, and channels) used for collecting and conveying precipitation runoff and which are not contaminated by contact with or that have not come into contact with, any overburden, raw material, intermediate products, finished product, byproduct, or waste products located on the site of such operations, except in accordance with paragraph (c)(1)(iv) of this section.

(ii) All field activities or operations associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and for the movement and placement of drilling equipment, whether or not such field activities or operations may be considered to be construction activities, except in accordance with paragraph (c)(1)(iii) of this section. Discharges of sediment from construction activities associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities are not subject to the provisions of paragraph (c)(1)(iii)(C) of this section.

(4) *Discharges through large and medium municipal separate storm sewer systems.* In addition to meeting the requirements of paragraph (c) of this section, an operator of a storm water discharge associated with industrial activity which discharges through a large or medium municipal separate storm sewer system shall submit, to the operator of the municipal separate storm sewer system receiving the discharge no later than May 15, 1991, or 180 days prior to commencing such discharge: the name of the facility; a contact person and phone number; the location of the discharge; a description, including Standard Industrial Classification, which best reflects the principal products or services provided by each facility; and any existing NPDES permit number.

(5) *Other municipal separate storm sewers.* The Director may issue permits for municipal separate storm sewers that are designated under paragraph (a)(1)(v) of this section on a system-wide basis, jurisdiction-wide basis, watershed basis or other appropriate basis, or may issue permits for individual discharges.

(6) *Non-municipal separate storm sewers.* For storm water discharges associated with industrial activity from point sources which discharge through a non-municipal or non-publicly owned separate storm sewer system, the Director, in his discretion, may issue: a single NPDES permit, with each discharger a co-permittee to a permit issued to the operator of the portion of the system that discharges into waters of the United States; or, individual permits to each discharger of storm water associated with industrial activity through the non-municipal conveyance system.

(i) All storm water discharges associated with industrial activity that discharge through a storm water discharge system that is not a municipal separate storm sewer must be covered by an individual permit, or a permit issued to the operator of the portion of the system that discharges to waters of the United States, with

each discharger to the non-municipal conveyance a co-permittee to that permit.

(ii) Where there is more than one operator of a single system of such conveyances, all operators of storm water discharges associated with industrial activity must submit applications.

(iii) Any permit covering more than one operator shall identify the effluent limitations, or other permit conditions, if any, that apply to each operator.

(7) *Combined sewer systems.* Conveyances that discharge storm water runoff combined with municipal sewage are point sources that must obtain NPDES permits in accordance with the procedures of §122.21 and are not subject to the provisions of this section.

(8) Whether a discharge from a municipal separate storm sewer is or is not subject to regulation under this section shall have no bearing on whether the owner or operator of the discharge is eligible for funding under title II, title III or title VI of the Clean Water Act. *See* 40 CFR part 35, subpart I, appendix A(b)H.2.j.

(9)(i) On and after October 1, 1994, for discharges composed entirely of storm water, that are not required by paragraph (a)(1) of this section to obtain a permit, operators shall be required to obtain a NPDES permit only if:

(A) The discharge is from a small MS4 required to be regulated pursuant to §122.32;

(B) The discharge is a storm water discharge associated with small construction activity pursuant to paragraph (b)(15) of this section;

(C) The Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, determines that storm water controls are needed for the discharge based on wasteload allocations that are part of "total maximum daily loads" (TMDLs) that address the pollutant(s) of concern; or

(D) The Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, determines that the discharge, or category of discharges within a geographic area, contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

(ii) Operators of small MS4s designated pursuant to paragraphs (a)(9)(i)(A), (a)(9)(i)(C), and (a)(9)(i)(D) of this section shall seek coverage under an NPDES permit in accordance with §§122.33 through 122.35. Operators of non-municipal sources designated pursuant to paragraphs (a)(9)(i)(B), (a)(9)(i)(C), and (a)(9)(i)(D) of this section shall seek coverage under an NPDES permit in accordance with paragraph (c)(1) of this section.

(iii) Operators of storm water discharges designated pursuant to paragraphs (a)(9)(i)(C) and (a)(9)(i)(D) of this section shall apply to the Director for a permit within 180 days of receipt of notice, unless permission for a later date is granted by the Director (see §124.52(c) of this chapter).

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(b) *Definitions.* (1) *Co-permittee* means a permittee to a NPDES permit that is only responsible for permit conditions relating to the discharge for which it is operator.

(2) *Illicit discharge* means any discharge to a municipal separate storm sewer that is not composed entirely of storm water except discharges pursuant to a NPDES permit (other than the NPDES permit for discharges from the municipal separate storm sewer) and discharges resulting from fire fighting activities.

(3) *Incorporated place* means the District of Columbia, or a city, town, township, or village that is incorporated under the laws of the State in which it is located.

(4) *Large municipal separate storm sewer system* means all municipal separate storm sewers that are either:

(i) Located in an incorporated place with a population of 250,000 or more as determined by the 1990 Decennial Census by the Bureau of the Census (Appendix F of this part); or

(ii) Located in the counties listed in appendix H, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties; or

(iii) Owned or operated by a municipality other than those described in paragraph (b)(4) (i) or (ii) of this section and that are designated by the Director as part of the large or medium municipal separate storm sewer system due to the interrelationship between the discharges of the designated storm sewer and the discharges from municipal separate storm sewers described under paragraph (b)(4) (i) or (ii) of this section. In making this determination the Director may consider the following factors:

(A) Physical interconnections between the municipal separate storm sewers;

(B) The location of discharges from the designated municipal separate storm sewer relative to discharges from municipal separate storm sewers described in paragraph (b)(4)(i) of this section;

(C) The quantity and nature of pollutants discharged to waters of the United States;

(D) The nature of the receiving waters; and

(E) Other relevant factors; or

(iv) The Director may, upon petition, designate as a large municipal separate storm sewer system, municipal separate storm sewers located within the boundaries of a region defined by a storm water management regional authority based on a jurisdictional, watershed, or other appropriate basis that includes one or more of the systems described in paragraph (b)(4) (i), (ii), (iii) of this section.

(5) *Major municipal separate storm sewer outfall* (or "major outfall") means a municipal separate storm sewer outfall that discharges from a single pipe with an inside diameter of 36 inches or more or its equivalent (discharge from a single conveyance other than circular pipe which is associated with a drainage area of more than 50 acres); or for municipal separate storm sewers that receive storm water from lands zoned for industrial activity (based on comprehensive zoning plans or the

equivalent), an outfall that discharges from a single pipe with an inside diameter of 12 inches or more or from its equivalent (discharge from other than a circular pipe associated with a drainage area of 2 acres or more).

(6) *Major outfall* means a major municipal separate storm sewer outfall.

(7) *Medium municipal separate storm sewer system* means all municipal separate storm sewers that are either:

(i) Located in an incorporated place with a population of 100,000 or more but less than 250,000, as determined by the 1990 Decennial Census by the Bureau of the Census (Appendix G of this part); or

(ii) Located in the counties listed in appendix I, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties; or

(iii) Owned or operated by a municipality other than those described in paragraph (b)(7) (i) or (ii) of this section and that are designated by the Director as part of the large or medium municipal separate storm sewer system due to the interrelationship between the discharges of the designated storm sewer and the discharges from municipal separate storm sewers described under paragraph (b)(7) (i) or (ii) of this section. In making this determination the Director may consider the following factors:

(A) Physical interconnections between the municipal separate storm sewers;

(B) The location of discharges from the designated municipal separate storm sewer relative to discharges from municipal separate storm sewers described in paragraph (b)(7)(i) of this section;

(C) The quantity and nature of pollutants discharged to waters of the United States;

(D) The nature of the receiving waters; or

(E) Other relevant factors; or

(iv) The Director may, upon petition, designate as a medium municipal separate storm sewer system, municipal separate storm sewers located within the boundaries of a region defined by a storm water management regional authority based on a jurisdictional, watershed, or other appropriate basis that includes one or more of the systems described in paragraphs (b)(7) (i), (ii), (iii) of this section.

(8) *Municipal separate storm sewer* means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

(i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section

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208 of the CWA that discharges to waters of the United States;

(ii) Designed or used for collecting or conveying storm water;

(iii) Which is not a combined sewer; and

(iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

(9) *Outfall* means a *point source* as defined by 40 CFR 122.2 at the point where a municipal separate storm sewer discharges to waters of the United States and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States.

(10) *Overburden* means any material of any nature, consolidated or unconsolidated, that overlies a mineral deposit, excluding topsoil or similar naturally-occurring surface materials that are not disturbed by mining operations.

(11) *Runoff coefficient* means the fraction of total rainfall that will appear at a conveyance as runoff.

(12) *Significant materials* includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of CERCLA; any chemical the facility is required to report pursuant to section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with storm water discharges.

(13) *Storm water* means storm water runoff, snow melt runoff, and surface runoff and drainage.

(14) *Storm water discharge associated with industrial activity* means the discharge from any conveyance that is used for collecting and conveying storm water and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program under this part 122. For the categories of industries identified in this section, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at part 401 of this chapter); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and final products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. For the purposes of this paragraph, material handling activities include storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product,

by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are federally, State, or municipally owned or operated that meet the description of the facilities listed in paragraphs (b)(14)(i) through (xi) of this section) include those facilities designated under the provisions of paragraph (a)(1)(v) of this section. The following categories of facilities are considered to be engaging in "industrial activity" for purposes of paragraph (b)(14):

(i) Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under 40 CFR subchapter N (except facilities with toxic pollutant effluent standards which are exempted under category (i) in paragraph (b)(14) of this section);

(ii) Facilities classified as Standard Industrial Classifications 24 (except 2434), 26 (except 265 and 267), 28 (except 283), 29, 311, 32 (except 323), 33, 3441, 373;

(iii) Facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(1) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations; (inactive mining operations are mining sites that are not being actively mined, but which have an identifiable owner/operator; inactive mining sites do not include sites where mining claims are being maintained prior to disturbances associated with the extraction, beneficiation, or processing of mined materials, nor sites where minimal activities are undertaken for the sole purpose of maintaining a mining claim);

(iv) Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under subtitle C of RCRA;

(v) Landfills, land application sites, and open dumps that receive or have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under subtitle D of RCRA;

(vi) Facilities involved in the recycling of materials, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as Standard Industrial Classification 5015 and 5093;

(vii) Steam electric power generating facilities, including coal handling sites;

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(viii) Transportation facilities classified as Standard Industrial Classifications 40, 41, 42 (except 4221-25), 43, 44, 45, and 5171 which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or which are otherwise identified under paragraphs (b)(14) (i)-(vii) or (ix)-(xi) of this section are associated with industrial activity;

(ix) Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under 40 CFR part 403. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with section 405 of the CWA;

(x) Construction activity including clearing, grading and excavation, except operations that result in the disturbance of less than five acres of total land area. Construction activity also includes the disturbance of less than five acres of total land area that is a part of a larger common plan of development or sale if the larger common plan will ultimately disturb five acres or more;

(xi) Facilities under Standard Industrial Classifications 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, and 4221-25;

(15) *Storm water discharge associated with small construction activity* means the discharge of storm water from:

(i) Construction activities including clearing, grading, and excavating that result in land disturbance of equal to or greater than one acre and less than five acres. Small construction activity also includes the disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb equal to or greater than one and less than five acres. Small construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of the facility. The Director may waive the otherwise applicable requirements in a general permit for a storm water discharge from construction activities that disturb less than five acres where:

(A) The value of the rainfall erosivity factor ("R" in the Revised Universal Soil Loss Equation) is less than five during the period of construction activity. The rainfall erosivity factor is determined in accordance with Chapter 2 of *Agriculture Handbook Number 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE)*, pages 21-64, dated January 1997. The Director of the Federal Register approves this incorporation

by reference in accordance with 5 U.S.C 552(a) and 1 CFR part 51. Copies may be obtained from EPA's Water Resource Center, Mail Code RC4100, 401 M St. SW, Washington, DC 20460. A copy is also available for inspection at the U.S. EPA Water Docket, 401 M Street SW, Washington, DC 20460, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. An operator must certify to the Director that the construction activity will take place during a period when the value of the rainfall erosivity factor is less than five; or

(B) Storm water controls are not needed based on a "total maximum daily load" (TMDL) approved or established by EPA that addresses the pollutant(s) of concern or, for non-impaired waters that do not require TMDLs, an equivalent analysis that determines allocations for small construction sites for the pollutant(s) of concern or that determines that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. For the purpose of this paragraph, the pollutant(s) of concern include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity. The operator must certify to the Director that the construction activity will take place, and storm water discharges will occur, within the drainage area addressed by the TMDL or equivalent analysis.

(ii) Any other construction activity designated by the Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the United States.

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EXHIBIT 1 TO § 122.26(B)(15).-SUMMARY OF COVERAGE OF “STORM WATER DISCHARGES ASSOCIATED WITH SMALL CONSTRUCTION ACTIVITY” UNDER THE NPDES STORM WATER PROGRAM

Automatic Designation: Required Nationwide Coverage.

Potential Designation: Optional Evaluation and Designation by the NPDES Permitting Authority or EPA Regional Administrator

Potential Waiver: Waiver from Requirements as Determined by the NPDES Permitting Authority.

- Construction activities that result in a land disturbance of equal to or greater than one acre and less than five acres
- Construction activities disturbing less than one acre if part of a larger common plan of development or sale with a planned disturbance of equal to or greater than one acre and less than five acres. (see § 122.26(b)(15)(i).)
- Construction activities that result in a land disturbance of less than one acre based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants. (see § 122.26(b)(15)(ii).)

Any automatically designated construction activity where the operator certifies: (1) A rainfall erosivity factor of less than five, or (2) That the activity will occur within an area where controls are not needed based on a TMDL or, for non-impaired waters that do not require a TMDL, an equivalent analysis for the pollutant(s) of concern. (see § 122.26(b)(15)(i).)

Exhibit 1 to § 122.26(b)(15).-Summary of Coverage of “Storm Water Discharges Associated with Small Construction Activity” Under the NPDES Storm Water Program, Continued

(16) *Small municipal separate storm sewer system* means all separate storm sewers that are:

(i) Owned or operated by the United States, a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the United States.

(ii) Not defined as “large” or “medium” municipal separate storm sewer systems pursuant to paragraphs (b)(4) and (b)(7) of this section, or designated under paragraph (a)(1)(v) of this section.

(iii) This term includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings.

(17) *Small MS4* means a small municipal separate storm sewer system.

(18) *Municipal separate storm sewer system* means all separate storm sewers that are defined as “large” or “medium” or “small” municipal separate storm sewer systems pursuant to paragraphs (b)(4), (b)(7), and (b)(16) of this section, or designated under paragraph (a)(1)(v) of this section.

(19) *MS4* means a municipal separate storm sewer system.

(20) *Uncontrolled sanitary landfill* means a landfill or open dump, whether in operation or closed, that does not meet the requirements for runoff or runoff controls established pursuant to subtitle D of the Solid Waste Disposal Act.

(c) *Application requirements for storm water discharges associated with industrial activity and storm water discharges associated with small construction*

activity—(1) *Individual application.* Dischargers of storm water associated with industrial activity and with small construction activity are required to apply for an individual permit or seek coverage under a promulgated storm water general permit. Facilities that are required to obtain an individual permit or any discharge of storm water which the Director is evaluating for designation (see §124.52(c) of this chapter) under paragraph (a)(1)(v) of this section and is not a municipal storm sewer, shall submit an NPDES application in accordance with the requirements of §122.21 as modified and supplemented by the provisions of this paragraph.

(i) Except as provided in §122.26(c)(1) (ii)-(iv), the operator of a storm water discharge associated with industrial activity subject to this section shall provide:

(A) A site map showing topography (or indicating the outline of drainage areas served by the outfall(s) covered in the application if a topographic map is unavailable) of the facility including: each of its drainage and discharge structures; the drainage area of each storm water outfall; paved areas and buildings within the drainage area of each storm water outfall, each past or present area used for outdoor storage or disposal of significant materials, each existing structural control measure to reduce pollutants in storm water runoff, materials loading and access areas, areas where pesticides, herbicides, soil conditioners and fertilizers are applied, each of its hazardous waste treatment, storage or disposal facilities (including each area not required to have a RCRA permit which is used for accumulating hazardous waste under 40 CFR 262.34); each well where fluids from the facility are injected underground; springs, and other surface water bodies which receive storm water discharges from the facility;

(B) An estimate of the area of impervious surfaces (including paved areas and building roofs) and the total area drained by each outfall (within a mile radius of the facility) and a narrative description of the following: Significant materials that in the three years prior to the submittal of this application have been treated, stored or disposed in a manner to allow exposure to storm water; method of treatment, storage or disposal of such materials; materials management practices employed, in the three years prior to the submittal of this application, to minimize contact by these materials with storm

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water runoff; materials loading and access areas; the location, manner and frequency in which pesticides, herbicides, soil conditioners and fertilizers are applied; the location and a description of existing structural and non-structural control measures to reduce pollutants in storm water runoff; and a description of the treatment the storm water receives, including the ultimate disposal of any solid or fluid wastes other than by discharge;

(C) A certification that all outfalls that should contain storm water discharges associated with industrial activity have been tested or evaluated for the presence of non-storm water discharges which are not covered by a NPDES permit; tests for such non-storm water discharges may include smoke tests, fluorometric dye tests, analysis of accurate schematics, as well as other appropriate tests. The certification shall include a description of the method used, the date of any testing, and the on-site drainage points that were directly observed during a test;

(D) Existing information regarding significant leaks or spills of toxic or hazardous pollutants at the facility that have taken place within the three years prior to the submittal of this application;

(E) Quantitative data based on samples collected during storm events and collected in accordance with §122.21 of this part from all outfalls containing a storm water discharge associated with industrial activity for the following parameters:

(1) Any pollutant limited in an effluent guideline to which the facility is subject;

(2) Any pollutant listed in the facility's NPDES permit for its process wastewater (if the facility is operating under an existing NPDES permit);

(3) Oil and grease, pH, BOD₅, COD, TSS, total phosphorus, total Kjeldahl nitrogen, and nitrate plus nitrite nitrogen;

(4) Any information on the discharge required under §122.21(g)(7)(vi) and (vii);

(5) Flow measurements or estimates of the flow rate, and the total amount of discharge for the storm event(s) sampled, and the method of flow measurement or estimation; and

(6) The date and duration (in hours) of the storm event(s) sampled, rainfall measurements or estimates of the storm event (in inches) which generated the sampled runoff and the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event (in hours);

(F) Operators of a discharge which is composed entirely of storm water are exempt from the requirements of §122.21 (g)(2), (g)(3), (g)(4), (g)(5), (g)(7)(iii), (g)(7)(iv), (g)(7)(v), and (g)(7)(viii); and

(G) Operators of new sources or new discharges (as defined in §122.2 of this part) which are composed in part or entirely of storm water must include estimates for the pollutants or parameters listed in paragraph (c)(1)(i)(E) of this section instead of actual sampling data, along with the source of each estimate. Operators of new sources or new discharges composed in part or entirely of storm water must provide quantitative data

for the parameters listed in paragraph (c)(1)(i)(E) of this section within two years after commencement of discharge, unless such data has already been reported under the monitoring requirements of the NPDES permit for the discharge. Operators of a new source or new discharge which is composed entirely of storm water are exempt from the requirements of §122.21 (k)(3)(ii), (k)(3)(iii), and (k)(5).

(ii) An operator of an existing or new storm water discharge that is associated with industrial activity solely under paragraph (b)(14)(x) of this section or is associated with small construction activity solely under paragraph (b)(15) of this section, is exempt from the requirements of §122.21(g) and paragraph (c)(1)(i) of this section. Such operator shall provide a narrative description of:

(A) The location (including a map) and the nature of the construction activity;

(B) The total area of the site and the area of the site that is expected to undergo excavation during the life of the permit;

(C) Proposed measures, including best management practices, to control pollutants in storm water discharges during construction, including a brief description of applicable State and local erosion and sediment control requirements;

(D) Proposed measures to control pollutants in storm water discharges that will occur after construction operations have been completed, including a brief description of applicable State or local erosion and sediment control requirements;

(E) An estimate of the runoff coefficient of the site and the increase in impervious area after the construction addressed in the permit application is completed, the nature of fill material and existing data describing the soil or the quality of the discharge; and

(F) The name of the receiving water.

(iii) The operator of an existing or new discharge composed entirely of storm water from an oil or gas exploration, production, processing, or treatment operation, or transmission facility is not required to submit a permit application in accordance with paragraph (c)(1)(i) of this section, unless the facility:

(A) Has had a discharge of storm water resulting in the discharge of a reportable quantity for which notification is or was required pursuant to 40 CFR 117.21 or 40 CFR 302.6 at anytime since November 16, 1987; or

(B) Has had a discharge of storm water resulting in the discharge of a reportable quantity for which notification is or was required pursuant to 40 CFR 110.6 at any time since November 16, 1987; or

(C) Contributes to a violation of a water quality standard.

(iv) The operator of an existing or new discharge composed entirely of storm water from a mining operation is not required to submit a permit application unless the discharge has come into contact with, any overburden, raw material, intermediate products, finished product, byproduct or waste products located on the site of such operations.

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(v) Applicants shall provide such other information the Director may reasonably require under §122.21(g)(13) of this part to determine whether to issue a permit and may require any facility subject to paragraph (c)(1)(ii) of this section to comply with paragraph (c)(1)(i) of this section.

(2) [Reserved]

(d) *Application requirements for large and medium municipal separate storm sewer discharges.* The operator of a discharge from a large or medium municipal separate storm sewer or a municipal separate storm sewer that is designated by the Director under paragraph (a)(1)(v) of this section, may submit a jurisdiction-wide or system-wide permit application. Where more than one public entity owns or operates a municipal separate storm sewer within a geographic area (including adjacent or interconnected municipal separate storm sewer systems), such operators may be a coapplicant to the same application. Permit applications for discharges from large and medium municipal storm sewers or municipal storm sewers designated under paragraph (a)(1)(v) of this section shall include;

(1) *Part 1.* Part 1 of the application shall consist of;

(i) *General information.* The applicants' name, address, telephone number of contact person, ownership status and status as a State or local government entity.

(ii) *Legal authority.* A description of existing legal authority to control discharges to the municipal separate storm sewer system. When existing legal authority is not sufficient to meet the criteria provided in paragraph (d)(2)(i) of this section, the description shall list additional authorities as will be necessary to meet the criteria and shall include a schedule and commitment to seek such additional authority that will be needed to meet the criteria.

(iii) *Source identification.* (A) A description of the historic use of ordinances, guidance or other controls which limited the discharge of non-storm water discharges to any Publicly Owned Treatment Works serving the same area as the municipal separate storm sewer system.

(B) A USGS 7.5 minute topographic map (or equivalent topographic map with a scale between 1:10,000 and 1:24,000 if cost effective) extending one mile beyond the service boundaries of the municipal storm sewer system covered by the permit application. The following information shall be provided:

(1) The location of known municipal storm sewer system outfalls discharging to waters of the United States;

(2) A description of the land use activities (e.g. divisions indicating undeveloped, residential, commercial, agricultural and industrial uses) accompanied with estimates of population densities and projected growth for a ten year period within the drainage area served by the separate storm sewer. For each land use type, an estimate of an average runoff coefficient shall be provided;

(3) The location and a description of the activities of the facility of each currently operating or closed municipal landfill or other treatment, storage or disposal facility for municipal waste;

(4) The location and the permit number of any known discharge to the municipal storm sewer that has been issued a NPDES permit;

(5) The location of major structural controls for storm water discharge (retention basins, detention basins, major infiltration devices, etc.); and

(6) The identification of publicly owned parks, recreational areas, and other open lands.

(iv) *Discharge characterization.* (A) Monthly mean rain and snow fall estimates (or summary of weather bureau data) and the monthly average number of storm events.

(B) Existing quantitative data describing the volume and quality of discharges from the municipal storm sewer, including a description of the outfalls sampled, sampling procedures and analytical methods used.

(C) A list of water bodies that receive discharges from the municipal separate storm sewer system, including downstream segments, lakes and estuaries, where pollutants from the system discharges may accumulate and cause water degradation and a brief description of known water quality impacts. At a minimum, the description of impacts shall include a description of whether the water bodies receiving such discharges have been:

(1) Assessed and reported in section 305(b) reports submitted by the State, the basis for the assessment (evaluated or monitored), a summary of designated use support and attainment of Clean Water Act (CWA) goals (fishable and swimmable waters), and causes of nonsupport of designated uses;

(2) Listed under section 304(l)(1)(A)(i), section 304(l)(1)(A)(ii), or section 304(l)(1)(B) of the CWA that is not expected to meet water quality standards or water quality goals;

(3) Listed in State Nonpoint Source Assessments required by section 319(a) of the CWA that, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain water quality standards due to storm sewers, construction, highway maintenance and runoff from municipal landfills and municipal sludge adding significant pollution (or contributing to a violation of water quality standards);

(4) Identified and classified according to eutrophic condition of publicly owned lakes listed in State reports required under section 314(a) of the CWA (include the following: A description of those publicly owned lakes for which uses are known to be impaired; a description of procedures, processes and methods to control the discharge of pollutants from municipal separate storm sewers into such lakes; and a description of methods and procedures to restore the quality of such lakes);

(5) Areas of concern of the Great Lakes identified by the International Joint Commission;

(6) Designated estuaries under the National Estuary Program under section 320 of the CWA;

(7) Recognized by the applicant as highly valued or sensitive waters;

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(8) Defined by the State or U.S. Fish and Wildlife Services's National Wetlands Inventory as wetlands; and

(9) Found to have pollutants in bottom sediments, fish tissue or biosurvey data.

(D) *Field screening.* Results of a field screening analysis for illicit connections and illegal dumping for either selected field screening points or major outfalls covered in the permit application. At a minimum, a screening analysis shall include a narrative description, for either each field screening point or major outfall, of visual observations made during dry weather periods. If any flow is observed, two grab samples shall be collected during a 24 hour period with a minimum period of four hours between samples. For all such samples, a narrative description of the color, odor, turbidity, the presence of an oil sheen or surface scum as well as any other relevant observations regarding the potential presence of non-storm water discharges or illegal dumping shall be provided. In addition, a narrative description of the results of a field analysis using suitable methods to estimate pH, total chlorine, total copper, total phenol, and detergents (or surfactants) shall be provided along with a description of the flow rate. Where the field analysis does not involve analytical methods approved under 40 CFR part 136, the applicant shall provide a description of the method used including the name of the manufacturer of the test method along with the range and accuracy of the test. Field screening points shall be either major outfalls or other outfall points (or any other point of access such as manholes) randomly located throughout the storm sewer system by placing a grid over a drainage system map and identifying those cells of the grid which contain a segment of the storm sewer system or major outfall. The field screening points shall be established using the following guidelines and criteria:

(1) A grid system consisting of perpendicular north-south and east-west lines spaced 1/4 mile apart shall be overlaid on a map of the municipal storm sewer system, creating a series of cells;

(2) All cells that contain a segment of the storm sewer system shall be identified; one field screening point shall be selected in each cell; major outfalls may be used as field screening points;

(3) Field screening points should be located downstream of any sources of suspected illegal or illicit activity;

(4) Field screening points shall be located to the degree practicable at the farthest manhole or other accessible location downstream in the system, within each cell; however, safety of personnel and accessibility of the location should be considered in making this determination;

(5) Hydrological conditions; total drainage area of the site; population density of the site; traffic density; age of the structures or buildings in the area; history of the area; and land use types;

(6) For medium municipal separate storm sewer systems, no more than 250 cells need to have identified field screening points; in large municipal separate storm

sewer systems, no more than 500 cells need to have identified field screening points; cells established by the grid that contain no storm sewer segments will be eliminated from consideration; if fewer than 250 cells in medium municipal sewers are created, and fewer than 500 in large systems are created by the overlay on the municipal sewer map, then all those cells which contain a segment of the sewer system shall be subject to field screening (unless access to the separate storm sewer system is impossible); and

(7) Large or medium municipal separate storm sewer systems which are unable to utilize the procedures described in paragraphs (d)(1)(iv)(D) (1) through (6) of this section, because a sufficiently detailed map of the separate storm sewer systems is unavailable, shall field screen no more than 500 or 250 major outfalls respectively (or all major outfalls in the system, if less); in such circumstances, the applicant shall establish a grid system consisting of north-south and east-west lines spaced 1/4 mile apart as an overlay to the boundaries of the municipal storm sewer system, thereby creating a series of cells; the applicant will then select major outfalls in as many cells as possible until at least 500 major outfalls (large municipalities) or 250 major outfalls (medium municipalities) are selected; a field screening analysis shall be undertaken at these major outfalls.

(E) *Characterization plan.* Information and a proposed program to meet the requirements of paragraph (d)(2)(iii) of this section. Such description shall include: the location of outfalls or field screening points appropriate for representative data collection under paragraph (d)(2)(iii)(A) of this section, a description of why the outfall or field screening point is representative, the seasons during which sampling is intended, a description of the sampling equipment. The proposed location of outfalls or field screening points for such sampling should reflect water quality concerns (see paragraph (d)(1)(iv)(C) of this section) to the extent practicable.

(v) *Management programs.* (A) A description of the existing management programs to control pollutants from the municipal separate storm sewer system. The description shall provide information on existing structural and source controls, including operation and maintenance measures for structural controls, that are currently being implemented. Such controls may include, but are not limited to: Procedures to control pollution resulting from construction activities; floodplain management controls; wetland protection measures; best management practices for new subdivisions; and emergency spill response programs. The description may address controls established under State law as well as local requirements.

(B) A description of the existing program to identify illicit connections to the municipal storm sewer system. The description should include inspection procedures and methods for detecting and preventing illicit discharges, and describe areas where this program has been implemented.

(vi) *Fiscal resources.* (A) A description of the financial resources currently available to the municipality to

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complete part 2 of the permit application. A description of the municipality's budget for existing storm water programs, including an overview of the municipality's financial resources and budget, including overall indebtedness and assets, and sources of funds for storm water programs.

(2) *Part 2.* Part 2 of the application shall consist of:

(i) *Adequate legal authority.* A demonstration that the applicant can operate pursuant to legal authority established by statute, ordinance or series of contracts which authorizes or enables the applicant at a minimum to:

(A) Control through ordinance, permit, contract, order or similar means, the contribution of pollutants to the municipal storm sewer by storm water discharges associated with industrial activity and the quality of storm water discharged from sites of industrial activity;

(B) Prohibit through ordinance, order or similar means, illicit discharges to the municipal separate storm sewer;

(C) Control through ordinance, order or similar means the discharge to a municipal separate storm sewer of spills, dumping or disposal of materials other than storm water;

(D) Control through interagency agreements among coapplicants the contribution of pollutants from one portion of the municipal system to another portion of the municipal system;

(E) Require compliance with conditions in ordinances, permits, contracts or orders; and

(F) Carry out all inspection, surveillance and monitoring procedures necessary to determine compliance and noncompliance with permit conditions including the prohibition on illicit discharges to the municipal separate storm sewer.

(ii) *Source identification.* The location of any major outfall that discharges to waters of the United States that was not reported under paragraph (d)(1)(iii)(B)(1) of this section. Provide an inventory, organized by watershed of the name and address, and a description (such as SIC codes) which best reflects the principal products or services provided by each facility which may discharge, to the municipal separate storm sewer, storm water associated with industrial activity;

(iii) *Characterization data.* When "quantitative data" for a pollutant are required under paragraph (d)(2)(iii)(A)(3) of this section, the applicant must collect a sample of effluent in accordance with 40 CFR 122.21(g)(7) and analyze it for the pollutant in accordance with analytical methods approved under part 136 of this chapter. When no analytical method is approved the applicant may use any suitable method but must provide a description of the method. The applicant must provide information characterizing the quality and quantity of discharges covered in the permit application, including:

(A) Quantitative data from representative outfalls designated by the Director (based on information received in part 1 of the application, the Director shall designate between five and ten outfalls or field screening points as representative of the commercial, residential and industrial land use activities of the

drainage area contributing to the system or, where there are less than five outfalls covered in the application, the Director shall designate all outfalls) developed as follows:

(1) For each outfall or field screening point designated under this subparagraph, samples shall be collected of storm water discharges from three storm events occurring at least one month apart in accordance with the requirements at §122.21(g)(7) (the Director may allow exemptions to sampling three storm events when climatic conditions create good cause for such exemptions);

(2) A narrative description shall be provided of the date and duration of the storm event(s) sampled, rainfall estimates of the storm event which generated the sampled discharge and the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event;

(3) For samples collected and described under paragraphs (d)(2)(iii) (A)(1) and (A)(2) of this section, quantitative data shall be provided for: the organic pollutants listed in Table II; the pollutants listed in Table III (toxic metals, cyanide, and total phenols) of appendix D of 40 CFR part 122, and for the following pollutants:

Total suspended solids (TSS)

Total dissolved solids (TDS)

COD

BOD5

Oil and grease

Fecal coliform

Fecal streptococcus

pH

Total Kjeldahl nitrogen

Nitrate plus nitrite

Dissolved phosphorus

Total ammonia plus organic nitrogen

Total phosphorus

(4) Additional limited quantitative data required by the Director for determining permit conditions (the Director may require that quantitative data shall be provided for additional parameters, and may establish sampling conditions such as the location, season of sample collection, form of precipitation (snow melt, rainfall) and other parameters necessary to insure representativeness);

(B) Estimates of the annual pollutant load of the cumulative discharges to waters of the United States from all identified municipal outfalls and the event mean concentration of the cumulative discharges to waters of the United States from all identified municipal outfalls during a storm event (as described under §122.21(c)(7)) for BOD5, COD, TSS, dissolved solids, total nitrogen, total ammonia plus organic nitrogen, total phosphorus, dissolved phosphorus, cadmium, copper, lead, and zinc. Estimates shall be accompanied by a description of the procedures for estimating constituent loads and concentrations, including any modelling, data analysis, and calculation methods;

(C) A proposed schedule to provide estimates for each major outfall identified in either paragraph (d)(2)(ii) or

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(d)(1)(iii)(B)(1) of this section of the seasonal pollutant load and of the event mean concentration of a representative storm for any constituent detected in any sample required under paragraph (d)(2)(iii)(A) of this section; and

(D) A proposed monitoring program for representative data collection for the term of the permit that describes the location of outfalls or field screening points to be sampled (or the location of instream stations), why the location is representative, the frequency of sampling, parameters to be sampled, and a description of sampling equipment.

(iv) *Proposed management program.* A proposed management program covers the duration of the permit. It shall include a comprehensive planning process which involves public participation and where necessary inter-governmental coordination, to reduce the discharge of pollutants to the maximum extent practicable using management practices, control techniques and system, design and engineering methods, and such other provisions which are appropriate. The program shall also include a description of staff and equipment available to implement the program. Separate proposed programs may be submitted by each coapplicant. Proposed programs may impose controls on a systemwide basis, a watershed basis, a jurisdiction basis, or on individual outfalls. Proposed programs will be considered by the Director when developing permit conditions to reduce pollutants in discharges to the maximum extent practicable. Proposed management programs shall describe priorities for implementing controls. Such programs shall be based on:

(A) A description of structural and source control measures to reduce pollutants from runoff from commercial and residential areas that are discharged from the municipal storm sewer system that are to be implemented during the life of the permit, accompanied with an estimate of the expected reduction of pollutant loads and a proposed schedule for implementing such controls. At a minimum, the description shall include:

(1) A description of maintenance activities and a maintenance schedule for structural controls to reduce pollutants (including floatables) in discharges from municipal separate storm sewers;

(2) A description of planning procedures including a comprehensive master plan to develop, implement and enforce controls to reduce the discharge of pollutants from municipal separate storm sewers which receive discharges from areas of new development and significant redevelopment. Such plan shall address controls to reduce pollutants in discharges from municipal separate storm sewers after construction is completed. (Controls to reduce pollutants in discharges from municipal separate storm sewers containing construction site runoff are addressed in paragraph (d)(2)(iv)(D) of this section;

(3) A description of practices for operating and maintaining public streets, roads and highways and procedures for reducing the impact on receiving waters of discharges from municipal storm sewer systems, including pollutants discharged as a result of deicing activities;

(4) A description of procedures to assure that flood management projects assess the impacts on the water quality of receiving water bodies and that existing structural flood control devices have been evaluated to determine if retrofitting the device to provide additional pollutant removal from storm water is feasible;

(5) A description of a program to monitor pollutants in runoff from operating or closed municipal landfills or other treatment, storage or disposal facilities for municipal waste, which shall identify priorities and procedures for inspections and establishing and implementing control measures for such discharges (this program can be coordinated with the program developed under paragraph (d)(2)(iv)(C) of this section); and

(6) A description of a program to reduce to the maximum extent practicable, pollutants in discharges from municipal separate storm sewers associated with the application of pesticides, herbicides and fertilizer which will include, as appropriate, controls such as educational activities, permits, certifications and other measures for commercial applicators and distributors, and controls for application in public right-of-ways and at municipal facilities.

(B) A description of a program, including a schedule, to detect and remove (or require the discharger to the municipal separate storm sewer to obtain a separate NPDES permit for) illicit discharges and improper disposal into the storm sewer. The proposed program shall include:

(1) A description of a program, including inspections, to implement and enforce an ordinance, orders or similar means to prevent illicit discharges to the municipal separate storm sewer system; this program description shall address all types of illicit discharges, however the following category of non-storm water discharges or flows shall be addressed where such discharges are identified by the municipality as sources of pollutants to waters of the United States: water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20)) to separate storm sewers, uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and street wash water (program descriptions shall address discharges or flows from fire fighting only where such discharges or flows are identified as significant sources of pollutants to waters of the United States);

(2) A description of procedures to conduct on-going field screening activities during the life of the permit, including areas or locations that will be evaluated by such field screens;

(3) A description of procedures to be followed to investigate portions of the separate storm sewer system that, based on the results of the field screen, or other appropriate information, indicate a reasonable potential of

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containing illicit discharges or other sources of non-storm water (such procedures may include: sampling procedures for constituents such as fecal coliform, fecal streptococcus, surfactants (MBAS), residual chlorine, fluorides and potassium; testing with fluorometric dyes; or conducting in storm sewer inspections where safety and other considerations allow. Such description shall include the location of storm sewers that have been identified for such evaluation);

(4) A description of procedures to prevent, contain, and respond to spills that may discharge into the municipal separate storm sewer;

(5) A description of a program to promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges from municipal separate storm sewers;

(6) A description of educational activities, public information activities, and other appropriate activities to facilitate the proper management and disposal of used oil and toxic materials; and

(7) A description of controls to limit infiltration of seepage from municipal sanitary sewers to municipal separate storm sewer systems where necessary;

(C) A description of a program to monitor and control pollutants in storm water discharges to municipal systems from municipal landfills, hazardous waste treatment, disposal and recovery facilities, industrial facilities that are subject to section 313 of title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), and industrial facilities that the municipal permit applicant determines are contributing a substantial pollutant loading to the municipal storm sewer system. The program shall:

(1) Identify priorities and procedures for inspections and establishing and implementing control measures for such discharges;

(2) Describe a monitoring program for storm water discharges associated with the industrial facilities identified in paragraph (d)(2)(iv)(C) of this section, to be implemented during the term of the permit, including the submission of quantitative data on the following constituents: any pollutants limited in effluent guidelines subcategories, where applicable; any pollutant listed in an existing NPDES permit for a facility; oil and grease, COD, pH, BOD₅, TSS, total phosphorus, total Kjeldahl nitrogen, nitrate plus nitrite nitrogen, and any information on discharges required under §122.21(g)(7)(vi) and (vii).

(D) A description of a program to implement and maintain structural and non-structural best management practices to reduce pollutants in storm water runoff from construction sites to the municipal storm sewer system, which shall include:

(1) A description of procedures for site planning which incorporate consideration of potential water quality impacts;

(2) A description of requirements for nonstructural and structural best management practices;

(3) A description of procedures for identifying priorities for inspecting sites and enforcing control measures which consider the nature of the construction activity,

topography, and the characteristics of soils and receiving water quality; and

(4) A description of appropriate educational and training measures for construction site operators.

(v) *Assessment of controls.* Estimated reductions in loadings of pollutants from discharges of municipal storm sewer constituents from municipal storm sewer systems expected as the result of the municipal storm water quality management program. The assessment shall also identify known impacts of storm water controls on ground water.

(vi) *Fiscal analysis.* For each fiscal year to be covered by the permit, a fiscal analysis of the necessary capital and operation and maintenance expenditures necessary to accomplish the activities of the programs under paragraphs (d)(2) (iii) and (iv) of this section. Such analysis shall include a description of the source of funds that are proposed to meet the necessary expenditures, including legal restrictions on the use of such funds.

(vii) Where more than one legal entity submits an application, the application shall contain a description of the roles and responsibilities of each legal entity and procedures to ensure effective coordination.

(viii) Where requirements under paragraph (d)(1)(iv)(E), (d)(2)(ii), (d)(2)(iii)(B) and (d)(2)(iv) of this section are not practicable or are not applicable, the Director may exclude any operator of a discharge from a municipal separate storm sewer which is designated under paragraph (a)(1)(v), (b)(4)(ii) or (b)(7)(ii) of this section from such requirements. The Director shall not exclude the operator of a discharge from a municipal separate storm sewer identified in appendix F, G, H or I of part 122, from any of the permit application requirements under this paragraph except where authorized under this section.

(e) *Application deadlines.* Any operator of a point source required to obtain a permit under this section that does not have an effective NPDES permit authorizing discharges from its storm water outfalls shall submit an application in accordance with the following deadlines:

(1) *Storm water discharges associated with industrial activity.* (i) Except as provided in paragraph (e)(1)(ii) of this section, for any storm water discharge associated with industrial activity identified in paragraphs (b)(14)(i) through (xi) of this section, that is not part of a group application as described in paragraph (c)(2) of this section or that is not authorized by a storm water general permit, a permit application made pursuant to paragraph (c) of this section must be submitted to the Director by October 1, 1992;

(ii) For any storm water discharge associated with industrial activity from a facility that is owned or operated by a municipality with a population of less than 100,000 that is not authorized by a general or individual permit, other than an airport, powerplant, or uncontrolled sanitary landfill, the permit application must be submitted to the Director by March 10, 2003.

(2) For any group application submitted in accordance with paragraph (c)(2) of this section:

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(i) *Part 1.* (A) Except as provided in paragraph (e)(2)(i)(B) of this section, part 1 of the application shall be submitted to the Director, Office of Wastewater Enforcement and Compliance by September 30, 1991;

(B) Any municipality with a population of less than 250,000 shall not be required to submit a part 1 application before May 18, 1992.

(C) For any storm water discharge associated with industrial activity from a facility that is owned or operated by a municipality with a population of less than 100,000 other than an airport, powerplant, or uncontrolled sanitary landfill, permit applications requirements are reserved.

(ii) Based on information in the part 1 application, the Director will approve or deny the members in the group application within 60 days after receiving part 1 of the group application.

(iii) *Part 2.* (A) Except as provided in paragraph (e)(2)(iii)(B) of this section, part 2 of the application shall be submitted to the Director, Office of Wastewater Enforcement and Compliance by October 1, 1992;

(B) Any municipality with a population of less than 250,000 shall not be required to submit a part 1 application before May 17, 1993.

(C) For any storm water discharge associated with industrial activity from a facility that is owned or operated by a municipality with a population of less than 100,000 other than an airport, powerplant, or uncontrolled sanitary landfill, permit applications requirements are reserved.

(iv) *Rejected facilities.* (A) Except as provided in paragraph (e)(2)(iv)(B) of this section, facilities that are rejected as members of the group shall submit an individual application (or obtain coverage under an applicable general permit) no later than 12 months after the date of receipt of the notice of rejection or October 1, 1992, whichever comes first.

(B) Facilities that are owned or operated by a municipality and that are rejected as members of part 1 group application shall submit an individual application no later than 180 days after the date of receipt of the notice of rejection or October 1, 1992, whichever is later.

(v) A facility listed under paragraph (b)(14) (i)-(xi) of this section may add on to a group application submitted in accordance with paragraph (e)(2)(i) of this section at the discretion of the Office of Water Enforcement and Permits, and only upon a showing of good cause by the facility and the group applicant; the request for the addition of the facility shall be made no later than February 18, 1992; the addition of the facility shall not cause the percentage of the facilities that are required to submit quantitative data to be less than 10%, unless there are over 100 facilities in the group that are submitting quantitative data; approval to become part of group application must be obtained from the group or the trade association representing the individual facilities.

(3) For any discharge from a large municipal separate storm sewer system;

(i) Part 1 of the application shall be submitted to the Director by November 18, 1991;

(ii) Based on information received in the part 1 application the Director will approve or deny a sampling plan under paragraph (d)(1)(iv)(E) of this section within 90 days after receiving the part 1 application;

(iii) Part 2 of the application shall be submitted to the Director by November 16, 1992.

(4) For any discharge from a medium municipal separate storm sewer system;

(i) Part 1 of the application shall be submitted to the Director by May 18, 1992.

(ii) Based on information received in the part 1 application the Director will approve or deny a sampling plan under paragraph (d)(1)(iv)(E) of this section within 90 days after receiving the part 1 application.

(iii) Part 2 of the application shall be submitted to the Director by May 17, 1993.

(5) A permit application shall be submitted to the Director within 180 days of notice, unless permission for a later date is granted by the Director (see §124.52(c) of this chapter), for:

(i) A storm water discharge that the Director, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator, determines that the discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States (see paragraphs (a)(1)(v) and (b)(15)(ii) of this section);

(ii) A storm water discharge subject to paragraph (c)(1)(v) of this section.

(6) Facilities with existing NPDES permits for storm water discharges associated with industrial activity shall maintain existing permits. Facilities with permits for storm water discharges associated with industrial activity which expire on or after May 18, 1992 shall submit a new application in accordance with the requirements of 40 CFR 122.21 and 40 CFR 122.26(c) (Form 1, Form 2F, and other applicable Forms) 180 days before the expiration of such permits.

(7) The Director shall issue or deny permits for discharges composed entirely of storm water under this section in accordance with the following schedule:

(i)(A) Except as provided in paragraph (e)(7)(i)(B) of this section, the Director shall issue or deny permits for storm water discharges associated with industrial activity no later than October 1, 1993, or, for new sources or existing sources which fail to submit a complete permit application by October 1, 1992, one year after receipt of a complete permit application;

(B) For any municipality with a population of less than 250,000 which submits a timely Part I group application under paragraph (e)(2)(i)(B) of this section, the Director shall issue or deny permits for storm water discharges associated with industrial activity no later than May 17, 1994, or, for any such municipality which fails to submit a complete Part II group permit application by May 17, 1993, one year after receipt of a complete permit application;

(ii) The Director shall issue or deny permits for large municipal separate storm sewer systems no later than November 16, 1993, or, for new sources or existing

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sources which fail to submit a complete permit application by November 16, 1992, one year after receipt of a complete permit application;

(iii) The Director shall issue or deny permits for medium municipal separate storm sewer systems no later than May 17, 1994, or, for new sources or existing sources which fail to submit a complete permit application by May 17, 1993, one year after receipt of a complete permit application.

(8) For any storm water discharge associated with small construction activities identified in paragraph (b)(15)(i) of this section, see §122.21(c)(1). Discharges from these sources require permit authorization by March 10, 2003, unless designated for coverage before then.

(9) For any discharge from a regulated small MS4, the permit application made under §122.33 must be submitted to the Director by:

(i) March 10, 2003 if designated under §122.32(a)(1) unless your MS4 serves a jurisdiction with a population under 10,000 and the NPDES permitting authority has established a phasing schedule under §123.35(d)(3) (see §122.33(c)(1)); or

(ii) Within 180 days of notice, unless the NPDES permitting authority grants a later date, if designated under §122.32(a)(2) (see §122.33(c)(2)).

(f) *Petitions.* (1) Any operator of a municipal separate storm sewer system may petition the Director to require a separate NPDES permit (or a permit issued under an approved NPDES State program) for any discharge into the municipal separate storm sewer system.

(2) Any person may petition the Director to require a NPDES permit for a discharge which is composed entirely of storm water which contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

(3) The owner or operator of a municipal separate storm sewer system may petition the Director to reduce the Census estimates of the population served by such separate system to account for storm water discharged to combined sewers as defined by 40 CFR 35.2005(b)(11) that is treated in a publicly owned treatment works. In municipalities in which combined sewers are operated, the Census estimates of population may be reduced proportional to the fraction, based on estimated lengths, of the length of combined sewers over the sum of the length of combined sewers and municipal separate storm sewers where an applicant has submitted the NPDES permit number associated with each discharge point and a map indicating areas served by combined sewers and the location of any combined sewer overflow discharge point.

(4) Any person may petition the Director for the designation of a large, medium, or small municipal separate storm sewer system as defined by paragraph (b)(4)(iv), (b)(7)(iv), or (b)(16) of this section.

(5) The Director shall make a final determination on any petition received under this section within 90 days after receiving the petition with the exception of petitions to designate a small MS4 in which case the

Director shall make a final determination on the petition within 180 days after its receipt.

* * * * *

§122.28 General permits (applicable to State NPDES programs, see §123.25).

* * * * *

(b)(2) *Authorization to discharge, or authorization to engage in sludge use and disposal practices.* (i) Except as provided in paragraphs (b)(2)(v) and (b)(2)(vi) of this section, dischargers (or treatment works treating domestic sewage) seeking coverage under a general permit shall submit to the Director a written notice of intent to be covered by the general permit. A discharger (or treatment works treating domestic sewage) who fails to submit a notice of intent in accordance with the terms of the permit is not authorized to discharge, (or in the case of sludge disposal permit, to engage in a sludge use or disposal practice), under the terms of the general permit unless the general permit, in accordance with paragraph (b)(2)(v) of this section, contains a provision that a notice of intent is not required or the Director notifies a discharger (or treatment works treating domestic sewage) that it is covered by a general permit in accordance with paragraph (b)(2)(vi) of this section. A complete and timely, notice of intent (NOI), to be covered in accordance with general permit requirements, fulfills the requirements for permit applications for purposes of §§122.6, 122.21 and 122.26.

(ii) The contents of the notice of intent shall be specified in the general permit and shall require the submission of information necessary for adequate program implementation, including at a minimum, the legal name and address of the owner or operator, the facility name and address, type of facility or discharges, and the receiving stream(s). General permits for storm water discharges associated with industrial activity from inactive mining, inactive oil and gas operations, or inactive landfills occurring on Federal lands where an operator cannot be identified may contain alternative notice of intent requirements. All notices of intent shall be signed in accordance with §122.22. Notices of intent for coverage under a general permit for concentrated animal feeding operations must include the information specified in §122.21(i)(1), including a topographic map.

(iii) General permits shall specify the deadlines for submitting notices of intent to be covered and the date(s) when a discharger is authorized to discharge under the permit;

(iv) General permits shall specify whether a discharger (or treatment works treating domestic sewage) that has submitted a complete and timely notice of intent to be covered in accordance with the general permit and that is eligible for coverage under the permit, is authorized to discharge, (or in the case of a sludge disposal permit, to engage in a sludge use or disposal practice), in accordance with the permit either upon receipt of the notice of intent by the Director, after a waiting period specified in the general permit, on a date specified in the general permit, or upon receipt of notification of inclusion by the Director. Coverage may be

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terminated or revoked in accordance with paragraph (b)(3) of this section.

(v) Discharges other than discharges from publicly owned treatment works, combined sewer overflows, municipal separate storm sewer systems, primary industrial facilities, and storm water discharges associated with industrial activity, may, at the discretion of the Director, be authorized to discharge under a general permit without submitting a notice of intent where the Director finds that a notice of intent requirement would be inappropriate. In making such a finding, the Director shall consider: the type of discharge; the expected nature of the discharge; the potential for toxic and conventional pollutants in the discharges; the expected volume of the discharges; other means of identifying discharges covered by the permit; and the estimated number of discharges to be covered by the permit. The Director shall provide in the public notice of the general permit the reasons for not requiring a notice of intent.

(vi) The Director may notify a discharger (or treatment works treating domestic sewage) that it is covered by a general permit, even if the discharger (or treatment works treating domestic sewage) has not submitted a notice of intent to be covered. A discharger (or treatment works treating domestic sewage) so notified may request an individual permit under paragraph (b)(3)(iii) of this section.

(3) *Requiring an individual permit.* (i) The Director may require any discharger authorized by a general permit to apply for and obtain an individual NPDES permit. Any interested person may petition the Director to take action under this paragraph. Cases where an individual NPDES permit may be required include the following:

(A) The discharger or “treatment works treating domestic sewage” is not in compliance with the conditions of the general NPDES permit;

(B) A change has occurred in the availability of demonstrated technology or practices for the control or abatement of pollutants applicable to the point source or treatment works treating domestic sewage;

(C) Effluent limitation guidelines are promulgated for point sources covered by the general NPDES permit;

(D) A Water Quality Management plan containing requirements applicable to such point sources is approved;

(E) Circumstances have changed since the time of the request to be covered so that the discharger is no longer appropriately controlled under the general permit, or either a temporary or permanent reduction or elimination of the authorized discharge is necessary;

(F) Standards for sewage sludge use or disposal have been promulgated for the sludge use and disposal practice covered by the general NPDES permit; or

(G) The discharge(s) is a significant contributor of pollutants. In making this determination, the Director may consider the following factors:

(1) The location of the discharge with respect to waters of the United States;

(2) The size of the discharge;

(3) The quantity and nature of the pollutants discharged to waters of the United States; and

(4) Other relevant factors;

(ii) *For EPA issued general permits only,* the Regional Administrator may require any owner or operator authorized by a general permit to apply for an individual NPDES permit as provided in paragraph (b)(3)(i) of this section, only if the owner or operator has been notified in writing that a permit application is required. This notice shall include a brief statement of the reasons for this decision, an application form, a statement setting a time for the owner or operator to file the application, and a statement that on the effective date of the individual NPDES permit the general permit as it applies to the individual permittee shall automatically terminate. The Director may grant additional time upon request of the applicant.

(iii) Any owner or operator authorized by a general permit may request to be excluded from the coverage of the general permit by applying for an individual permit. The owner or operator shall submit an application under §122.21, with reasons supporting the request, to the Director no later than 90 days after the publication by EPA of the general permit in the Federal Register or the publication by a State in accordance with applicable State law. The request shall be processed under part 124 or applicable State procedures. The request shall be granted by issuing of any individual permit if the reasons cited by the owner or operator are adequate to support the request.

(iv) When an individual NPDES permit is issued to an owner or operator otherwise subject to a general NPDES permit, the applicability of the general permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit.

(v) A source excluded from a general permit solely because it already has an individual permit may request that the individual permit be revoked, and that it be covered by the general permit. Upon revocation of the individual permit, the general permit shall apply to the source.

(c) *Offshore oil and gas facilities* (Not applicable to State programs). (1) The Regional Administrator shall, except as provided below, issue general permits covering discharges from offshore oil and gas exploration and production facilities within the Region's jurisdiction. Where the offshore area includes areas, such as areas of biological concern, for which separate permit conditions are required, the Regional Administrator may issue separate general permits, individual permits, or both. The reason for separate general permits or individual permits shall be set forth in the appropriate fact sheets or statements of basis. Any statement of basis or fact sheet for a draft permit shall include the Regional Administrator's tentative determination as to whether the permit applies to “new sources,” “new dischargers,” or existing sources and the reasons for this determination, and the Regional Administrator's proposals as to areas of biological concern subject either to separate individual or general permits. For Federally leased lands, the general permit area should generally be no less extensive than the lease sale area defined by the

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Department of the Interior.

(2) Any interested person, including any prospective permittee, may petition the Regional Administrator to issue a general permit. Unless the Regional Administrator determines under paragraph (c)(1) of this section that no general permit is appropriate, he shall promptly provide a project decision schedule covering the issuance of the general permit or permits for any lease sale area for which the Department of the Interior has published a draft environmental impact statement. The project decision schedule shall meet the requirements of §124.3(g), and shall include a schedule providing for the issuance of the final general permit or permits not later than the date of the final notice of sale projected by the Department of the Interior or six months after the date of the request, whichever is later. The Regional Administrator may, at his discretion, issue a project decision schedule for offshore oil and gas facilities in the territorial seas.

(3) Nothing in this paragraph (c) shall affect the authority of the Regional Administrator to require an individual permit under §122.28(b)(3)(i) (A) through (G).

(Clean Water Act (33 U.S.C. 1251 *et seq.*), Safe Drinking Water Act (42 U.S.C. 300f *et seq.*), Clean Air Act (42 U.S.C. 7401 *et seq.*), Resource Conservation and Recovery Act (42 U.S.C. 6901 *et seq.*)

§122.42 Additional conditions applicable to specified categories of NPDES permits (applicable to State NPDES programs, see §123.25).

* * * * *

(c) *Municipal separate storm sewer systems.* The operator of a large or medium municipal separate storm sewer system or a municipal separate storm sewer that has been designated by the Director under §122.26(a)(1)(v) of this part must submit an annual report by the anniversary of the date of the issuance of the permit for such system. The report shall include:

(1) The status of implementing the components of the storm water management program that are established as permit conditions;

(2) Proposed changes to the storm water management programs that are established as permit condition. Such proposed changes shall be consistent with §122.26(d)(2)(iii) of this part; and

(3) Revisions, if necessary, to the assessment of controls and the fiscal analysis reported in the permit application under §122.26(d)(2)(iv) and (d)(2)(v) of this part;

(4) A summary of data, including monitoring data, that is accumulated throughout the reporting year;

(5) Annual expenditures and budget for year following each annual report;

(6) A summary describing the number and nature of enforcement actions, inspections, and public education programs;

(7) Identification of water quality improvements or degradation;

* * * * *

Part 260—General

Subpart A—General

- 260.1 Purpose, scope, and applicability.
- 260.2 Availability of information; confidentiality of information.
- 260.3 Use of number and gender.

Subpart B—Definitions

- 260.10 Definitions.
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Subpart C—Rulemaking Petitions

- 260.20 General.
- 260.21 Petitions for equivalent testing or analytical methods.
- 260.22 Petitions to amend part 261 to exclude a waste produced at a particular facility.
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- 260.30 Variances from classification as a solid waste.
- 260.31 Standards and criteria for variances from classification as a solid waste.
- 260.32 Variances to be classified as a boiler.
- 260.33 Procedures for variances from classification as a solid waste or to be classified as a boiler.
- 260.40 Additional regulation of certain hazardous waste recycling activities on a case-by-case basis.
- 260.41 Procedures for case-by-case regulation of hazardous waste recycling activities.

Appendix I to Part 260—Overview of Subtitle C Regulations

Part 261—Identification and listing of hazardous waste

Subpart A—General

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- 261.1 Purpose and scope.
- 261.2 Definition of solid waste.
- 261.3 Definition of hazardous waste.
- 261.4 Exclusions.
- 261.5 Special requirements for hazardous waste generated by conditionally exempt small quantity generators.
- 261.6 Requirements for recyclable materials.
- 261.7 Residues of hazardous waste in empty containers.
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- 261.9 Requirements for Universal Waste.

Subpart B—Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste

- 261.10 Criteria for identifying the characteristics of hazardous waste.
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Subpart C—Characteristics of Hazardous Waste

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Subpart D—Lists of Hazardous Wastes

- 261.30 General.
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Subpart E—Exclusions/Exemptions

- 261.38 Exclusion of comparable fuel and syngas fuel.
- 261.39 Conditional Exclusion for Used, Broken Cathode Ray Tubes (CRTs) and Processed CRT Glass Undergoing Recycling.
- 261.40 Conditional Exclusion for Used, Intact Cathode Ray Tubes (CRTs) Exported for Recycling.
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Appendix I to Part 261—Representative Sampling Methods
 Appendix II to Part 261 [Reserved]
 Appendix III to Part 261 [Reserved]
 Appendix IV to Part 261 [Reserved for Radioactive Waste Test Methods]
 Appendix V to Part 261 [Reserved for Infectious Waste Treatment Specifications]
 Appendix VI to Part 261 [Reserved for Etiologic Agents]
 Appendix VII to Part 261—Basis for Listing Hazardous Waste
 Appendix
 VIII to Part 261—Hazardous Constituents

Subpart A—General

§261.1 Purpose and scope.

(a) This part identifies those solid wastes which are subject to regulation as hazardous wastes under Parts 262 through 265, 268, and Parts 270, 271, and 124 of this chapter and which are subject to the notification requirements of section 3010 of RCRA. In this part:

(1) Subpart A defines the terms “solid waste” and “hazardous waste”, identifies those wastes which are excluded from regulation under Parts 262 through 266, 268 and 270 and establishes special management requirements for hazardous waste produced by conditionally exempt small quantity generators and hazardous waste which is recycled.

(2) Subpart B sets forth the criteria used by EPA to identify characteristics of hazardous waste and to list particular hazardous wastes.

(3) Subpart C identifies characteristics of hazardous waste.

(4) Subpart D lists particular hazardous wastes.

(1) The definition of solid waste contained in this part applies only to wastes that also are hazardous for purposes of the regulations implementing Subtitle C of RCRA. For example, it does not apply to materials (such as non-hazardous scrap, paper, textiles, or rubber) that are not otherwise hazardous wastes and that are recycled.

(2) This part identifies only some of the materials which are solid wastes and hazardous wastes under sections 3007, 3013, and 7003 of RCRA. A material which is not defined as a solid waste in this part, or is not a hazardous waste identified or listed in this part, is still a solid

waste and a hazardous waste for purposes of these sections if:

(i) In the case of sections 3007 and 3013, EPA has reason to believe that the material may be a solid waste within the meaning of section 1004(27) of RCRA and a hazardous waste within the meaning of section 1004(5) of RCRA; or

(ii) In the case of section 7003, the statutory elements are established.

(c) For the purposes of §261.2 and 261.6:

(1) A “spent material” is any material that has been used and as a result of contamination can no longer serve the purpose for which it was produced without processing;

(2) “Sludge” has the same meaning used in §260.10 of this chapter;

(3) A “by-product” is a material that is not one of the primary products of a production process and is not solely or separately produced by the production process. Examples are process residues such as slags or distillation column bottoms. The term does not include a co-product that is produced for the general public’s use and is ordinarily used in the form it is produced by the process.

(4) A material is “reclaimed” if it is processed to recover a usable product, or if it is regenerated. Examples are recovery of lead values from spent batteries and regeneration of spent solvents. In addition, for purposes of §261.2(a)(2)(ii), 261.4(a)(23), and 261.4(a)(24) smelting, melting and refining furnaces are considered to be solely engaged in metals reclamation if the metal recovery from the hazardous secondary materials meets the same requirements as those specified for metals recovery from hazardous waste found in §266.100(d)(1)-(3) of this chapter, and if the residuals meet the requirements specified in §266.112 of this chapter.

(5) A material is “used or reused” if it is either:

(i) Employed as an ingredient (including use as an intermediate) in an industrial process to make a product (for example, distillation bottoms from one process used as feedstock in another process). However, a material will not satisfy this condition if distinct components of the material are recovered as separate end products (as when metals are recovered from metal-containing secondary materials); or

(ii) Employed in a particular function or application as an effective substitute for a commercial product (for example, spent pickle liquor used as phosphorous precipitant and sludge conditioner in wastewater treatment).

(6) “Scrap metal” is bits and pieces of metal parts (e.g., bars, turnings, rods, sheets, wire) or metal pieces that may be combined together with bolts or soldering (e.g., radiators, scrap automobiles, railroad box cars), which when worn or superfluous can be recycled.

(7) A material is “recycled” if it is used, reused, or reclaimed.

(8) A material is “accumulated speculatively” if it is accumulated before being recycled. A material is not accumulated speculatively, however, if the person

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accumulating it can show that the material is potentially recyclable and has a feasible means of being recycled; and that during the calendar year (commencing on January 1)-the amount of material that is recycled, or transferred to a different site for recycling, equals at least 75 percent by weight or volume of the amount of that material accumulated at the beginning of the period. In calculating the percentage of turnover, the 75 percent requirement is to be applied to each material of the same type (e.g., slags from a single smelting process) that is recycled in the same way (i.e., from which the same material is recovered or that is used in the same way). Materials accumulating in units that would be exempt from regulation under §261.4(c) are not to be included in making the calculation. (Materials that are already defined as solid wastes also are not to be included in making the calculation.) Materials are no longer in this category once they are removed from accumulation for recycling, however.

(9) "Excluded scrap metal" is processed scrap metal, unprocessed home scrap metal, and unprocessed prompt scrap metal.

(10) "Processed scrap metal" is scrap metal which has been manually or physically altered to either separate it into distinct materials to enhance economic value or to improve the handling of materials. Processed scrap metal includes, but is not limited to scrap metal which has been baled, shredded, sheared, chopped, crushed, flattened, cut, melted, or separated by metal type (i.e., sorted), and, fines, drosses and related materials which have been agglomerated. (Note: shredded circuit boards being sent for recycling are not considered processed scrap metal. They are covered under the exclusion from the definition of solid waste for shredded circuit boards being recycled (§261.4(a)(14)).

(11) "Home scrap metal" is scrap metal as generated by steel mills, foundries, and refineries such as turnings, cuttings, punchings, and borings.

(12) "Prompt scrap metal" is scrap metal as generated by the metal working/fabrication industries and includes such scrap metal as turnings, cuttings, punchings, and borings. Prompt scrap is also known as industrial or new scrap metal.

§261.2 Definition of solid waste.

(1) A *solid waste* is any discarded material that is not excluded under §261.4(a) or that is not excluded by a variance granted under §§260.30 and 260.31 or that is not excluded by a non-waste determination under §§260.30 and 260.34.

(2)(i) A *discarded material* is any material which is:

(A) Abandoned, as explained in paragraph (b) of this section; or

(B) Recycled, as explained in paragraph (c) of this section; or

(C) Considered inherently waste-like, as explained in paragraph (d) of this section; or

(D) A military munition identified as a solid waste in §266.202.

(ii) A hazardous secondary material is not discarded if it is generated and reclaimed under the control of the generator as defined in §260.10, it is not speculatively accumulated as defined in §261.1(c)(8), it is handled only in non-land-based units and is contained in such units, it is generated and reclaimed within the United States and its territories, it is not otherwise subject to material-specific management conditions under §261.4(a) when reclaimed, it is not a spent lead acid battery (see §266.80 and §273.2), it does not meet the listing description for K171 or K172 in §261.32, and the reclamation of the material is legitimate, as specified under §260.43. (See also the notification requirements of §260.42). (For hazardous secondary materials managed in land-based units, see §261.4(a)(23)).

(b) Materials are solid waste if they are *abandoned* by being:

(1) Disposed of; or

(2) Burned or incinerated; or

(3) Accumulated, stored, or treated (but not recycled) before or in lieu of being abandoned by being disposed of, burned, or incinerated.

(c) Materials are solid wastes if they are *recycled*-or accumulated, stored, or treated before recycling-as specified in paragraphs (c)(1) through (4) of this section.

(1) *Used in a manner constituting disposal*. (i) Materials noted with a "*" in Column 1 of Table 1 are solid wastes when they are:

(A) Applied to or placed on the land in a manner that constitutes disposal; or

(B) Used to produce products that are applied to or placed on the land or are otherwise contained in products that are applied to or placed on the land (in which cases the product itself remains a solid waste).

(ii) However, commercial chemical products listed in §261.33 are not solid wastes if they are applied to the land and that is their ordinary manner of use.

(2) *Burning for energy recovery*. (i) Materials noted with a "*" in column 2 of Table 1 are solid wastes when they are:

(A) Burned to recover energy;

(B) Used to produce a fuel or are otherwise contained in fuels (in which cases the fuel itself remains a solid waste).

(ii) However, commercial chemical products listed in §261.33 are not solid wastes if they are themselves fuels.

(3) *Reclaimed*. Materials noted with a "—" in column 3 of Table 1 are not solid wastes when reclaimed. Materials noted with an "*" in column 3 of Table 1 are solid wastes when reclaimed unless they meet the requirements of §§261.2(a)(2)(ii), or 261.4(a)(17), or 261.4(a)(23), or 261.4(a)(24) or 261.4(a)(25).

(4) *Accumulated speculatively*. Materials noted with a "*" in column 4 of Table 1 are solid wastes when accumulated speculatively.

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TABLE 1

	Use constituting disposal (§261.2(c)(1))	Energy recovery/fuel (§261.2(c)(2))	Reclamation (§261.2(c)(3)) except as provided in 261.4(a)(17), 261.4(a)(23), 261.4(a)(24), or 261.4(a)(25) for mineral processing secondary materials)	Speculative accumulation (§261.2(c)(4))
	1	2	3	4
Spent Materials.....	(*)	(*)	(*)	(*)
Sludges (listed in 40 CFR part 261.31 or 261.32)	(*)	(*)	(*)	(*)
Sludges exhibiting a characteristic of hazardous waste ...	(*)	(*)	—	(*)
By-products (listed in 40 CFR part 261.31 or 261.32)	(*)	(*)	(*)	(*)
By-products exhibiting a characteristic of hazardous waste.....	(*)	(*)	—	(*)
Commercial chemical products listed in 40 CFR 261.33	(*)	(*)	—	—
Scrap metal that is not excluded under §261.4(a)(13)	(*)	(*)	(*)	(*)

Note: The terms “spent materials,” “sludges,” “by-products,” and “scrap metal” and “processed scrap metal” are defined in §261.1.

(d) **Inherently waste-like materials.** The following materials are solid wastes when they are recycled in any manner:

(1) Hazardous Waste Nos. F020, F021 (unless used as an ingredient to make a product at the site of generation), F022, F023, F026, and F028.

(2) Secondary materials fed to a halogen acid furnace that exhibit a characteristic of a hazardous waste or are listed as a hazardous waste as defined in subparts C or D of this part, except for brominated material that meets the following criteria:

(i) The material must contain a bromine concentration of at least 45%; and

(ii) The material must contain less than a total of 1% of toxic organic compounds listed in appendix VIII; and

(iii) The material is processed on-site in the halogen acid furnace via direct conveyance (hard piping).

(3) The Administrator will use the following criteria to add wastes to that list:

(i)(A) The materials are ordinarily disposed of, burned, or incinerated; or

(B) The materials contain toxic constituents listed in Appendix VIII of Part 261 and these constituents are not ordinarily found in raw materials or products for which the materials substitute (or are found in raw materials or products in smaller concentrations) and are not used or reused during the recycling process; and

(ii) The material may pose a substantial hazard to human health and the environment when recycled.

(e) **Materials that are not solid waste when recycled.** (1) Materials are not solid wastes when they can be shown to be recycled by being:

(i) Used or reused as ingredients in an industrial process to make a product, provided the materials are not being reclaimed; or

(ii) Used or reused as effective substitutes for commercial products; or

(iii) Returned to the original process from which they are generated, without first being reclaimed or land disposed. The material must be returned as a substitute for

feedstock materials. In cases where the original process to which the material is returned is a secondary process, the materials must be managed such that there is no placement on the land. In cases where the materials are generated and reclaimed within the primary mineral processing industry, the conditions of the exclusion found at §261.4(a)(17) apply rather than this paragraph.

(2) The following materials are solid wastes, even if the recycling involves use, reuse, or return to the original process (described in paragraphs (e)(1)(i) through (iii) of this section):

(i) Materials used in a manner constituting disposal, or used to produce products that are applied to the land; or

(ii) Materials burned for energy recovery, used to produce a fuel, or contained in fuels; or

(iii) Materials accumulated speculatively; or

(iv) Materials listed in paragraphs (d)(1) and (d)(2) of this section.

(f) **Documentation of claims that materials are not solid wastes or are conditionally exempt from regulation.** Respondents in actions to enforce regulations implementing Subtitle C of RCRA who raise a claim that a certain material is not a solid waste, or is conditionally exempt from regulation, must demonstrate that there is a known market or disposition for the material, and that they meet the terms of the exclusion or exemption. In doing so, they must provide appropriate documentation (such as contracts showing that a second person uses the material as an ingredient in a production process) to demonstrate that the material is not a waste, or is exempt from regulation. In addition, owners or operators of facilities claiming that they actually are recycling materials must show that they have the necessary equipment to do so.

§261.3 Definition of hazardous waste.

(a) A solid waste, as defined in §261.2, is a hazardous waste if:

(1) It is not excluded from regulation as a hazardous waste under §261.4(b); and

(2) It meets any of the following criteria:

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(i) It exhibits any of the characteristics of hazardous waste identified in subpart C of this part. However, any mixture of a waste from the extraction, beneficiation, and processing of ores and minerals excluded under §261.4(b)(7) and any other solid waste exhibiting a characteristic of hazardous waste under subpart C is a hazardous waste only if it exhibits a characteristic that would not have been exhibited by the excluded waste alone if such mixture had not occurred, or if it continues to exhibit any of the characteristics exhibited by the non-excluded wastes prior to mixture. Further, for the purposes of applying the Toxicity Characteristic to such mixtures, the mixture is also a hazardous waste if it exceeds the maximum concentration for any contaminant listed in table 1 to §261.24 that would not have been exceeded by the excluded waste alone if the mixture had not occurred or if it continues to exceed the maximum concentration for any contaminant exceeded by the nonexempt waste prior to mixture.

(ii) It is listed in subpart D of this part and has not been excluded from the lists in subpart D of this part under §§260.20 and 260.22 of this chapter.

(iii) [Reserved]

(iv) It is a mixture of solid waste and one or more hazardous wastes listed in subpart D of this part and has not been excluded from paragraph (a)(2) of this section under §§260.20 and 260.22, paragraph (g) of this section, or paragraph (h) of this section; however, the following mixtures of solid wastes and hazardous wastes listed in subpart D of this part are not hazardous wastes (except by application of paragraph (a)(2)(i) or (ii) of this section) if the generator can demonstrate that the mixture consists of wastewater the discharge of which is subject to regulation under either section 402 or section 307(b) of the Clean Water Act (including wastewater at facilities which have eliminated the discharge of wastewater) and;

(A) One or more of the following spent solvents listed in §261.31—benzene, carbon tetrachloride, tetrachloroethylene, trichloroethylene or the scrubber waters derived from the combustion of these spent solvents— *Provided*, That the maximum total weekly usage of these solvents (other than the amounts that can be demonstrated not to be discharged to wastewater) divided by the average weekly flow of wastewater into the headworks of the facility's wastewater treatment or pretreatment system does not exceed 1 part per million, OR the total measured concentration of these solvents entering the headworks of the facility's wastewater treatment system (at facilities subject to regulation under the Clean Air Act, as amended, at 40 CFR parts 60, 61, or 63, or at facilities subject to an enforceable limit in a federal operating permit that minimizes fugitive emissions), does not exceed 1 part per million on an average weekly basis. Any facility that uses benzene as a solvent and claims this exemption must use an aerated biological wastewater treatment system and must use only lined surface impoundments or tanks prior to secondary clarification in the wastewater treatment system. Facilities that choose to measure concentration levels must file a copy of their sampling and analysis plan with the Regional Administrator, or

State Director, as the context requires, or an authorized representative ("Director" as defined in 40 CFR 270.2). A facility must file a copy of a revised sampling and analysis plan only if the initial plan is rendered inaccurate by changes in the facility's operations. The sampling and analysis plan must include the monitoring point location (headworks), the sampling frequency and methodology, and a list of constituents to be monitored. A facility is eligible for the direct monitoring option once they receive confirmation that the sampling and analysis plan has been received by the Director. The Director may reject the sampling and analysis plan if he/she finds that, the sampling and analysis plan fails to include the above information; or the plan parameters would not enable the facility to calculate the weekly average concentration of these chemicals accurately. If the Director rejects the sampling and analysis plan or if the Director finds that the facility is not following the sampling and analysis plan, the Director shall notify the facility to cease the use of the direct monitoring option until such time as the bases for rejection are corrected; or

(B) One or more of the following spent solvents listed in §261.31—methylene chloride, 1,1,1-trichloroethane, chlorobenzene, o-dichlorobenzene, cresols, cresylic acid, nitrobenzene, toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, spent chlorofluorocarbon solvents, 2-ethoxyethanol, or the scrubber waters derived from the combustion of these spent solvents— *Provided* That the maximum total weekly usage of these solvents (other than the amounts that can be demonstrated not to be discharged to wastewater) divided by the average weekly flow of wastewater into the headworks of the facility's wastewater treatment or pretreatment system does not exceed 25 parts per million, OR the total measured concentration of these solvents entering the headworks of the facility's wastewater treatment system (at facilities subject to regulation under the Clean Air Act as amended, at 40 CFR parts 60, 61, or 63, or at facilities subject to an enforceable limit in a federal operating permit that minimizes fugitive emissions), does not exceed 25 parts per million on an average weekly basis. Facilities that choose to measure concentration levels must file a copy of their sampling and analysis plan with the Regional Administrator, or State Director, as the context requires, or an authorized representative ("Director" as defined in 40 CFR 270.2). A facility must file a copy of a revised sampling and analysis plan only if the initial plan is rendered inaccurate by changes in the facility's operations. The sampling and analysis plan must include the monitoring point location (headworks), the sampling frequency and methodology, and a list of constituents to be monitored. A facility is eligible for the direct monitoring option once they receive confirmation that the sampling and analysis plan has been received by the Director. The Director may reject the sampling and analysis plan if he/she finds that, the sampling and analysis plan fails to include the above information; or the plan parameters would not enable the facility to calculate the weekly average concentration of these chemicals accurately. If the Director rejects the sampling and analysis plan or if the Director finds that the

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facility is not following the sampling and analysis plan, the Director shall notify the facility to cease the use of the direct monitoring option until such time as the bases for rejection are corrected; or

(C) One of the following wastes listed in §261.32, provided that the wastes are discharged to the refinery oil recovery sewer before primary oil/water/solids separation—heat exchanger bundle cleaning sludge from the petroleum refining industry (EPA Hazardous Waste No. K050), crude oil storage tank sediment from petroleum refining operations (EPA Hazardous Waste No. K169), clarified slurry oil tank sediment and/or in-line filter/separation solids from petroleum refining operations (EPA Hazardous Waste No. K170), spent hydrotreating catalyst (EPA Hazardous Waste No. K171), and spent hydrorefining catalyst (EPA Hazardous Waste No. K172); or

(D) A discarded hazardous waste, commercial chemical product, or chemical intermediate listed in §§261.31 through 261.33, arising from *de minimis* losses of these materials. For purposes of this paragraph (a)(2)(iv)(D), *de minimis* losses are inadvertent releases to a wastewater treatment system, including those from normal material handling operations (e.g., spills from the unloading or transfer of materials from bins or other containers, leaks from pipes, valves or other devices used to transfer materials); minor leaks of process equipment, storage tanks or containers; leaks from well maintained pump packings and seals; sample purgings; relief device discharges; discharges from safety showers and rinsing and cleaning of personal safety equipment; and rinsate from empty containers or from containers that are rendered empty by that rinsing. Any manufacturing facility that claims an exemption for *de minimis* quantities of wastes listed in §§261.31 through 261.32, or any nonmanufacturing facility that claims an exemption for *de minimis* quantities of wastes listed in subpart D of this part must either have eliminated the discharge of wastewaters or have included in its Clean Water Act permit application or submission to its pretreatment control authority the constituents for which each waste was listed (in 40 CFR 261 appendix VII) of this part; and the constituents in the table “Treatment Standards for Hazardous Wastes” in 40 CFR 268.40 for which each waste has a treatment standard (i.e., Land Disposal Restriction constituents). A facility is eligible to claim the exemption once the permit writer or control authority has been notified of possible *de minimis* releases via the Clean Water Act permit application or the pretreatment control authority submission. A copy of the Clean Water permit application or the submission to the pretreatment control authority must be placed in the facility’s on-site files; or

(E) Wastewater resulting from laboratory operations containing toxic (T) wastes listed in subpart D of this part, Provided, That the annualized average flow of laboratory wastewater does not exceed one percent of total wastewater flow into the headworks of the facility’s wastewater treatment or pre-treatment system or provided the wastes, combined annualized average concentration does not exceed one part per million in the

headworks of the facility’s wastewater treatment or pre-treatment facility. Toxic (T) wastes used in laboratories that are demonstrated not to be discharged to wastewater are not to be included in this calculation; or

(F) One or more of the following wastes listed in §261.32—wastewaters from the production of carbamates and carbamoyl oximes (EPA Hazardous Waste No. K157)—*Provided* that the maximum weekly usage of formaldehyde, methyl chloride, methylene chloride, and triethylamine (including all amounts that cannot be demonstrated to be reacted in the process, destroyed through treatment, or is recovered, i.e., what is discharged or volatilized) divided by the average weekly flow of process wastewater prior to any dilution into the headworks of the facility’s wastewater treatment system does not exceed a total of 5 parts per million by weight OR the total measured concentration of these chemicals entering the headworks of the facility’s wastewater treatment system (at facilities subject to regulation under the Clean Air Act as amended, at 40 CFR parts 60, 61, or 63, or at facilities subject to an enforceable limit in a federal operating permit that minimizes fugitive emissions), does not exceed 5 parts per million on an average weekly basis. Facilities that choose to measure concentration levels must file copy of their sampling and analysis plan with the Regional Administrator, or State Director, as the context requires, or an authorized representative (“Director” as defined in 40 CFR 270.2). A facility must file a copy of a revised sampling and analysis plan only if the initial plan is rendered inaccurate by changes in the facility’s operations. The sampling and analysis plan must include the monitoring point location (headworks), the sampling frequency and methodology, and a list of constituents to be monitored. A facility is eligible for the direct monitoring option once they receive confirmation that the sampling and analysis plan has been received by the Director. The Director may reject the sampling and analysis plan if he/she finds that, the sampling and analysis plan fails to include the above information; or the plan parameters would not enable the facility to calculate the weekly average concentration of these chemicals accurately. If the Director rejects the sampling and analysis plan or if the Director finds that the facility is not following the sampling and analysis plan, the Director shall notify the facility to cease the use of the direct monitoring option until such time as the bases for rejection are corrected; or

(G) Wastewaters derived from the treatment of one or more of the following wastes listed in §261.32—organic waste (including heavy ends, still bottoms, light ends, spent solvents, filtrates, and decantates) from the production of carbamates and carbamoyl oximes (EPA Hazardous Waste No. K156).—*Provided*, that the maximum concentration of formaldehyde, methyl chloride, methylene chloride, and triethylamine prior to any dilutions into the headworks of the facility’s wastewater treatment system does not exceed a total of 5 milligrams per liter OR the total measured concentration of these chemicals entering the headworks of the facility’s wastewater treatment system (at facilities subject to regulation under the Clean Air Act as amended, at 40 CFR parts 60, 61, or 63, or at facilities subject to an

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enforceable limit in a federal operating permit that minimizes fugitive emissions), does not exceed 5 milligrams per liter on an average weekly basis. Facilities that choose to measure concentration levels must file copy of their sampling and analysis plan with the Regional Administrator, or State Director, as the context requires, or an authorized representative ("Director" as defined in 40 CFR 270.2). A facility must file a copy of a revised sampling and analysis plan only if the initial plan is rendered inaccurate by changes in the facility's operations. The sampling and analysis plan must include the monitoring point location (headworks), the sampling frequency and methodology, and a list of constituents to be monitored. A facility is eligible for the direct monitoring option once they receive confirmation that the sampling and analysis plan has been received by the Director. The Director may reject the sampling and analysis plan if he/she finds that, the sampling and analysis plan fails to include the above information; or the plan parameters would not enable the facility to calculate the weekly average concentration of these chemicals accurately. If the Director rejects the sampling and analysis plan or if the Director finds that the facility is not following the sampling and analysis plan, the Director shall notify the facility to cease the use of the direct monitoring option until such time as the bases for rejection are corrected.

(v) *Rebuttable presumption for used oil.* Used oil containing more than 1000 ppm total halogens is presumed to be a hazardous waste because it has been mixed with alogenated hazardous waste listed in subpart D of part 261 of this chapter. Persons may rebut this presumption by demonstrating that the used oil does not contain hazardous waste (for example, to show that the used oil does not contain significant concentrations of halogenated hazardous constituents listed in appendix VIII of part 261 of this chapter).

(A) The rebuttable presumption does not apply to metalworking oils/fluids containing chlorinated paraffins, if they are processed, through a tolling agreement, to reclaim metalworking oils/fluids. The presumption does apply to metalworking oils/fluids if such oils/fluids are recycled in any other manner, or disposed.

(B) The rebuttable presumption does not apply to used oils contaminated with chlorofluorocarbons (CFCs) removed from refrigeration units where the CFCs are destined for reclamation. The rebuttable presumption does apply to used oils contaminated with CFCs that have been mixed with used oil from sources other than refrigeration units.

(b) A solid waste which is not excluded from regulation under paragraph (a)(1) of this section becomes a hazardous waste when any of the following events occur:

(1) In the case of a waste listed in Subpart D of this part, when the waste first meets the listing description set forth in subpart D of this part.

(2) In the case of a mixture of solid waste and one or more listed hazardous wastes, when a hazardous waste listed in subpart D is first added to the solid waste.

(3) In the case of any other waste (including a waste mixture), when the waste exhibits any of the characteristics identified in subpart C of this part.

(c) Unless and until it meets the criteria of paragraph (d) of this section:

(1) A hazardous waste will remain a hazardous waste.

(i) Except as otherwise provided in paragraph (c)(2)(ii), (g) or (h) of this section, any solid waste generated from the treatment, storage, or disposal of a hazardous waste, including any sludge, spill residue, ash emission control dust, or leachate (but not including precipitation run-off) is a hazardous waste. (However, materials that are reclaimed from solid wastes and that are used beneficially are not solid wastes and hence are not hazardous wastes under this provision unless the reclaimed material is burned for energy recovery or used in a manner constituting disposal.)

(ii) The following solid wastes are not hazardous even though they are generated from the treatment, storage, or disposal of a hazardous waste, unless they exhibit one or more of the characteristics of hazardous waste:

(A) Waste pickle liquor sludge generated by lime stabilization of spent pickle liquor from the iron and steel industry (SIC Codes 331 and 332).

(B) Waste from burning any of the materials exempted from regulation by §261.6(a)(3)(iii) and (iv).

(C)(1) Nonwastewater residues, such as slag, resulting from high temperature metals recovery (HTMR) processing of K061, K062 or F006 waste, in units identified as rotary kilns, flame reactors, electric furnaces, plasma arc furnaces, slag reactors, rotary hearth furnace/electric furnace combinations or industrial furnaces (as defined in paragraphs (6), (7), and (13) of the definition for "Industrial furnace" in 40 CFR 260.10), that are disposed in subtitle D units, provided that these residues meet the generic exclusion levels identified in the tables in this paragraph for all constituents, and exhibit no characteristics of hazardous waste. Testing requirements must be incorporated in a facility's waste analysis plan or a generator's self-implementing waste analysis plan; at a minimum, composite samples of residues must be collected and analyzed quarterly and/or when the process or operation generating the waste changes. Persons claiming this exclusion in an enforcement action will have the burden of proving by clear and convincing evidence that the material meets all of the exclusion requirements.

Constituent	Maximum for any single composite sample—TCLP (mg/l)
Generic exclusion levels for K061 and K062 nonwastewater HTMR residues	
Antimony	0.10
Arsenic	0.50
Barium	7.6
Beryllium	0.010
Cadmium	0.050
Chromium (total)	0.33
Lead	0.15
Mercury	0.009
Nickel	1.0
Selenium	0.16
Silver	0.30

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Constituent	Maximum for any single composite sample—TCLP (mg/l)
Thallium	0.020
Zinc	70
Generic exclusion levels for F006 nonwastewater HTMR residues	
Antimony	0.10
Arsenic	0.50
Barium	7.6
Beryllium	0.010
Cadmium	0.050
Chromium (total)	0.33
Cyanide (total) (mg/kg)	1.8
Lead	0.15
Mercury	0.009
Nickel	1.0
Selenium	0.16
Silver	0.30
Thallium	0.020
Zinc	70

(2) A one-time notification and certification must be placed in the facility's files and sent to the EPA region or authorized state for K061, K062 or F006 HTMR residues that meet the generic exclusion levels for all constituents and do not exhibit any characteristics that are sent to subtitle D units. The notification and certification that is placed in the generators or treaters files must be updated if the process or operation generating the waste changes and/or if the subtitle D unit receiving the waste changes. However, the generator or treater need only notify the EPA region or an authorized state on an annual basis if such changes occur. Such notification and certification should be sent to the EPA region or authorized state by the end of the calendar year, but no later than December 31. The notification must include the following information: The name and address of the subtitle D unit receiving the waste shipments; the EPA Hazardous Waste Number(s) and treatability group(s) at the initial point of generation; and, the treatment standards applicable to the waste at the initial point of generation. The certification must be signed by an authorized representative and must state as follows: "I certify under penalty of law that the generic exclusion levels for all constituents have been met without impermissible dilution and that no characteristic of hazardous waste is exhibited. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

(D) Biological treatment sludge from the treatment of one of the following wastes listed in §261.32-organic waste (including heavy ends, still bottoms, light ends, spent solvents, filtrates, and decantates) from the production of carbamates and carbamoyl oximes (EPA Hazardous Waste No. K156), and wastewaters from the production of carbamates and carbamoyl oximes (EPA Hazardous Waste No. K157).

(E) Catalyst inert support media separated from one of the following wastes listed in §261.32-Spent hydrotreating catalyst (EPA Hazardous Waste No. K171), and Spent hydrotreating catalyst (EPA Hazardous Waste No. K172).

(d) Any solid waste described in paragraph (c) of this section is not a hazardous waste if it meets the following criteria:

(1) In the case of any solid waste, it does not exhibit any of the characteristics of hazardous waste identified in subpart C of this part. (However, wastes that exhibit a characteristic at the point of generation may still be subject to the requirements of part 268, even if they no longer exhibit a characteristic at the point of land disposal.)

(2) In the case of a waste which is a listed waste under subpart D of this part, contains a waste listed under subpart D of this part or is derived from a waste listed in subpart D of this part, it also has been excluded from paragraph (c) of this section under §260.20 and 260.22 of this chapter.

(e) [Reserved]

(f) Notwithstanding paragraphs (a) through (d) of this section and provided the debris as defined in part 268 of this chapter does not exhibit a characteristic identified at subpart C of this part, the following materials are not subject to regulation under 40 CFR parts 260, 261 to 266, 268, or 270:

(1) Hazardous debris as defined in part 268 of this chapter that has been treated using one of the required extraction or destruction technologies specified in Table 1 of §268.45 of this chapter; persons claiming this exclusion in an enforcement action will have the burden of proving by clear and convincing evidence that the material meets all of the exclusion requirements; or

(2) Debris as defined in part 268 of this chapter that the Regional Administrator, considering the extent of contamination, has determined is no longer contaminated with hazardous waste.

(1) A hazardous waste that is listed in subpart D of this part solely because it exhibits one or more characteristics of ignitability as defined under §261.21, corrosivity as defined under §261.22, or reactivity as defined under §261.23 is not a hazardous waste, if the waste no longer exhibits any characteristic of hazardous waste identified in subpart C of this part.

(2) The exclusion described in paragraph (g)(1) of this section also pertains to:

(i) Any mixture of a solid waste and a hazardous waste listed in subpart D of this part solely because it exhibits the characteristics of ignitability, corrosivity, or reactivity as regulated under paragraph (a)(2)(iv) of this section; and

(ii) Any solid waste generated from treating, storing, or disposing of a hazardous waste listed in subpart D of this part solely because it exhibits the characteristics of ignitability, corrosivity, or reactivity as regulated under paragraph (c)(2)(i) of this section.

(3) Wastes excluded under this section are subject to part 268 of this chapter (as applicable), even if they no longer exhibit a characteristic at the point of land disposal.

(4) any mixture of a solid waste excluded from regulation under § 261.4(b)(7) and a hazardous waste listed in subpart D of this part solely because it exhibits one or more of the characteristics of ignitability, corrosivity, or

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reactivity as regulated under paragraph (a)(2)(iv) of this section is not a hazardous waste, if the mixture no longer exhibits any characteristic of hazardous waste identified in subpart C of this part for which the hazardous waste listed in subpart D of this part was listed.

(1) Hazardous waste containing radioactive waste is no longer a hazardous waste when it meets the eligibility criteria and conditions of 40 CFR part 266, Subpart N (“eligible radioactive mixed waste”).

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(2) The exemption described in paragraph (h)(1) of this section also pertains to:

(i) Any mixture of a solid waste and an eligible radioactive mixed waste; and

(ii) Any solid waste generated from treating, storing, or disposing of an eligible radioactive mixed waste.

(3) Waste exempted under this section must meet the eligibility criteria and specified conditions in 40 CFR 266.225 and 40 CFR 266.230 (for storage and treatment) and in 40 CFR 266.310 and 40 CFR 266.315 (for transportation and disposal). Waste that fails to satisfy these eligibility criteria and conditions is regulated as hazardous waste.

§261.4 Exclusions.

(a) **Materials which are not solid wastes.** The following materials are not solid wastes for the purpose of this part:

(1)(i) Domestic sewage; and

(ii) Any mixture of domestic sewage and other wastes that passes through a sewer system to a publicly-owned treatment works for treatment. “Domestic sewage” means untreated sanitary wastes that pass through a sewer system.

(2) Industrial wastewater discharges that are point source discharges subject to regulation under section 402 of the Clean Water Act, as amended.

[*Comment:* This exclusion applies only to the actual point source discharge. It does not exclude industrial wastewaters while they are being collected, stored or treated before discharge, nor does it exclude sludges that are generated by industrial wastewater treatment.]

(3) Irrigation return flows.

(4) Source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 *et seq.*

(5) Materials subjected to in-situ mining techniques which are not removed from the ground as part of the extraction process.

(6) Pulping liquors (*i.e.*, black liquor) that are reclaimed in a pulping liquor recovery furnace and then reused in the pulping process, unless it is accumulated speculatively as defined in §261.1(c) of this chapter.

(7) Spent sulfuric acid used to produce virgin sulfuric acid, unless it is accumulated speculatively as defined in §261.1(c) of this chapter.

(8) Secondary materials that are reclaimed and returned to the original process or processes in which they were generated where they are reused in the production process provided:

(i) Only tank storage is involved, and the entire process through completion of reclamation is closed by being entirely connected with pipes or other comparable enclosed means of conveyance;

(ii) Reclamation does not involve controlled flame combustion (such as occurs in boilers, industrial furnaces, or incinerators);

(iii) The secondary materials are never accumulated in such tanks for over twelve months without being reclaimed; and

(iv) The reclaimed material is not used to produce a fuel, or used to produce products that are used in a manner constituting disposal.

(9)(i) Spent wood preserving solutions that have been reclaimed and are reused for their original intended purpose; and

(ii) Wastewaters from the wood preserving process that have been reclaimed and are reused to treat wood.

(iii) Prior to reuse, the wood preserving wastewaters and spent wood preserving solutions described in paragraphs (a)(9)(i) and (a)(9)(ii) of this section, so long as they meet all of the following conditions:

(A) The wood preserving wastewaters and spent wood preserving solutions are reused on-site at water borne plants in the production process for their original intended purpose;

(B) Prior to reuse, the wastewaters and spent wood preserving solutions are managed to prevent release to either land or groundwater or both;

(C) Any unit used to manage wastewaters and/or spent wood preserving solutions prior to reuse can be visually or otherwise determined to prevent such releases;

(D) Any drip pad used to manage the wastewaters and/or spent wood preserving solutions prior to reuse complies with the standards in part 265, subpart W of this chapter, regardless of whether the plant generates a total of less than 100 kg/month of hazardous waste; and

(E) Prior to operating pursuant to this exclusion, the plant owner or operator prepares a one-time notification stating that the plant intends to claim the exclusion, giving the date on which the plant intends to begin operating under the exclusion, and containing the following language: “I have read the applicable regulation establishing an exclusion for wood preserving wastewaters and spent wood preserving solutions and understand it requires me to comply at all times with the conditions set out in the regulation.” The plant must maintain a copy of that document in its on-site records until closure of the facility. The exclusion applies so long as the plant meets all of the conditions. If the plant goes out of compliance with any condition, it may apply to the appropriate Regional Administrator or state Director for reinstatement. The Regional Administrator or state Director may reinstate the exclusion upon finding that the plant has returned to compliance with all conditions and that the violations are not likely to recur.

(10) EPA Hazardous Waste Nos. K060, K087, K141, K142, K143, K144, K145, K147, and K148, and any wastes from the coke by-products processes that are hazardous only because they exhibit the Toxicity Characteristic (TC) specified in section 261.24 of this part when, subsequent to generation, these materials are recycled to coke ovens, to the tar recovery process as a feedstock to produce coal tar, or mixed with coal tar prior to the tar’s sale or refining. This exclusion is conditioned on there being no land disposal of the wastes

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from the point they are generated to the point they are recycled to coke ovens or tar recovery or refining processes, or mixed with coal tar.

(11) Nonwastewater splash condenser dross residue from the treatment of K061 in high temperature metals recovery units, provided it is shipped in drums (if shipped) and not land disposed before recovery.

(12)(i) Oil-bearing hazardous secondary materials (i.e., sludges, byproducts, or spent materials) that are generated at a petroleum refinery (SIC code 2911) and are inserted into the petroleum refining process (SIC code 2911—including, but not limited to, distillation, catalytic cracking, fractionation, gasification (as defined in 40 CFR 260.10) or thermal cracking units (i.e., cokers)) unless the material is placed on the land, or speculatively accumulated before being so recycled. Materials inserted into thermal cracking units are excluded under this paragraph, provided that the coke product also does not exhibit a characteristic of hazardous waste. Oil-bearing hazardous secondary materials may be inserted into the same petroleum refinery where they are generated, or sent directly to another petroleum refinery and still be excluded under this provision. Except as provided in paragraph (a)(12)(ii) of this section, oil-bearing hazardous secondary materials generated elsewhere in the petroleum industry (i.e., from sources other than petroleum refineries) are not excluded under this section. Residuals generated from processing or recycling materials excluded under this paragraph (a)(12)(i), where such materials as generated would have otherwise met a listing under subpart D of this part, are designated as F037 listed wastes when disposed of or intended for disposal.

(ii) Recovered oil that is recycled in the same manner and with the same conditions as described in paragraph (a)(12)(i) of this section. Recovered oil is oil that has been reclaimed from secondary materials (including wastewater) generated from normal petroleum industry practices, including refining, exploration and production, bulk storage, and transportation incident thereto (SIC codes 1311, 1321, 1381, 1382, 1389, 2911, 4612, 4613, 4922, 4923, 4789, 5171, and 5172.) Recovered oil does not include oil-bearing hazardous wastes listed in subpart D of this part; however, oil recovered from such wastes may be considered recovered oil. Recovered oil does not include used oil as defined in 40 CFR 279.1.

(13) Excluded scrap metal (processed scrap metal, unprocessed home scrap metal, and unprocessed prompt scrap metal) being recycled.

(14) Shredded circuit boards being recycled provided that they are:

(i) Stored in containers sufficient to prevent a release to the environment prior to recovery; and

(ii) Free of mercury switches, mercury relays and nickel-cadmium batteries and lithium batteries.

(15) Condensates derived from the overhead gases from kraft mill steam strippers that are used to comply with 40 CFR 63.446(e). The exemption applies only to combustion at the mill generating the condensates.

(16) Comparable fuels or comparable syngas fuels (i.e., comparable/syngas fuels) that meet the requirements of §261.38.

(17) Spent materials (as defined in §261.1) (other than hazardous wastes listed in subpart D of this part) generated within the primary mineral processing industry from which minerals, acids, cyanide, water, or other values are recovered by mineral processing or by beneficiation, provided that:

(i) The spent material is legitimately recycled to recover minerals, acids, cyanide, water or other values;

(ii) The spent material is not accumulated speculatively;

(iii) Except as provided in paragraph (a)(17)(iv) of this section, the spent material is stored in tanks, containers, or buildings meeting the following minimum integrity standards: a building must be an engineered structure with a floor, walls, and a roof all of which are made of non-earthen materials providing structural support (except smelter buildings may have partially earthen floors provided the secondary material is stored on the non-earthen portion), and have a roof suitable for diverting rainwater away from the foundation; a tank must be free standing, not be a surface impoundment (as defined in 40 CFR 260.10), and be manufactured of a material suitable for containment of its contents; a container must be free standing and be manufactured of a material suitable for containment of its contents. If tanks or containers contain any particulate which may be subject to wind dispersal, the owner/operator must operate these units in a manner which controls fugitive dust. Tanks, containers, and buildings must be designed, constructed and operated to prevent significant releases to the environment of these materials.

(iv) The Regional Administrator or State Director may make a site-specific determination, after public review and comment, that only solid mineral processing spent material may be placed on pads rather than tanks containers, or buildings. Solid mineral processing spent materials do not contain any free liquid. The decision-maker must affirm that pads are designed, constructed and operated to prevent significant releases of the secondary material into the environment. Pads must provide the same degree of containment afforded by the non-RCRA tanks, containers and buildings eligible for exclusion.

(A) The decision-maker must also consider if storage on pads poses the potential for significant releases via groundwater, surface water, and air exposure pathways. Factors to be considered for assessing the groundwater, surface water, air exposure pathways are: The volume and physical and chemical properties of the secondary material, including its potential for migration off the pad; the potential for human or environmental exposure to hazardous constituents migrating from the pad via each exposure pathway, and the possibility and extent of harm to human and environmental receptors via each exposure pathway.

(B) Pads must meet the following minimum standards: Be designed of non-earthen material that is compatible with the chemical nature of the mineral processing spent material, capable of withstanding

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physical stresses associated with placement and removal, have run on/runoff controls, be operated in a manner which controls fugitive dust, and have integrity assurance through inspections and maintenance programs.

(C) Before making a determination under this paragraph, the Regional Administrator or State Director must provide notice and the opportunity for comment to all persons potentially interested in the determination. This can be accomplished by placing notice of this action in major local newspapers, or broadcasting notice over local radio stations.

(v) The owner or operator provides notice to the Regional Administrator or State Director providing the following information: The types of materials to be recycled; the type and location of the storage units and recycling processes; and the annual quantities expected to be placed in land-based units. This notification must be updated when there is a change in the type of materials recycled or the location of the recycling process.

(vi) For purposes of paragraph (b)(7) of this section, mineral processing spent materials must be the result of mineral processing and may not include any listed hazardous wastes. Listed hazardous wastes and characteristic hazardous wastes generated by non-mineral processing industries are not eligible for the conditional exclusion from the definition of solid waste.

(18) Petrochemical recovered oil from an associated organic chemical manufacturing facility, where the oil is to be inserted into the petroleum refining process (SIC code 2911) along with normal petroleum refinery process streams, provided:

(i) The oil is hazardous only because it exhibits the characteristic of ignitability (as defined in §261.21) and/or toxicity for benzene (§261.24, waste code D018); and

(ii) The oil generated by the organic chemical manufacturing facility is not placed on the land, or speculatively accumulated before being recycled into the petroleum refining process. An "associated organic chemical manufacturing facility" is a facility where the primary SIC code is 2869, but where operations may also include SIC codes 2821, 2822, and 2865; and is physically co-located with a petroleum refinery; and where the petroleum refinery to which the oil being recycled is returned also provides hydrocarbon feedstocks to the organic chemical manufacturing facility. "Petrochemical recovered oil" is oil that has been reclaimed from secondary materials (i.e., sludges, byproducts, or spent materials, including wastewater) from normal organic chemical manufacturing operations, as well as oil recovered from organic chemical manufacturing processes.

(19) Spent caustic solutions from petroleum refining liquid treating processes used as a feedstock to produce cresylic or naphthenic acid unless the material is placed on the land, or accumulated speculatively as defined in §261.1(c).

(20) Hazardous secondary materials used to make zinc fertilizers, provided that the following conditions specified are satisfied:

(i) Hazardous secondary materials used to make zinc micronutrient fertilizers must not be accumulated speculatively, as defined in §261.1 (c)(8).

(ii) Generators and intermediate handlers of zinc-bearing hazardous secondary materials that are to be incorporated into zinc fertilizers must:

(A) Submit a one-time notice to the Regional Administrator or State Director in whose jurisdiction the exclusion is being claimed, which contains the name, address and EPA ID number of the generator or intermediate handler facility, provides a brief description of the secondary material that will be subject to the exclusion, and identifies when the manufacturer intends to begin managing excluded, zinc-bearing hazardous secondary materials under the conditions specified in this paragraph (a)(20).

(B) Store the excluded secondary material in tanks, containers, or buildings that are constructed and maintained in a way that prevents releases of the secondary materials into the environment. At a minimum, any building used for this purpose must be an engineered structure made of non-earthen materials that provide structural support, and must have a floor, walls and a roof that prevent wind dispersal and contact with rainwater. Tanks used for this purpose must be structurally sound and, if outdoors, must have roofs or covers that prevent contact with wind and rain. Containers used for this purpose must be kept closed except when it is necessary to add or remove material, and must be in sound condition. Containers that are stored outdoors must be managed within storage areas that:

(1) have containment structures or systems sufficiently impervious to contain leaks, spills and accumulated precipitation; and

(2) provide for effective drainage and removal of leaks, spills and accumulated precipitation; and

(3) prevent run-on into the containment system.

(C) With each off-site shipment of excluded hazardous secondary materials, provide written notice to the receiving facility that the material is subject to the conditions of this paragraph (a)(20).

(D) Maintain at the generator's or intermediate handlers's facility for no less than three years records of all shipments of excluded hazardous secondary materials. For each shipment these records must at a minimum contain the following information:

(1) Name of the transporter and date of the shipment;

(2) Name and address of the facility that received the excluded material, and documentation confirming receipt of the shipment; and

(3) Type and quantity of excluded secondary material in each shipment.

(iii) Manufacturers of zinc fertilizers or zinc fertilizer ingredients made from excluded hazardous secondary materials must:

(A) Store excluded hazardous secondary materials in accordance with the storage requirements for generators and intermediate handlers, as specified in paragraph (a)(20)(ii)(B) of this section.

(B) Submit a one-time notification to the Regional Administrator or State Director that, at a minimum, specifies the name, address and EPA ID number of the

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manufacturing facility, and identifies when the manufacturer intends to begin managing excluded, zinc-bearing hazardous secondary materials under the conditions specified in this paragraph (a)(20).

(C) Maintain for a minimum of three years records of all shipments of excluded hazardous secondary materials received by the manufacturer, which must at a minimum identify for each shipment the name and address of the generating facility, name of transporter and date the materials were received, the quantity received, and a brief description of the industrial process that generated the material.

(D) Submit to the Regional Administrator or State Director an annual report that identifies the total quantities of all excluded hazardous secondary materials that were used to manufacture zinc fertilizers or zinc fertilizer ingredients in the previous year, the name and address of each generating facility, and the industrial process(s) from which they were generated.

(iv) Nothing in this section preempts, overrides or otherwise negates the provision in Sec. 262.11 of this chapter, which requires any person who generates a solid waste to determine if that waste is a hazardous waste.

(v) Interim status and permitted storage units that have been used to store only zinc-bearing hazardous wastes prior to the submission of the one-time notice described in paragraph (a)(20)(ii)(A) of this section, and that afterward will be used only to store hazardous secondary materials excluded under this paragraph, are not subject to the closure requirements of 40 CFR Parts 264 and 265.

(21) Zinc fertilizers made from hazardous wastes, or hazardous secondary materials that are excluded under paragraph (a)(20) of this section, provided that:

(i) The fertilizers meet the following contaminant limits:

(A) For metal contaminants:

Constituent	Maximum Allowable Total Concentration in Fertilizer, per Unit (1%) of Zinc (ppm)
Arsenic	0.3
Cadmium	1.4
Chromium	0.6
Lead	2.8
Mercury	0.3

(B) For dioxin contaminants the fertilizer must contain no more than eight (8) parts per trillion of dioxin, measured as toxic equivalent (TEQ).

(ii) The manufacturer performs sampling and analysis of the fertilizer product to determine compliance with the contaminant limits for metals no less than every six months, and for dioxins no less than every twelve months. Testing must also be performed whenever changes occur to manufacturing processes or ingredients that could significantly affect the amounts of contaminants in the fertilizer product. The manufacturer may use any reliable analytical method to demonstrate that no constituent of concern is present in the product at concentrations above the applicable limits. It is the responsibility of the

manufacturer to ensure that the sampling and analysis are unbiased, precise, and representative of the product(s) introduced into commerce.

(iii) The manufacturer maintains for no less than three years records of all sampling and analyses performed for purposes of determining compliance with the requirements of paragraph (a)(21)(ii) of this section. Such records must at a minimum include:

(A) The dates and times product samples were taken, and the dates the samples were analyzed;

(B) The names and qualifications of the person(s) taking the samples;

(C) A description of the methods and equipment used to take the samples;

(D) The name and address of the laboratory facility at which analyses of the samples were performed;

(E) A description of the analytical methods used, including any cleanup and sample preparation methods; and

(F) All laboratory analytical results used to determine compliance with the contaminant limits specified in this paragraph (a)(21).

(22) Used cathode ray tubes (CRTs)

(i) Used, intact CRTs as defined in §260.10 of this chapter are not solid wastes within the United States unless they are disposed, or unless they are speculatively accumulated as defined in §261.1(c)(8) by CRT collectors or glass processors.

(ii) Used, intact CRTs as defined in §260.10 of this chapter are not solid wastes when exported for recycling provided that they meet the requirements of §261.40.

(iii) Used, broken CRTs as defined in §260.10 of this chapter are not solid wastes provided that they meet the requirements of §261.39.

(iv) Glass removed from CRTs is not a solid waste provided that it meets the requirements of §261.39(c).

(23) Hazardous secondary material generated and reclaimed within the United States or its territories and managed in land-based units as defined in §260.10 of this chapter is not a solid waste provided that:

(i) The material is contained;

(ii) The material is a hazardous secondary material generated and reclaimed under the control of the generator, as defined in §260.10;

(iii) The material is not speculatively accumulated, as defined in §261.1(c)(8);

(iv) The material is not otherwise subject to material-specific management conditions under paragraph (a) of this section when reclaimed, it is not a spent lead acid battery (see §266.80 and §273.2 of this chapter), and it does not meet the listing description for K171 or K172 in §261.32;

(v) The reclamation of the material is legitimate, as specified under §260.43 of this chapter; and

(vi) In addition, persons claiming the exclusion under this paragraph (a)(23) must provide notification as required by §260.42 of this chapter. (For hazardous secondary material managed in a non-land-based unit, see §261.2(a)(2)(ii)).

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(24) Hazardous secondary material that is generated and then transferred to another person for the purpose of reclamation is not a solid waste, provided that:

(i) The material is not speculatively accumulated, as defined in §261.1(c)(8);

(ii) The material is not handled by any person or facility other than the hazardous secondary material generator, the transporter, an intermediate facility or a reclaimer, and, while in transport, is not stored for more than 10 days at a transfer facility, as defined in §260.10 of this chapter, and is packaged according to applicable Department of Transportation regulations at 49 CFR Parts 173, 178, and 179 while in transport;

(iii) The material is not otherwise subject to material-specific management conditions under paragraph (a) of this section when reclaimed, it is not a spent lead-acid battery (see §266.80 and §273.2 of this chapter), and it does not meet the listing description for K171 or K172 in §261.32;

(iv) The reclamation of the material is legitimate, as specified under §260.43 of this chapter;

(v) The hazardous secondary material generator satisfies all of the following conditions:

(A) The material must be contained.

(B) Prior to arranging for transport of hazardous secondary materials to a reclamation facility (or facilities) where the management of the hazardous secondary materials is not addressed under a RCRA Part B permit or interim status standards, the hazardous secondary material generator must make reasonable efforts to ensure that each reclaimer intends to properly and legitimately reclaim the hazardous secondary material and not discard it, and that each reclaimer will manage the hazardous secondary material in a manner that is protective of human health and the environment. If the hazardous secondary material will be passing through an intermediate facility where the management of the hazardous secondary materials is not addressed under a RCRA Part B permit or interim status standards, the hazardous secondary material generator must make contractual arrangements with the intermediate facility to ensure that the hazardous secondary material is sent to the reclamation facility identified by the hazardous secondary material generator, and the hazardous secondary material generator must perform reasonable efforts to ensure that the intermediate facility will manage the hazardous secondary material in a manner that is protective of human health and the environment. Reasonable efforts must be repeated at a minimum of every three years for the hazardous secondary material generator to claim the exclusion and to send the hazardous secondary materials to each reclaimer and any intermediate facility. In making these reasonable efforts, the generator may use any credible evidence available, including information gathered by the hazardous secondary material generator, provided by the reclaimer or intermediate facility, and/ or provided by a third party. The hazardous secondary material generator must affirmatively answer all of the following questions for each reclamation facility and any intermediate facility:

(1) Does the available information indicate that the reclamation process is legitimate pursuant to §260.43 of this chapter? In answering this question, the hazardous secondary material generator can rely on their existing knowledge of the physical and chemical properties of the hazardous secondary material, as well as information from other sources (e.g., the reclamation facility, audit reports, etc.) about the reclamation process. (By responding to this question, the hazardous secondary material generator has also satisfied its requirement in §260.43(a) of this chapter to be able to demonstrate that the recycling is legitimate).

(2) Does the publicly available information indicate that the reclamation facility and any intermediate facility that is used by the hazardous secondary material generator notified the appropriate authorities of hazardous secondary materials reclamation activities pursuant to §260.42 of this chapter and have they notified the appropriate authorities that the financial assurance condition is satisfied per paragraph (a)(24)(vi)(F) of this section? In answering these questions, the hazardous secondary material generator can rely on the available information documenting the reclamation facility's and any intermediate facility's compliance with the notification requirements per §260.42 of this chapter, including the requirement in §260.42(a)(5) to notify EPA whether the reclaimer or intermediate facility has financial assurance.

(3) Does publicly available information indicate that the reclamation facility or any intermediate facility that is used by the hazardous secondary material generator has not had any formal enforcement actions taken against the facility in the previous three years for violations of the RCRA hazardous waste regulations and has not been classified as a significant non-complier with RCRA Subtitle C? In answering this question, the hazardous secondary material generator can rely on the publicly available information from EPA or the state. If the reclamation facility or any intermediate facility that is used by the hazardous secondary material generator has had a formal enforcement action taken against the facility in the previous three years for violations of the RCRA hazardous waste regulations and has been classified as a significant non-complier with RCRA Subtitle C, does the hazardous secondary material generator have credible evidence that the facilities will manage the hazardous secondary materials properly? In answering this question, the hazardous secondary material generator can obtain additional information from EPA, the state, or the facility itself that the facility has addressed the violations, taken remedial steps to address the violations and prevent future violations, or that the violations are not relevant to the proper management of the hazardous secondary materials.

(4) Does the available information indicate that the reclamation facility and any intermediate facility that is used by the hazardous secondary material generator have the equipment and trained personnel to safely recycle the hazardous secondary material? In answering this question, the generator may rely on a description by the reclamation facility or by an independent third party of

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the equipment and trained personnel to be used to recycle the generator's hazardous secondary material.

(5) If residuals are generated from the reclamation of the excluded hazardous secondary materials, does the reclamation facility have the permits required (if any) to manage the residuals? If not, does the reclamation facility have a contract with an appropriately permitted facility to dispose of the residuals? If not, does the hazardous secondary material generator have credible evidence that the residuals will be managed in a manner that is protective of human health and the environment? In answering these questions, the hazardous secondary material generator can rely on publicly available information from EPA or the state, or information provided by the facility itself.

(C) The hazardous secondary material generator must maintain for a minimum of three years documentation and certification that reasonable efforts were made for each reclamation facility and, if applicable, intermediate facility where the management of the hazardous secondary materials is not addressed under a RCRA Part B permit or interim status standards prior to transferring hazardous secondary material. Documentation and certification must be made available upon request by a regulatory authority within 72 hours, or within a longer period of time as specified by the regulatory authority. The certification statement must:

(1) Include the printed name and official title of an authorized representative of the hazardous secondary material generator company, the authorized representative's signature, and the date signed;

(2) Incorporate the following language: "I hereby certify in good faith and to the best of my knowledge that, prior to arranging for transport of excluded hazardous secondary materials to [insert name(s) of reclamation facility and any intermediate facility], reasonable efforts were made in accordance with §261.4(a)(24)(v)(B) to ensure that the hazardous secondary materials would be recycled legitimately, and otherwise managed in a manner that is protective of human health and the environment, and that such efforts were based on current and accurate information."

(D) The hazardous secondary material generator must maintain at the generating facility for no less than three (3) years records of all off-site shipments of hazardous secondary materials. For each shipment, these records must, at a minimum, contain the following information:

- (1) Name of the transporter and date of the shipment;
- (2) Name and address of each reclaimer and, if applicable, the name and address of each intermediate facility to which the hazardous secondary material was sent;
- (3) The type and quantity of hazardous secondary material in the shipment.

(E) The hazardous secondary material generator must maintain at the generating facility for no less than three (3) years confirmations of receipt from each reclaimer and, if applicable, each intermediate facility for all off-site shipments of hazardous secondary materials. Confirmations of receipt must include the name and address of the reclaimer (or intermediate facility), the type and quantity of the hazardous secondary materials

received and the date which the hazardous secondary materials were received. This requirement may be satisfied by routine business records (e.g., financial records, bills of lading, copies of DOT shipping papers, or electronic confirmations of receipt); and

(vi) Reclaimers of hazardous secondary material excluded from regulation under this exclusion and intermediate facilities as defined in §260.10 of this chapter satisfy all of the following conditions:

(A) The reclaimer and intermediate facility must maintain at its facility for no less than three (3) years records of all shipments of hazardous secondary material that were received at the facility and, if applicable, for all shipments of hazardous secondary materials that were received and subsequently sent off-site from the facility for further reclamation. For each shipment, these records must at a minimum contain the following information:

- (1) Name of the transporter and date of the shipment;
- (2) Name and address of the hazardous secondary material generator and, if applicable, the name and address of the reclaimer or intermediate facility which the hazardous secondary materials were received from;
- (3) The type and quantity of hazardous secondary material in the shipment; and

(4) For hazardous secondary materials that, after being received by the reclaimer or intermediate facility, were subsequently transferred off-site for further reclamation, the name and address of the (subsequent) reclaimer and, if applicable, the name and address of each intermediate facility to which the hazardous secondary material was sent.

(B) The intermediate facility must send the hazardous secondary material to the reclaimer(s) designated by the hazardous secondary materials generator.

(C) The reclaimer and intermediate facility must send to the hazardous secondary material generator confirmations of receipt for all off-site shipments of hazardous secondary materials. Confirmations of receipt must include the name and address of the reclaimer (or intermediate facility), the type and quantity of the hazardous secondary materials received and the date which the hazardous secondary materials were received. This requirement may be satisfied by routine business records (e.g., financial records, bills of lading, copies of DOT shipping papers, or electronic confirmations of receipt).

(D) The reclaimer and intermediate facility must manage the hazardous secondary material in a manner that is at least as protective as that employed for analogous raw material and must be contained. An "analogous raw material" is a raw material for which a hazardous secondary material is a substitute and serves the same function and has similar physical and chemical properties as the hazardous secondary material.

(E) Any residuals that are generated from reclamation processes will be managed in a manner that is protective of human health and the environment. If any residuals exhibit a hazardous characteristic according to subpart C of 40 CFR part 261, or if they themselves are specifically listed in subpart D of 40 CFR part 261, such residuals are hazardous wastes and must be managed in

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accordance with the applicable requirements of 40 CFR parts 260 through 272.

(F) The reclaimer and intermediate facility has financial assurance as required under subpart H of 40 CFR part 261.

(vii) In addition, all persons claiming the exclusion under this paragraph (a)(24) of this section must provide notification as required under §260.42 of this chapter.

(25) Hazardous secondary material that is exported from the United States and reclaimed at a reclamation facility located in a foreign country is not a solid waste, provided that the hazardous secondary material generator complies with the applicable requirements of paragraph (a)(24)(i)–(v) of this section (excepting paragraph (a)(v)(B)(2) of this section for foreign reclaimers and foreign intermediate facilities), and that the hazardous secondary material generator also complies with the following requirements:

(i) Notify EPA of an intended export before the hazardous secondary material is scheduled to leave the United States. A complete notification must be submitted at least sixty (60) days before the initial shipment is intended to be shipped off-site. This notification may cover export activities extending over a twelve (12) month or lesser period. The notification must be in writing, signed by the hazardous secondary material generator, and include the following information:

(A) Name, mailing address, telephone number and EPA ID number (if applicable) of the hazardous secondary material generator;

(B) A description of the hazardous secondary material and the EPA hazardous waste number that would apply if the hazardous secondary material was managed as hazardous waste and the U.S. DOT proper shipping name, hazard class and ID number (UN/ NA) for each hazardous secondary material as identified in 49 CFR parts 171 through 177;

(C) The estimated frequency or rate at which the hazardous secondary material is to be exported and the period of time over which the hazardous secondary material is to be exported;

(D) The estimated total quantity of hazardous secondary material;

(E) All points of entry to and departure from each foreign country through which the hazardous secondary material will pass;

(F) A description of the means by which each shipment of the hazardous secondary material will be transported (e.g., mode of transportation vehicle (air, highway, rail, water, etc.), type(s) of container (drums, boxes, tanks, etc.));

(G) A description of the manner in which the hazardous secondary material will be reclaimed in the receiving country;

(H) The name and address of the reclaimer, any intermediate facility and any alternate reclaimer and intermediate facilities; and

(I) The name of any transit countries through which the hazardous secondary material will be sent and a

description of the approximate length of time it will remain in such countries and the nature of its handling while there (for purposes of this section, the terms “Acknowledgement of Consent”, “receiving country” and “transit country” are used as defined in 40 CFR 262.51 with the exception that the terms in this section refer to hazardous secondary materials, rather than hazardous waste):

(ii) Notifications submitted by mail should be sent to the following mailing address: Office of Enforcement and Compliance Assurance, Office of Federal Activities, International Compliance Assurance Division, (Mail Code 2254A), Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460. Hand-delivered notifications should be delivered to: Office of Enforcement and Compliance Assurance, Office of Federal Activities, International Compliance Assurance Division, Environmental Protection Agency, Ariel Rios Bldg., Room 6144, 12th St. and Pennsylvania Ave., NW., Washington, DC 20004. In both cases, the following shall be prominently displayed on the front of the envelope: “Attention: Notification of Intent to Export.”

(iii) Except for changes to the telephone number in paragraph (a)(25)(i)(A) of this section and decreases in the quantity of hazardous secondary material indicated pursuant to paragraph (a)(25)(i)(D) of this section, when the conditions specified on the original notification change (including any exceedance of the estimate of the quantity of hazardous secondary material specified in the original notification), the hazardous secondary material generator must provide EPA with a written renotification of the change. The shipment cannot take place until consent of the receiving country to the changes (except for changes to paragraph (a)(25)(i)(I) of this section and in the ports of entry to and departure from transit countries pursuant to paragraphs (a)(25)(i)(E) of this section) has been obtained and the hazardous secondary material generator receives from EPA an Acknowledgment of Consent reflecting the receiving country's consent to the changes.

(iv) Upon request by EPA, the hazardous secondary material generator shall furnish to EPA any additional information which a receiving country requests in order to respond to a notification.

(v) EPA will provide a complete notification to the receiving country and any transit countries. A notification is complete when EPA receives a notification which EPA determines satisfies the requirements of paragraph (a)(25)(i) of this section. Where a claim of confidentiality is asserted with respect to any notification information required by paragraph (a)(25)(i) of this section, EPA may find the notification not complete until any such claim is resolved in accordance with 40 CFR 260.2.

(vi) The export of hazardous secondary material under this paragraph (a)(25) is prohibited unless the receiving country consents to the intended export. When the receiving country consents in writing to the receipt of the hazardous secondary material, EPA will send an Acknowledgment of Consent to the hazardous secondary material generator. Where the receiving country objects to receipt of the hazardous secondary material or

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withdraws a prior consent, EPA will notify the hazardous secondary material generator in writing. EPA will also notify the hazardous secondary material generator of any responses from transit countries.

(vii) For exports to OECD Member countries, the receiving country may respond to the notification using tacit consent. If no objection has been lodged by any receiving country or transit countries to a notification provided pursuant to paragraph (a)(25)(i) of this section within thirty (30) days after the date of issuance of the acknowledgement of receipt of notification by the competent authority of the receiving country, the transboundary movement may commence. In such cases, EPA will send an Acknowledgment of Consent to inform the hazardous secondary material generator that the receiving country and any relevant transit countries have not objected to the shipment, and are thus presumed to have consented tacitly. Tacit consent expires one (1) calendar year after the close of the thirty (30) day period; renotification and renewal of all consents is required for exports after that date.

(viii) A copy of the Acknowledgment of Consent must accompany the shipment. The shipment must conform to the terms of the Acknowledgment of Consent.

(ix) If a shipment cannot be delivered for any reason to the reclaimer, intermediate facility or the alternate reclaimer or alternate intermediate facility, the hazardous secondary material generator must re-notify EPA of a change in the conditions of the original notification to allow shipment to a new reclaimer in accordance with paragraph (iii) of this section and obtain another Acknowledgment of Consent.

(x) Hazardous secondary material generators must keep a copy of each notification of intent to export and each Acknowledgment of Consent for a period of three years following receipt of the Acknowledgment of Consent.

(xi) Hazardous secondary material generators must file with the Administrator no later than March 1 of each year, a report summarizing the types, quantities, frequency and ultimate destination of all hazardous secondary materials exported during the previous calendar year. Annual reports submitted by mail should be sent to the following address: Office of Enforcement and Compliance Assurance, Office of Federal Activities, International Compliance Assurance Division (Mail Code 2254A), Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460. Hand-delivered reports should be delivered to: Office of Enforcement and Compliance Assurance, Office of Federal Activities, International Compliance Assurance Division, Environmental Protection Agency, Ariel Rios Bldg., Room 6144, 12th St. and Pennsylvania Ave., NW., Washington, DC 20004. Such reports must include the following information:

(A) Name, mailing and site address, and EPA ID number (if applicable) of the hazardous secondary material generator;

(B) The calendar year covered by the report;

(C) The name and site address of each reclaimer and intermediate facility;

(D) By reclaimer and intermediate facility, for each hazardous secondary material exported, a description of the hazardous secondary material and the EPA hazardous waste number that would apply if the hazardous secondary material was managed as hazardous waste, DOT hazard class, the name and U.S. EPA ID number (where applicable) for each transporter used, the total amount of hazardous secondary material shipped and the number of shipments pursuant to each notification;

(E) A certification signed by the hazardous secondary material generator which states: "I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment."

(xii) All persons claiming an exclusion under this paragraph (a)(25) must provide notification as required by §260.42 of this chapter.

(26) Solvent-contaminated wipes that are sent for cleaning and reuse are not solid wastes from the point of generation, provided that

(i) The solvent-contaminated wipes, when accumulated, stored, and transported, are contained in non-leaking, closed containers that are labeled "Excluded Solvent-Contaminated Wipes." The containers must be able to contain free liquids, should free liquids occur. During accumulation, a container is considered closed when there is complete contact between the fitted lid and the rim, except when it is necessary to add or remove solvent-contaminated wipes. When the container is full, or when the solvent-contaminated wipes are no longer being accumulated, or when the container is being transported, the container must be sealed with all lids properly and securely affixed to the container and all openings tightly bound or closed sufficiently to prevent leaks and emissions;

(ii) The solvent-contaminated wipes may be accumulated by the generator for up to 180 days from the start date of accumulation for each container prior to being sent for cleaning;

(iii) At the point of being sent for cleaning on-site or at the point of being transported off-site for cleaning, the solvent-contaminated wipes must contain no free liquids as defined in §260.10 of this chapter.

(iv) Free liquids removed from the solvent-contaminated wipes or from the container holding the wipes must be managed according to the applicable regulations found in 40 CFR parts 260 through 273;

(v) Generators must maintain at their site the following documentation:

(A) Name and address of the laundry or dry cleaner that is receiving the solvent-contaminated wipes;

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(B) Documentation that the 180-day accumulation time limit in 40 CFR 261.4(a)(26)(ii) is being met;

(C) Description of the process the generator is using to ensure the solvent-contaminated wipes contain no free liquids at the point of being laundered or dry cleaned on-site or at the point of being transported off-site for laundering or dry cleaning;

(vi) The solvent-contaminated wipes are sent to a laundry or dry cleaner whose discharge, if any, is regulated under sections 301 and 402 or section 307 of the Clean Water Act.

(b) **Solid wastes which are not hazardous wastes.** The following solid wastes are not hazardous wastes:

(1) Household waste, including household waste that has been collected, transported, stored, treated, disposed, recovered (e.g., refuse-derived fuel) or reused. "Household waste" means any material (including garbage, trash and sanitary wastes in septic tanks) derived from households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds and day-use recreation areas). A resource recovery facility managing municipal solid waste shall not be deemed to be treating, storing, disposing of, or otherwise managing hazardous wastes for the purposes of regulation under this subtitle, if such facility:

(i) Receives and burns only

(A) Household waste (from single and multiple dwellings, hotels, motels, and other residential sources) and

(B) Solid waste from commercial or industrial sources that does not contain hazardous waste; and

(ii) Such facility does not accept hazardous wastes and the owner or operator of such facility has established contractual requirements or other appropriate notification or inspection procedures to assure that hazardous wastes are not received at or burned in such facility.

(2) Solid wastes generated by any of the following and which are returned to the soils as fertilizers:

(i) The growing and harvesting of agricultural crops.

(ii) The raising of animals, including animal manures.

(3) Mining overburden returned to the mine site.

(4) Fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste, generated primarily from the combustion of coal or other fossil fuels, except as provided by §266.112 of this chapter for facilities that burn or process hazardous waste.

(5) Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas or geothermal energy.

(6)(i) Wastes which fail the test for the Toxicity Characteristic because chromium is present or are listed in subpart D due to the presence of chromium, which do not fail the test for the Toxicity Characteristic for any other constituent or are not listed due to the presence of any other constituent, and which do not fail the test for any other characteristic, if it is shown by a waste generator or by waste generators that:

(A) The chromium in the waste is exclusively (or nearly exclusively) trivalent chromium; and

(B) The waste is generated from an industrial process which uses trivalent chromium exclusively (or nearly exclusively) and the process does not generate hexavalent chromium; and

(C) The waste is typically and frequently managed in non-oxidizing environments.

(ii) Specific wastes which meet the standard in paragraphs (b)(6)(i) (A), (B), and (C) (so long as they do not fail the test for the toxicity characteristic for any other constituent, and do not exhibit any other characteristic) are:

(A) Chrome (blue) trimmings generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearling.

(B) Chrome (blue) shavings generated by the following subcategories of the leather tanning and finishing industry: Hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearling.

(C) Buffing dust generated by the following subcategories of the leather tanning and finishing industry: hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue.

(D) Sewer screenings generated by the following subcategories of the leather tanning and finishing industry: Hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearling.

(E) Wastewater treatment sludges generated by the following subcategories of the leather tanning and finishing industry: Hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; retan/wet finish; no beamhouse; through-the-blue; and shearling.

(F) Wastewater treatment sludges generated by the following subcategories of the leather tanning and finishing industry: Hair pulp/chrome tan/retan/wet finish; hair save/chrome tan/retan/wet finish; and through-the-blue.

(G) Waste scrap leather from the leather tanning industry, the shoe manufacturing industry, and other leather product manufacturing industries.

(H) Wastewater treatment sludges from the production of TiO₂ pigment using chromium-bearing ores by the chloride process.

(7) Solid waste from the extraction, beneficiation, and processing of ores and minerals (including coal, phosphate rock, and overburden from the mining of uranium ore), except as provided by §266.112 of this chapter for facilities that burn or process hazardous waste.

(i) For purposes of §261.4(b)(7) beneficiation of ores and minerals is restricted to the following activities; crushing; grinding; washing; dissolution; crystallization; filtration; sorting; sizing; drying; sintering; pelletizing; briquetting; calcining to remove water and/or

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carbon dioxide; roasting, autoclaving, and/or chlorination in preparation for leaching (except where the roasting (and/or autoclaving and/or chlorination)/leaching sequence produces a final or intermediate product that does not undergo further beneficiation or processing); gravity concentration; magnetic separation; electrostatic separation; flotation; ion exchange; solvent extraction; electrowinning; precipitation; amalgamation; and heap, dump, vat, tank, and in situ leaching.

(ii) For the purposes of §261.4(b)(7), solid waste from the processing of ores and minerals includes only the following wastes as generated:

- (A) Slag from primary copper processing;
- (B) Slag from primary lead processing;
- (C) Red and brown muds from bauxite refining;
- (D) Phosphogypsum from phosphoric acid production;
- (E) Slag from elemental phosphorus production;
- (F) Gasifier ash from coal gasification;
- (G) Process wastewater from coal gasification;
- (H) Calcium sulfate wastewater treatment plant sludge from primary copper processing;
- (I) Slag tailings from primary copper processing;
- (J) Fluorogypsum from hydrofluoric acid production;
- (K) Process wastewater from hydrofluoric acid production;
- (L) Air pollution control dust/sludge from iron blast furnaces;
- (M) Iron blast furnace slag;
- (N) Treated residue from roasting/leaching of chrome ore;
- (O) Process wastewater from primary magnesium processing by the anhydrous process;
- (P) Process wastewater from phosphoric acid production;
- (Q) Basic oxygen furnace and open hearth furnace air pollution control dust/sludge from carbon steel production;
- (R) Basic oxygen furnace and open hearth furnace slag from carbon steel production;
- (S) Chloride process waste solids from titanium tetrachloride production;
- (T) Slag from primary zinc processing.

(iii) A residue derived from co-processing mineral processing secondary materials with normal beneficiation raw materials or with normal mineral processing raw materials remains excluded under paragraph (b) of this section if the owner or operator:

- (A) Processes at least 50 percent by weight normal beneficiation raw materials or normal mineral processing raw materials; and,
 - (B) Legitimately reclaims the secondary mineral processing materials.
- (8) Cement kiln dust waste, except as provided by §266.112 of this chapter for facilities that burn or process hazardous waste.

(9) Solid waste which consists of discarded arsenical-treated wood or wood products which fails the test for the Toxicity Characteristic for Hazardous Waste Codes

D004 through D017 and which is not a hazardous waste for any other reason if the waste is generated by persons who utilize the arsenical-treated wood and wood products for these materials' intended end use.

(10) Petroleum-contaminated media and debris that fail the test for the Toxicity Characteristic of §261.24 (Hazardous Waste Codes D018 through D043 only) and are subject to the corrective action regulations under part 280 of this chapter.

(11) Injected groundwater that is hazardous only because it exhibits the Toxicity Characteristic (Hazardous Waste Codes D018 through D043 only) in §261.24 of this part that is reinjected through an underground injection well pursuant to free phase hydrocarbon recovery operations undertaken at petroleum refineries, petroleum marketing terminals, petroleum bulk plants, petroleum pipelines, and petroleum transportation spill sites until January 25, 1993. This extension applies to recovery operations in existence, or for which contracts have been issued, on or before March 25, 1991. For groundwater returned through infiltration galleries from such operations at petroleum refineries, marketing terminals, and bulk plants, until [insert date six months after publication]. New operations involving injection wells (beginning after March 25, 1991) will qualify for this compliance date extension (until January 25, 1993) only if:

(i) Operations are performed pursuant to a written state agreement that includes a provision to assess the groundwater and the need for further remediation once the free phase recovery is completed; and

(ii) A copy of the written agreement has been submitted to: Characteristics Section (OS-333), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460.

(12) Used chlorofluorocarbon refrigerants from totally enclosed heat transfer equipment, including mobile air conditioning systems, mobile refrigeration, and commercial and industrial air conditioning and refrigeration systems that use chlorofluorocarbons as the heat transfer fluid in a refrigeration cycle, provided the refrigerant is reclaimed for further use.

(13) Non-terne plated used oil filters that are not mixed with waste listed in Subpart D of this part if these oil filters have been gravity hot-drained using one of the following methods:

- (i) Puncturing the filter anti-drain back valve or the filter dome end and hot-draining;
- (ii) Hot-draining and crushing;
- (iii) Dismantling and hot-draining; or
- (iv) Any other equivalent hot-draining method which will remove used oil.

(14) Used oil re-refining distillation bottoms that are used as feedstock to manufacture asphalt products.

(15) Leachate or gas condensate collected from landfills where certain solid wastes have been disposed, provided that:

(i) The solid wastes disposed would meet one or more of the listing descriptions for Hazardous Waste Codes K169, K170, K171, K172, K174, K175, K176, K177,

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K178 and K181 if these wastes had been generated after the effective date of the listing;

(ii) The solid wastes described in paragraph (b)(15)(i) of this section were disposed prior to the effective date of the listing;

(iii) The leachate or gas condensate do not exhibit any characteristic of hazardous waste nor are derived from any other listed hazardous waste;

(iv) Discharge of the leachate or gas condensate, including leachate or gas condensate transferred from the landfill to a POTW by truck, rail, or dedicated pipe, is subject to regulation under sections 307(b) or 402 of the Clean Water Act.

(v) As of February 13, 2001, leachate or gas condensate derived from K169-K172 is no longer exempt if it is stored or managed in a surface impoundment prior to discharge. As of November 21, 2003, leachate or gas condensate derived from K176, K177, and K178 is no longer exempt if it is stored or managed in a surface impoundment prior to discharge. After February 26, 2007, leachate or gas condensate derived from K181 will no longer be exempt if it is stored or managed in a surface impoundment prior to discharge. There is one exception: if the surface impoundment is used to temporarily store leachate or gas condensate in response to an emergency situation (e.g., shutdown of wastewater treatment system), provided the impoundment has a double liner, and provided the leachate or gas condensate is removed from the impoundment and continues to be managed in compliance with the conditions of this paragraph (b)(15)(v) after the emergency ends.

(16) [Reserved]

(17) Solid waste that would otherwise meet the definition of low-level mixed wastes (LLMW) pursuant to §266.210 of this chapter that is generated at the Ortho-McNeil Pharmaceutical, Inc. (OMP Spring House) research and development facility in Spring House, Pennsylvania and treated on-site using a bench-scale high temperature catalytic oxidation unit is not a hazardous waste provided that:

(i) The total volume of LLMW generated and treated is no greater than 50 liters/year,

(ii) OMP Spring House submits a written report to the EPA Region III office once every six months beginning six months after June 27, 2005, that must contain the following:

(A) Analysis demonstrating the destruction and removal efficiency of the treatment technology for all organic components of the wastestream,

(B) Analysis demonstrating the capture efficiencies of the treatment technology for all radioactive components of the wastestream and an estimate of the amount of radioactivity released during the reporting period,

(C) Analysis (including concentrations of constituents, including inorganic constituents, present and radioactivity) of the wastestream prior to and after treatment,

(D) Volume of the wastestream being treated per batch, as well as a total for the duration of the reporting period, and

(E) Final disposition of the radioactive residuals from the treatment of the wastestream.

(iii) OMP Spring House makes no significant changes to the design or operation of the high temperature catalytic oxidation unit or the wastestream.

(iv) This exclusion will remain in affect for 5 years from June 27, 2005.

(18) Solvent-contaminated wipes, except for wipes that are hazardous waste due to the presence of trichloroethylene, that are sent for disposal are not hazardous wastes from the point of generation provided that

(i) The solvent-contaminated wipes, when accumulated, stored, and transported, are contained in non-leaking, closed containers that are labeled "Excluded Solvent-Contaminated Wipes." The containers must be able to contain free liquids, should free liquids occur. During accumulation, a container is considered closed when there is complete contact between the fitted lid and the rim, except when it is necessary to add or remove solvent-contaminated wipes. When the container is full, or when the solvent-contaminated wipes are no longer being accumulated, or when the container is being transported, the container must be sealed with all lids properly and securely affixed to the container and all openings tightly bound or closed sufficiently to prevent leaks and emissions;

(ii) The solvent-contaminated wipes may be accumulated by the generator for up to 180 days from the start date of accumulation for each container prior to being sent for disposal;

(iii) At the point of being transported for disposal, the solvent-contaminated wipes must contain no free liquids as defined in §260.10 of this chapter.

(iv) Free liquids removed from the solvent-contaminated wipes or from the container holding the wipes must be managed according to the applicable regulations found in 40 CFR parts 260 through 273;

(v) Generators must maintain at their site the following documentation:

(A) Name and address of the landfill or combustor that is receiving the solvent-contaminated wipes;

(B) Documentation that the 180 day accumulation time limit in 40 CFR 261.4(b)(18)(ii) is being met;

(C) Description of the process the generator is using to ensure solvent-contaminated wipes contain no free liquids at the point of being transported for disposal;

(vi) The solvent-contaminated wipes are sent for disposal

(A) To a municipal solid waste landfill regulated under 40 CFR part 258, including 40 CFR 258.40, or to a hazardous waste landfill regulated under 40 CFR parts 264 or 265; or

(B) To a municipal waste combustor or other combustion facility regulated under section 129 of the Clean Air Act or to a hazardous waste combustor, boiler, or industrial furnace regulated under 40 CFR parts 264, 265, or 266 subpart H.

(c) Hazardous wastes which are exempted from certain regulations. A hazardous waste which is generated in a product or raw material storage tank, a product or

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raw material transport vehicle or vessel, a product or raw material pipeline, or in a manufacturing process unit or an associated non-waste-treatment-manufacturing unit, is not subject to regulation under Parts 262 through 265, 268, 270, 271 and 124 of this chapter or to the notification requirements of section 3010 of RCRA until it exits the unit in which it was generated, unless the unit is a surface impoundment, or unless the hazardous waste remains in the unit more than 90 days after the unit ceases to be operated for manufacturing, or for storage or transportation of product or raw materials.

(d) **Samples.** (1) Except as provided in paragraph (d)(2) of this section, a sample of solid waste or a sample of water, soil, or air, which is collected for the sole purpose of testing to determine its characteristics or composition, is not subject to any requirements of this part or Parts 262 through 268 or Part 270 or Part 124 of this chapter or to the notification requirements of section 3010 of RCRA, when:

- (i) The sample is being transported to a laboratory for the purpose of testing; or
- (ii) The sample is being transported back to the sample collector after testing; or
- (iii) The sample is being stored by the sample collector before transport to a laboratory for testing; or
- (iv) The sample is being stored in a laboratory before testing; or
- (v) The sample is being stored in a laboratory after testing but before it is returned to the sample collector; or
- (vi) The sample is being stored temporarily in the laboratory after testing for a specific purpose (for example, until conclusion of a court case or enforcement action where further testing of the sample may be necessary).

(2) In order to qualify for the exemption in paragraphs (d)(1)(i) and (ii) of this section, a sample collector shipping samples to a laboratory and a laboratory returning samples to a sample collector must:

- (i) Comply with U.S. Department of Transportation (DOT), U.S. Postal Service (USPS), or any other applicable shipping requirements; or
- (ii) Comply with the following requirements if the sample collector determines that DOT, USPS, or other shipping requirements do not apply to the shipment of the sample:

(A) Assure that the following information accompanies the sample:

- (1) The sample collector's name, mailing address, and telephone number;
- (2) The laboratory's name, mailing address, and telephone number;
- (3) The quantity of the sample;
- (4) The date of shipment; and
- (5) A description of the sample.

(B) Package the sample so that it does not leak, spill, or vaporize from its packaging.

(3) This exemption does not apply if the laboratory determines that the waste is hazardous but the laboratory is no longer meeting any of the conditions stated in paragraph (d)(1) of this section.

(e) **Treatability Study Samples.** (1) Except as provided in paragraph (e)(2) of this section, persons who generate or collect samples for the purpose of conducting treatability studies as defined in section 260.10, are not subject to any requirement of Parts 261 through 263 of this chapter or to the notification requirements of Section 3010 of RCRA, nor are such samples included in the quantity determinations of §261.5 and §262.34(d) when:

- (i) The sample is being collected and prepared for transportation by the generator or sample collector; or
- (ii) The sample is being accumulated or stored by the generator or sample collector prior to transportation to a laboratory or testing facility; or
- (iii) The sample is being transported to the laboratory or testing facility for the purpose of conducting a treatability study.

(2) The exemption in paragraph (e)(1) of this section is applicable to samples of hazardous waste being collected and shipped for the purpose of conducting treatability studies provided that:

- (i) The generator or sample collector uses (in "treatability studies") no more than 10,000 kg of media contaminated with non-acute hazardous waste, 1000 kg of non-acute hazardous waste other than contaminated media, 1 kg of acute hazardous waste, 2500 kg of media contaminated with acute hazardous waste for each process being evaluated for each generated waste stream; and
- (ii) The mass of each sample shipment does not exceed 10,000 kg; the 10,000 kg quantity may be all media contaminated with non-acute hazardous waste, or may include 2500 kg of media contaminated with acute hazardous waste, 1000 kg of hazardous waste, and 1 kg of acute hazardous waste; and
- (iii) The sample must be packaged so that it will not leak, spill, or vaporize from its packaging during shipment and the requirements of paragraph A or B of this subparagraph are met.

(A) The transportation of each sample shipment complies with U.S. Department of Transportation (DOT), U.S. Postal Service (USPS), or any other applicable shipping requirements; or

(B) If the DOT, USPS, or other shipping requirements do not apply to the shipment of the sample, the following information must accompany the sample:

- (1) The name, mailing address, and telephone number of the originator of the sample;
- (2) The name, address, and telephone number of the facility that will perform the treatability study;
- (3) The quantity of the sample;
- (4) The date of shipment; and
- (5) A description of the sample, including its EPA Hazardous Waste Number.

(iv) The sample is shipped to a laboratory or testing facility which is exempt under §261.4(f) or has an appropriate RCRA permit or interim status.

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(v) The generator or sample collector maintains the following records for a period ending 3 years after completion of the treatability study:

- (A) Copies of the shipping documents;
- (B) A copy of the contract with the facility conducting the treatability study;
- (C) Documentation showing:
 - (1) The amount of waste shipped under this exemption;
 - (2) The name, address, and EPA identification number of the laboratory or testing facility that received the waste;
 - (3) The date the shipment was made; and
 - (4) Whether or not unused samples and residues were returned to the generator.

(vi) The generator reports the information required under paragraph (e)(2)(v)(C) of this section in its biennial report.

(3) The Regional Administrator may grant requests on a case-by-case basis for up to an additional two years for treatability studies involving bioremediation. The Regional Administrator may grant requests on a case-by-case basis for quantity limits in excess of those specified in paragraphs (e)(2)(i) and (ii) and (f)(4) of this section, for up to an additional 5000 kg of media contaminated with non-acute hazardous waste, 500 kg of non-acute hazardous waste, 2500 kg of media contaminated with acute hazardous waste and 1 kg of acute hazardous waste:

(i) In response to requests for authorization to ship, store and conduct treatability studies on additional quantities in advance of commencing treatability studies. Factors to be considered in reviewing such requests include the nature of the technology, the type of process (e.g., batch versus continuous), size of the unit undergoing testing (particularly in relation to scale-up considerations), the time/quantity of material required to reach steady state operating conditions, or test design considerations such as mass balance calculations.

(ii) In response to requests for authorization to ship, store and conduct treatability studies on additional quantities after initiation or completion of initial treatability studies, when: There has been an equipment or mechanical failure during the conduct of a treatability study; there is a need to verify the results of a previously conducted treatability study; there is a need to study and analyze alternative techniques within a previously evaluated treatment process; or there is a need to do further evaluation of an ongoing treatability study to determine final specifications for treatment.

(iii) The additional quantities and timeframes allowed in paragraph (e)(3)(i) and (ii) of this section are subject to all the provisions in paragraphs (e)(1) and (e)(2)(iii) through (vi) of this section. The generator or sample collector must apply to the Regional Administrator in the Region where the sample is collected and provide in writing the following information:

(A) The reason why the generator or sample collector requires additional time or quantity of sample for treat-

ability study evaluation and the additional time or quantity needed;

(B) Documentation accounting for all samples of hazardous waste from the waste stream which have been sent for or undergone treatability studies including the date each previous sample from the waste stream was shipped, the quantity of each previous shipment, the laboratory or testing facility to which it was shipped, what treatability study processes were conducted on each sample shipped, and the available results on each treatability study;

(C) A description of the technical modifications or change in specifications which will be evaluated and the expected results;

(D) If such further study is being required due to equipment or mechanical failure, the applicant must include information regarding the reason for the failure or breakdown and also include what procedures or equipment improvements have been made to protect against further breakdowns; and

(E) Such other information that the Regional Administrator considers necessary.

(f) Samples Undergoing Treatability Studies at Laboratories and Testing Facilities. Samples undergoing treatability studies and the laboratory or testing facility conducting such treatability studies (to the extent such facilities are not otherwise subject to RCRA requirements) are not subject to any requirement of this Part, Part 124, Parts 262-266, 268, and 270, or to the notification requirements of Section 3010 of RCRA provided that the conditions of paragraphs (f)(1) through (11) of this section are met. A mobile treatment unit (MTU) may qualify as a testing facility subject to paragraphs (f)(1) through (11) of this section. Where a group of MTUs are located at the same site, the limitations specified in (f)(1) through (11) of this section apply to the entire group of MTUs collectively as if the group were one MTU.

(1) No less than 45 days before conducting treatability studies, the facility notifies the Regional Administrator, or State Director (if located in an authorized State), in writing that it intends to conduct treatability studies under this paragraph.

(2) The laboratory or testing facility conducting the treatability study has an EPA identification number.

(3) No more than a total of 10,000 kg of "as received" media contaminated with non-acute hazardous waste, 2500 kg of media contaminated with acute hazardous waste or 250 kg of other "as received" hazardous waste is subject to initiation of treatment in all treatability studies in any single day. "As received" waste refers to the waste as received in the shipment from the generator or sample collector.

(4) The quantity of "as received" hazardous waste stored at the facility for the purpose of evaluation in treatability studies does not exceed 10,000 kg, the total of which can include 10,000 kg of media contaminated with non-acute hazardous waste, 2500 kg of media contaminated with acute hazardous waste, 1000 kg of non-acute hazardous wastes other than contaminated

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media, and 1 kg of acute hazardous waste. This quantity limitation does not include treatment materials (including nonhazardous solid waste) added to “as received” hazardous waste.

(5) No more than 90 days have elapsed since the treatability study for the sample was completed, or no more than one year (two years for treatability studies involving bioremediation) have elapsed since the generator or sample collector shipped the sample to the laboratory or testing facility, whichever date first occurs. Up to 500 kg of treated material from a particular waste stream from treatability studies may be archived for future evaluation up to five years from the date of initial receipt. Quantities of materials archived are counted against the total storage limit for the facility.

(6) The treatability study does not involve the placement of hazardous waste on the land or open burning of hazardous waste.

(7) The facility maintains records for 3 years following completion of each study that show compliance with the treatment rate limits and the storage time and quantity limits. The following specific information must be included for each treatability study conducted:

(i) The name, address, and EPA identification number of the generator or sample collector of each waste sample;

(ii) The date the shipment was received;

(iii) The quantity of waste accepted;

(iv) The quantity of “as received” waste in storage each day;

(v) The date the treatment study was initiated and the amount of “as received” waste introduced to treatment each day;

(vi) The date the treatability study was concluded;

(vii) The date any unused sample or residues generated from the treatability study were returned to the generator or sample collector or, if sent to a designated facility, the name of the facility and the EPA identification number.

(8) The facility keeps, on-site, a copy of the treatability study contract and all shipping papers associated with the transport of treatability study samples to and from the facility for a period ending 3 years from the completion date of each treatability study.

(9) The facility prepares and submits a report to the Regional Administrator, or state Director (if located in an authorized state), by March 15 of each year, that includes the following information for the previous calendar year:

(i) The name, address, and EPA identification number of the facility conducting the treatability studies;

(ii) The types (by process) of treatability studies conducted;

(iii) The names and addresses of persons for whom studies have been conducted (including their EPA identification numbers);

(iv) The total quantity of waste in storage each day;

(v) The quantity and types of waste subjected to treatability studies;

(vi) When each treatability study was conducted;

(vii) The final disposition of residues and unused sample from each treatability study.

(10) The facility determines whether any unused sample or residues generated by the treatability study are hazardous waste under §261.3 and, if so, are subject to Parts 261 through 268, and Part 270 of this Chapter, unless the residues and unused samples are returned to the sample originator under the §261.4(e) exemption.

(11) The facility notifies the Regional Administrator, or State Director (if located in an authorized State), by letter when the facility is no longer planning to conduct any treatability studies at the site.

(g) **Dredged material that is not a hazardous waste.** Dredged material that is subject to the requirements of a permit that has been issued under 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste. For this paragraph (g), the following definitions apply:

(1) The term *dredged material* has the same meaning as defined in 40 CFR 232.2;

(2) The term *permit* means:

(i) A permit issued by the U.S. Army Corps of Engineers (Corps) or an approved State under section 404 of the Federal Water Pollution Control Act (33 U.S.C. 1344);

(ii) A permit issued by the Corps under section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413); or

(iii) In the case of Corps civil works projects, the administrative equivalent of the permits referred to in paragraphs (g)(2)(i) and (ii) of this section, as provided for in Corps regulations (for example, see 33 CFR 336.1, 336.2, and 337.6).

(h) **Carbon dioxide stream injected for geologic sequestration.** Carbon dioxide streams that are captured and transported for purposes of injection into an underground injection well subject to the requirements for Class VI Underground Injection Control wells, including the requirements in 40 CFR Parts 144 and 146 of the Underground Injection Control Program of the Safe Drinking Water Act, are not a hazardous waste, provided the following conditions are met:

(1) Transportation of the carbon dioxide stream must be in compliance with U.S. Department of Transportation requirements, including the pipeline safety laws (49 U.S.C. 60101 et seq.) and regulations (49 CFR Parts 190-199) of the U.S. Department of Transportation, and pipeline safety regulations adopted and administered by a state authority pursuant to a certification under 49 U.S.C. 60105, as applicable.

(2) Injection of the carbon dioxide stream must be in compliance with the applicable requirements for Class VI Underground Injection Control wells, including the applicable requirements in 40 CFR Parts 144 and 146;

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(3) No hazardous wastes shall be mixed with, or otherwise co-injected with, the carbon dioxide stream; and

(4)(i) Any generator of a carbon dioxide stream, who claims that a carbon dioxide stream is excluded under this paragraph (h), must have an authorized representative (as defined in 40 CFR 260.10) sign a certification statement worded as follows:

I certify under penalty of law that the carbon dioxide stream that I am claiming to be excluded under 40 CFR 261.4(h) has not been mixed with hazardous wastes, and I have transported the carbon dioxide stream in compliance with (or have contracted with a pipeline operator or transporter to transport the carbon dioxide stream in compliance with) Department of Transportation requirements, including the pipeline safety laws (49 U.S.C. 60101 et seq.) and regulations (49 CFR Parts 190-199) of the U.S. Department of Transportation, and the pipeline safety regulations adopted and administered by a state authority pursuant to a certification under 49 U.S.C. 60105, as applicable, for injection into a well subject to the requirements for the Class VI Underground Injection Control Program of the Safe Drinking Water Act.

(ii) Any Class VI Underground Injection Control well owner or operator, who claims that a carbon dioxide stream is excluded under paragraph (h) of this section, must have an authorized representative (as defined in 40 CFR 260.10) sign a certification statement worded as follows:

I certify under penalty of law that the carbon dioxide stream that I am claiming to be excluded under 40 CFR 261.4(h) has not been mixed with, or otherwise co-injected with, hazardous waste at the Underground Injection Control (UIC) Class VI permitted facility, and that injection of the carbon dioxide stream is in compliance with the applicable requirements for UIC Class VI wells, including the applicable requirements in 40 CFR Parts 144 and 146.

(iii) The signed certification statement must be kept on-site for no less than three years, and must be made available within 72 hours of a written request from the Administrator, Regional Administrator, or state Director (if located in an authorized state), or their designee. The signed certification statement must be renewed every year that the exclusion is claimed, by having an authorized representative (as defined in 40 CFR 260.10) annually prepare and sign a new copy of the certification statement within one year of the date of the previous statement. The signed certification statement must also be readily accessible on the facility's publicly-available Web site (if such Web site exists) as a public notification with the title of "Carbon Dioxide Stream Certification" at the time the exclusion is claimed.

§261.5 Special requirements for hazardous waste generated by conditionally exempt small quantity generators.

(a) A generator is a conditionally exempt small quantity generator in a calendar month if he generates no more than 100 kilograms of hazardous waste in that month.

(b) Except for those wastes identified in paragraphs (e), (f), (g), and (j) of this section, a conditionally exempt small quantity generator's hazardous wastes are not subject to regulation under parts 262 through 268, and parts 270 and 124 of this chapter, and the notification requirements of section 3010 of RCRA, provided the generator complies with the requirements of paragraphs (f), (g), and (j) of this section.

(c) When making the quantity determinations of this part and 40 CFR part 262, the generator must include all hazardous waste that it generates, except hazardous waste that:

(1) Is exempt from regulation under 40 CFR 261.4(c) through (f), 261.6(a)(3), 261.7(a)(1), or 261.8; or

(2) Is managed immediately upon generation only in on-site elementary neutralization units, wastewater treatment units, or totally enclosed treatment facilities as defined in 40 CFR 260.10; or

(3) Is recycled, without prior storage or accumulation, only in an on-site process subject to regulation under 40 CFR 261.6(c)(2); or

(4) Is used oil managed under the requirements of 40 CFR 261.6(a)(4) and 40 CFR part 279; or

(5) Is spent lead-acid batteries managed under the requirements of 40 CFR part 266, subpart G; or

(6) Is universal waste managed under 40 CFR 261.9 and 40 CFR part 273;

(7) Is a hazardous waste that is an unused commercial chemical product (listed in 40 CFR part 261, subpart D or exhibiting one or more characteristics in 40 CFR part 261, subpart C) that is generated solely as a result of a laboratory clean-out conducted at an eligible academic entity pursuant to §262.213. For purposes of this provision, the term eligible academic entity shall have the meaning as defined in §262.200 of Part 262.

(d) In determining the quantity of hazardous waste generated, a generator need not include:

(1) Hazardous waste when it is removed from on-site storage; or

(2) Hazardous waste produced by on-site treatment (including reclamation) of his hazardous waste, so long as the hazardous waste that is treated was counted once; or

(3) Spent materials that are generated, reclaimed, and subsequently reused on-site, so long as such spent materials have been counted once.

(e) If a generator generates acute hazardous waste in a calendar month in quantities greater than set forth below, all quantities of that acute hazardous waste are subject to full regulation under parts 262 through 268, and parts 270 and 124 of this chapter, and the notification requirements of section 3010 of RCRA:

(1) A total of one kilogram of acute hazardous wastes listed in §§261.31 or 261.33(e).

(2) A total of 100 kilograms of any residue or contaminated soil, waste, or other debris resulting from the clean-up of a spill, into or on any land or water, of any acute hazardous wastes listed in §§261.31, or 261.33(e).

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Note to paragraph (e): "Full regulation" means those regulations applicable to generators of 1,000 kg or greater of hazardous waste in a calendar month.

(f) In order for acute hazardous wastes generated by a generator of acute hazardous wastes in quantities equal to or less than those set forth in paragraphs (e)(1) or (e)(2) of this section to be excluded from full regulation under this section, the generator must comply with the following requirements:

- (1) Section 262.11 of this chapter;
- (2) The generator may accumulate acute hazardous waste on-site. If he accumulates at any time acute hazardous wastes in quantities greater than those set forth in paragraph (e)(1) or (e)(2) of this section, all of those accumulated wastes are subject to regulation under parts 262 through 268, and parts 270 and 124 of this chapter, and the applicable notification requirements of section 3010 of RCRA. The time period of §262.34(a) of this chapter, for accumulation of wastes on-site, begins when the accumulated wastes exceed the applicable exclusion limit;
- (3) A conditionally exempt small quantity generator may either treat or dispose of his acute hazardous waste in an on-site facility or ensure delivery to an off-site treatment, storage or disposal facility, either of which, if located in the U.S., is:
 - (i) Permitted under part 270 of this chapter;
 - (ii) In interim status under parts 270 and 265 of this chapter;
 - (iii) Authorized to manage hazardous waste by a State with a hazardous waste management program approved under part 271 of this chapter;
 - (iv) Permitted, licensed, or registered by a State to manage municipal solid waste and, if managed in a municipal solid waste landfill is subject to Part 258 of this chapter;
 - (v) Permitted, licensed, or registered by a State to manage non-municipal non-hazardous waste and, if managed in a non-municipal non-hazardous waste disposal unit after January 1, 1998, is subject to the requirements in §§257.5 through 257.30 of this chapter; or
 - (vi) A facility which:
 - (A) Beneficially uses or reuses, or legitimately recycles or reclaims its waste; or
 - (B) Treats its waste prior to beneficial use or reuse, or legitimate recycling or reclamation; or
 - (vii) For universal waste managed under part 273 of this chapter, a universal waste handler or destination facility subject to the requirements of part 273 of this chapter.
- (g) In order for hazardous waste generated by a conditionally exempt small quantity generator in quantities of 100 kilograms or less of hazardous waste during a calendar month to be excluded from full regulation under this section, the generator must comply with the following requirements:
 - (1) Section 262.11 of this chapter;
 - (2) The generator may accumulate acute hazardous waste on-site. If he accumulates at any time acute hazardous wastes in quantities greater than those set forth

in paragraph (e)(1) or (e)(2) of this section, all of those accumulated wastes are subject to regulation under parts 262 through 268, and parts 270 and 124 of this chapter, and the applicable notification requirements of section 3010 of RCRA. The time period of §262.34(a) of this chapter, for accumulation of wastes on-site, begins when the accumulated wastes exceed the applicable exclusion limit;

(3) A conditionally exempt small quantity generator may either treat or dispose of his hazardous waste in an on-site facility or ensure delivery to an off-site treatment, storage or disposal facility, either of which, if located in the U.S., is:

- (i) Permitted under part 270 of this chapter;
- (ii) In interim status under parts 270 and 265 of this chapter;
- (iii) Authorized to manage hazardous waste by a State with a hazardous waste management program approved under part 271 of this chapter;
- (iv) Permitted, licensed, or registered by a State to manage municipal solid waste and, if managed in a municipal solid waste landfill is subject to Part 258 of this chapter;
- (v) Permitted, licensed, or registered by a State to manage non-municipal non-hazardous waste and, if managed in a non-municipal non-hazardous waste disposal unit after January 1, 1998, is subject to the requirements in §§257.5 through 257.30 of this chapter; or
- (vi) A facility which:
 - (A) Beneficially uses or reuses, or legitimately recycles or reclaims its waste; or
 - (B) Treats its waste prior to beneficial use or reuse, or legitimate recycling or reclamation; or
- (vii) For universal waste managed under part 273 of this chapter, a universal waste handler or destination facility subject to the requirements of part 273 of this chapter.
- (h) Hazardous waste subject to the reduced requirements of this section may be mixed with non-hazardous waste and remain subject to these reduced requirements even though the resultant mixture exceeds the quantity limitations identified in this section, unless the mixture meets any of the characteristics of hazardous waste identified in Subpart C.

Regulations

(i) If any person mixes a solid waste with a hazardous waste that exceeds a quantity exclusion level of this section, the mixture is subject to full regulation.

(j) If a conditionally exempt small quantity generator's wastes are mixed with used oil, the mixture is subject to part 279 of this chapter if it is destined to be burned for energy recovery. Any material produced from such a mixture by processing, blending, or other treatment is also so regulated if it is destined to be burned for energy recovery.

§261.6 Requirements for recyclable materials.

(1) Hazardous wastes that are recycled are subject to the requirements for generators, transporters, and storage facilities of paragraphs (b) and (c) of this section, except for the materials listed in paragraphs (a)(2) and (a)(3) of this section. Hazardous wastes that are recycled will be known as "recyclable materials."

(2) The following recyclable materials are not subject to the requirements of this section but are regulated under subparts C through N of part 266 of this chapter and all applicable provisions in parts 268, 270, and 124 of this chapter.

(i) Recyclable materials used in a manner constituting disposal (40 CFR part 266, subpart C);

(ii) Hazardous wastes burned (as defined in section 266.100(a)) in boilers and industrial furnaces that are not regulated under subpart O of part 264 or 265 of this chapter (40 CFR part 266, subpart H);

(iii) Recyclable materials from which precious metals are reclaimed (40 CFR part 266, subpart F);

(iv) Spent lead-acid batteries that are being reclaimed (40 CFR part 266, subpart G).

(3) The following recyclable materials are not subject to regulation under parts 262 through parts 268, 270 or 124 of this chapter, and are not subject to the notification requirements of section 3010 of RCRA:

(i) Industrial ethyl alcohol that is reclaimed except that, unless provided otherwise in an international agreement as specified in §262.58.

(A) A person initiating a shipment for reclamation in a foreign country, and any intermediary arranging for the shipment, must comply with the requirements applicable to a primary exporter in §262.53, 262.56 (a)(1)-(4), (6), and (b), and 262.57, export such materials only upon consent of the receiving country and in conformance with the EPA Acknowledgment of Consent as defined in Subpart E of Part 262, and provide a copy of the EPA Acknowledgment of Consent to the shipment to the transporter transporting the shipment for export;

(B) Transporters transporting a shipment for export may not accept a shipment if he knows the shipment does not conform to the EPA Acknowledgment of Consent, must ensure that a copy of the EPA Acknowledgment of Consent accompanies the shipment and must ensure that it is delivered to the facility designated by the person initiating the shipment.

(ii) Scrap metal that is not excluded under §261.4(a)(13);

(iii) Fuels produced from the refining of oil-bearing hazardous waste along with normal process streams at a petroleum refining facility if such wastes result from

normal petroleum refining, production, and transportation practices (this exemption does not apply to fuels produced from oil recovered from oil-bearing hazardous waste, where such recovered oil is already excluded under §261.4(a)(12));

(iv)(A) Hazardous waste fuel produced from oil-bearing hazardous wastes from petroleum refining, production, or transportation practices, or produced from oil reclaimed from such hazardous wastes, where such hazardous wastes are reintroduced into a process that does not use distillation or does not produce products from crude oil so long as the resulting fuel meets the used oil specification under §279.11 of this chapter and so long as no other hazardous wastes are used to produce the hazardous waste fuel;

(B) Hazardous waste fuel produced from oil-bearing hazardous waste from petroleum refining production, and transportation practices, where such hazardous wastes are reintroduced into a refining process after a point at which contaminants are removed, so long as the fuel meets the used oil fuel specification under §279.11 of this chapter; and

(C) Oil reclaimed from oil-bearing hazardous wastes from petroleum refining, production, and transportation practices, which reclaimed oil is burned as a fuel without reintroduction to a refining process, so long as the reclaimed oil meets the used oil fuel specification under §279.11 of this chapter.

(4) Used oil that is recycled and is also a hazardous waste solely because it exhibits a hazardous characteristic is not subject to the requirements of parts 260 through 268 of this chapter, but is regulated under part 279 of this chapter. Used oil that is recycled includes any used oil which is reused, following its original use, for any purpose (including the purpose for which the oil was originally used). Such term includes, but is not limited to, oil which is re-refined, reclaimed, burned for energy recovery, or reprocessed.

(5) Hazardous waste that is exported to or imported from designated member countries of the Organization for Economic Cooperation and Development (OECD) (as defined in §262.58(a)(1) for purpose of recovery is subject to the requirements of 40 CFR part 262, subpart H, if it is subject to either the Federal manifesting requirements of 40 CFR Part 262, to the universal waste management standards of 40 CFR Part 273, or to State requirements analogous to 40 CFR Part 273.

(b) Generators and transporters of recyclable materials are subject to the applicable requirements of Parts 262 and 263 of this chapter and the notification requirements under section 3010 of RCRA, except as provided in paragraph (a) of this section.

(1) Owners and operators of facilities that store recyclable materials before they are recycled are regulated under all applicable provisions of subparts A through L, AA, BB, and CC of parts 264 and 265, and under parts 124, 266, 267, 268, and 270 of this chapter and the notification requirements under section 3010 of RCRA, except as provided in paragraph (a) of this section. (The recycling process itself is exempt from regulation except as provided in §261.6(d).)

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(2) Owners or operators of facilities that recycle recyclable materials without storing them before they are recycled are subject to the following requirements, except as provided in paragraph (a) of this section:

(i) Notification requirements under section 3010 of RCRA;

(ii) Sections 265.71 and 265.72 (dealing with the use of the manifest and manifest discrepancies) of this chapter.

(iii) Section 261.6(d) of this chapter.

(d) Owners or operators of facilities subject to RCRA permitting requirements with hazardous waste management units that recycle hazardous wastes are subject to the requirements of subparts AA and BB of part 264, 265 or 267 of this chapter.

§261.7 Residues of hazardous waste in empty containers.

(1) Any hazardous waste remaining in either: an empty container; or an inner liner removed from an empty container, as defined in paragraph (b) of this section, is not subject to regulation under parts 261 through 268, 270, or 124 this chapter or to the notification requirements of section 3010 of RCRA.

(2) Any hazardous waste in either a container that is not empty or an inner liner removed from a container that is not empty, as defined in paragraph (b) of this section, is subject to regulation under parts 261 through 268, 270 and 124 of this chapter and to the notification requirements of section 3010 of RCRA.

(1) A container or an inner liner removed from a container that has held any hazardous waste, except a waste that is a compressed gas or that is identified as an acute hazardous waste listed in §§261.31 or 261.33(e) of this chapter is empty if:

(i) All wastes have been removed that can be removed using the practices commonly employed to remove materials from that type of container, e.g., pouring, pumping, and aspirating, and

(ii) No more than 2.5 centimeters (one inch) of residue remain on the bottom of the container or inner liner, or

(iii)(A) No more than 3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is less than or equal to 119 gallons in size; or

(B) No more than 0.3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is greater than 119 gallons in size.

(2) A container that has held a hazardous waste that is a compressed gas is empty when the pressure in the container approaches atmospheric.

(3) A container or an inner liner removed from a container that has held an acute hazardous waste listed in §§261.31 or 261.33(e) is empty if:

(i) The container or inner liner has been triple rinsed using a solvent capable of removing the commercial chemical product or manufacturing chemical intermediate;

(ii) The container or inner liner has been cleaned by another method that has been shown in the scientific

literature, or by tests conducted by the generator, to achieve equivalent removal; or

(iii) In the case of a container, the inner liner that prevented contact of the commercial chemical product or manufacturing chemical intermediate with the container, has been removed.

§261.8 PCB Wastes Regulated Under Toxic Substance Control Act

The disposal of PCB-containing dielectric fluid and electric equipment containing such fluid authorized for use and regulated under part 761 of this chapter and that are hazardous only because they fail the test for the Toxicity Characteristic (Hazardous Waste Codes D018 through D043 only) are exempt from regulation under parts 261 through 265, and parts 268, 270, and 124 of this chapter, and the notification requirements of section 3010 of RCRA.

§261.9 Requirements for Universal Waste.

The wastes listed in this section are exempt from regulation under parts 262 through 270 of this chapter except as specified in part 273 of this chapter and, therefore are not fully regulated as hazardous waste. The wastes listed in this section are subject to regulation under 40 CFR part 273:

(a) Batteries as described in 40 CFR 273.2;

(b) Pesticides as described in §273.3 of this chapter;

(c) Mercury-containing equipment as described in §273.4 of this chapter; and

(d) Lamps as described in §273.5 of this chapter.

Subpart B—Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste

§261.10 Criteria for identifying the characteristics of hazardous waste.

(a) The Administrator shall identify and define a characteristic of hazardous waste in Subpart C only upon determining that:

(1) A solid waste that exhibits the characteristic may:

(i) Cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

(ii) Pose a substantial present or potential hazard to human health or the environment when it is improperly treated, stored, transported, disposed of or otherwise managed; and

(2) The characteristic can be:

(i) Measured by an available standardized test method which is reasonably within the capability of generators of solid waste or private sector laboratories that are available to serve generators of solid waste; or

(ii) Reasonably detected by generators of solid waste through their knowledge of their waste.

(b) [Reserved]

Regulations

§261.11 Criteria for listing hazardous waste.

(a) The Administrator shall list a solid waste as a hazardous waste only upon determining that the solid waste meets one of the following criteria:

(1) It exhibits any of the characteristics of hazardous waste identified in Subpart C.

(2) It has been found to be fatal to humans in low doses or, in the absence of data on human toxicity, it has been shown in studies to have an oral LD 50 toxicity (rat) of less than 50 milligrams per kilogram, an inhalation LC 50 toxicity (rat) of less than 2 milligrams per liter, or a dermal LD 50 toxicity (rabbit) of less than 200 milligrams per kilogram or is otherwise capable of causing or significantly contributing to an increase in serious irreversible, or incapacitating reversible, illness. (Waste listed in accordance with these criteria will be designated Acute Hazardous Waste.)

(3) It contains any of the toxic constituents listed in appendix VIII and, after considering the following factors, the Administrator concludes that the waste is capable of posing a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed:

(i) The nature of the toxicity presented by the constituent.

(ii) The concentration of the constituent in the waste.

(iii) The potential of the constituent or any toxic degradation product of the constituent to migrate from the waste into the environment under the types of improper management considered in paragraph (a)(3)(vii) of this section.

(iv) The persistence of the constituent or any toxic degradation product of the constituent.

(v) The potential for the constituent or any toxic degradation product of the constituent to degrade into non-harmful constituents and the rate of degradation.

(vi) The degree to which the constituent or any degradation product of the constituent bioaccumulates in ecosystems.

(vii) The plausible types of improper management to which the waste could be subjected.

(viii) The quantities of the waste generated at individual generation sites or on a regional or national basis.

(ix) The nature and severity of the human health and environmental damage that has occurred as a result of the improper management of wastes containing the constituent.

(x) Action taken by other governmental agencies or regulatory programs based on the health or environmental hazard posed by the waste or waste constituent.

(xi) Such other factors as may be appropriate.

Substances will be listed on Appendix VIII only if they have been shown in scientific studies to have toxic, carcinogenic, mutagenic or teratogenic effects on humans or other life forms.

(Wastes listed in accordance with these criteria will be designated Toxic wastes.)

(b) The Administrator may list classes or types of solid waste as hazardous waste if he has reason to believe that individual wastes, within the class or type of waste, typically or frequently are hazardous under the definition of hazardous waste found in section 1004(5) of the Act.

(c) The Administrator will use the criteria for listing specified in this section to establish the exclusion limits referred to in §261.5(c).

Subpart C—Characteristics of Hazardous Waste

§261.20 General.

(a) A solid waste, as defined in §261.2, which is not excluded from regulation as a hazardous waste under §261.4(b), is a hazardous waste if it exhibits any of the characteristics identified in this subpart.

[Comment: §262.11 of this chapter sets forth the generator's responsibility to determine whether his waste exhibits one or more of the characteristics identified in this subpart]

(b) A hazardous waste which is identified by a characteristic in this Subpart is assigned every EPA Hazardous Waste Number that is applicable as set forth in this Subpart. This number must be used in complying with the notification requirements of section 3010 of the Act and all applicable recordkeeping and reporting requirements under Parts 262 through 265, 268, and 270 of this chapter.

(c) For purposes of this subpart, the Administrator will consider a sample obtained using any of the applicable sampling methods specified in Appendix I to be a representative sample within the meaning of Part 260 of this chapter.

[Comment: Since the Appendix I sampling methods are not being formally adopted by the Administrator, a person who desires to employ an alternative sampling method is not required to demonstrate the equivalency of his method under the procedures set forth in §§260.20 and 260.21.]

§261.21 Characteristic of ignitability.

(a) A solid waste exhibits the characteristic of ignitability if a representative sample of the waste has any of the following properties:

(1) It is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume and has flash point less than 60°C (140°F), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard D 93-79 or D 93-80 (incorporated by reference, see §260.11), or a Setaflash Closed Cup Tester, using the test method specified in ASTM Standard D 3278-78 (incorporated by reference, see §260.11).

(2) It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

(3) It is an ignitable compressed gas.

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(i) The term “compressed gas” shall designate any material or mixture having in the container an absolute pressure exceeding 40 p.s.i. at 70°F or, regardless of the pressure at 70 [deg]F, having an absolute pressure exceeding 104 p.s.i. at 130°F; or any liquid flammable material having a vapor pressure exceeding 40 p.s.i. absolute at 100°F as determined by ASTM Test D-323.

(ii) A compressed gas shall be characterized as ignitable if any one of the following occurs:

(A) Either a mixture of 13 percent or less (by volume) with air forms a flammable mixture or the flammable range with air is wider than 12 percent regardless of the lower limit. These limits shall be determined at atmospheric temperature and pressure. The method of sampling and test procedure shall be acceptable to the Bureau of Explosives and approved by the director, Pipeline and Hazardous Materials Technology, U.S. Department of Transportation (see Note 2).

(B) Using the Bureau of Explosives' Flame Projection Apparatus (see Note 1), the flame projects more than 18 inches beyond the ignition source with valve opened fully, or, the flame flashes back and burns at the valve with any degree of valve opening.

(C) Using the Bureau of Explosives' Open Drum Apparatus (see Note 1), there is any significant propagation of flame away from the ignition source.

(D) Using the Bureau of Explosives' Closed Drum Apparatus (see Note 1), there is any explosion of the vapor-air mixture in the drum.

(4) It is an oxidizer. An oxidizer for the purpose of this subchapter is a substance such as a chlorate, permanganate, inorganic peroxide, or a nitrate, that yields oxygen readily to stimulate the combustion of organic matter (see Note 4).

(i) An organic compound containing the bivalent -O-O- structure and which may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals must be classed as an organic peroxide unless:

(A) The material meets the definition of a Class A explosive or a Class B explosive, as defined in §261.23(a)(8), in which case it must be classed as an explosive,

(B) The material is forbidden to be offered for transportation according to 49 CFR 172.101 and 49 CFR 173.21,

(C) It is determined that the predominant hazard of the material containing an organic peroxide is other than that of an organic peroxide, or

(D) According to data on file with the Pipeline and Hazardous Materials Safety Administration in the U.S. Department of Transportation (see Note 3), it has been determined that the material does not present a hazard in transportation.

(b) A solid waste that exhibits the characteristic of ignitability has the EPA Hazardous Waste Number of D001.

Note 1: A description of the Bureau of Explosives' Flame Projection Apparatus, Open Drum Apparatus, Closed Drum Apparatus, and method of tests may be procured from the Bureau of Explosives.

Note 2: As part of a U.S. Department of Transportation (DOT) reorganization, the Office of Hazardous Materials Technology (OHMT), which was

the office listed in the 1980 publication of 49 CFR 173.300 for the purposes of approving sampling and test procedures for a flammable gas, ceased operations on February 20, 2005. OHMT programs have moved to the Pipeline and Hazardous Materials Safety Administration (PHMSA) in the DOT.

Note 3: As part of a U.S. Department of Transportation (DOT) reorganization, the Research and Special Programs Administration (RSPA), which was the office listed in the 1980 publication of 49 CFR 173.151a for the purposes of determining that a material does not present a hazard in transport, ceased operations on February 20, 2005. RSPA programs have moved to the Pipeline and Hazardous Materials Safety Administration (PHMSA) in the DOT.

Note 4: The DOT regulatory definition of an oxidizer was contained in §173.151 of 49 CFR, and the definition of an organic peroxide was contained in paragraph 173.15 Note 4:1a. An organic peroxide is a type of oxidizer.

§261.22 Characteristic of corrosivity.

(a) A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:

(1) It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by a pH meter using Method 9040C in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,” EPA Publication SW-846, as incorporated by reference in §260.11 of this chapter.

(2) It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55 °C (130 °F) as determined by Method 1110A in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,” EPA Publication SW-846, and as incorporated by reference in §260.11 of this chapter.

(b) A solid waste that exhibits the characteristic of corrosivity has the EPA Hazardous Waste Number of D002.

§261.23 Characteristic of reactivity.

(a) A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has any of the following properties:

(1) It is normally unstable and readily undergoes violent change without detonating.

(2) It reacts violently with water.

(3) It forms potentially explosive mixtures with water.

(4) When mixed with water, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.

(5) It is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.

(6) It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

(7) It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

(8) It is a forbidden explosive as defined in 49 CFR 173.54, or is a Division 1.1, 1.2 or 1.3 explosive as defined in 49 CFR 173.50 and 173.53.

(b) A solid waste that exhibits the characteristic of reactivity has the EPA Hazardous Waste Number of D003.

Regulations

§261.24 Toxicity characteristic.

(a) A solid waste (except manufactured gas plant waste) exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in §260.11 of this chapter, the extract from a representative sample of the waste contains any of the contaminants listed in table 1 at the concentration equal to or greater than the respective value given in that table. Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using the methodology outlined in Method 1311, is considered to be the extract for the purpose of this section.

(b) A solid waste that exhibits the characteristic of toxicity has the EPA Hazardous Waste Number specified in Table 1 which corresponds to the toxic contaminant causing it to be hazardous.

TABLE 1 —MAXIMUM CONCENTRATION OF
CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC

EPA HW No. ¹	Contaminant	CAS No. ²	Regulatory Level (mg/L)
D004	Arsenic.....	7440-38-2	5.0
D005	Barium.....	7440-39-3	100.0
D018	Benzene.....	71-43-2	0.5
D006	Cadmium.....	7440-43-9	1.0
D019	Carbon tetrachloride.....	56-23-5	0.5
D020	Chlordane.....	57-74-9	0.03
D021	Chlorobenzene.....	108-90-7	100.0
D022	Chloroform.....	67-66-3	6.0
D007	Chromium.....	7440-47-3	5.0
D023	o-Cresol.....	95-48-7	⁴ 200.0
D024	m-Cresol.....	108-39-4	⁴ 200.0
D025	p-Cresol.....	106-44-5	⁴ 200.0
D026	Cresol.....	.....	⁴ 200.0
D016	2,4-D.....	94-75-7	10.0
D027	1,4-Dichlorobenzene.....	106-46-7	7.5
D028	1,2-Dichloroethane.....	107-06-2	0.5
D029	1,1-Dichloroethylene.....	75-35-4	0.7
D030	2,4-Dinitrotoluene.....	121-14-2	³ 0.13
D012	Endrin.....	72-20-8	0.02
D031	Heptachlor (and its epoxide).....	76-44-8	0.008
D032	Hexachlorobenzene.....	118-74-1	³ 0.13
D033	Hexachlorobutadiene.....	87-68-3	0.5
D034	Hexachloroethane.....	67-72-1	3.0
D008	Lead.....	7439-92-1	5.0
D013	Lindane.....	58-89-9	0.4
D009	Mercury.....	7439-97-6	0.2
D014	Methoxychlor.....	72-43-5	10.0
D035	Methyl ethyl ketone.....	78-93-3	200.0
D036	Nitrobenzene.....	98-95-3	2.0
D037	Pentachlorophenol.....	87-86-5	100.0
D038	Pyridine.....	110-86-1	³ 5.0
D010	Selenium.....	7782-49-2	1.0
D011	Silver.....	7440-22-4	5.0
D039	Tetrachloroethylene.....	127-18-4	0.7
D015	Toxaphene.....	8001-35-2	0.5

TABLE 1 —MAXIMUM CONCENTRATION OF
CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC,
Continued

EPA HW No. ¹	Contaminant	CAS No. ²	Regulatory Level (mg/L)
D040	Trichloroethylene.....	79-01-6	0.5
D041	2,4,5-Trichlorophenol.....	95-95-4	400.0
D042	2,4,6-Trichlorophenol.....	88-06-2	2.0
D017	2,4,5-TP (Silvex).....	93-72-1	1.0
D043	Vinyl chloride.....	75-01-4	0.2

¹Hazardous waste number.

²Chemical abstracts service number.

³Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

⁴If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

Subpart D—Lists of Hazardous Wastes

§261.30 General.

(a) A solid waste is a hazardous waste if it is listed in this subpart, unless it has been excluded from this list under §260.20 and 260.22.

(b) The Administrator will indicate his basis for listing the classes or types of wastes listed in this subpart by employing one or more of the following Hazard Codes:

Ignitable Waste	(I)
Corrosive Waste	(C)
Reactive Waste	(R)
Toxicity Characteristic Waste	(E)
Acute Hazardous Waste	(H)
Toxic Waste	(T)

Appendix VII identifies the constituent which caused the Administrator to list the waste as a Toxicity Characteristic Waste (E) or Toxic Waste (T) in §261.31 and 261.32.

(c) Each hazardous waste listed in this subpart is assigned an EPA Hazardous Waste Number which precedes the name of the waste. This number must be used in complying with the notification requirements of Section 3010 of the Act and certain recordkeeping and reporting requirements under parts 262 through 265, 267, 268, and 270 of this chapter.

(d) The following hazardous wastes listed in §261.31 are subject to the exclusion limits for acutely hazardous wastes established in §261.5: EPA Hazardous Wastes Nos. F020, F021, F022, F023, F026 and F027.

§261.31 Hazardous wastes from non-specific sources.

(a) The following solid wastes are listed hazardous wastes from non-specific sources unless they are excluded under §260.20 and 260.22 and listed in Appendix IX.(a) The following solid wastes are listed hazardous wastes from non-specific sources unless they are excluded under §§260.20 and 260.22 and listed in appendix IX.

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Industry and EPA hazardous waste No.	Hazardous waste	Hazard code	Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Generic:			F010	Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process	(R, T)
F001	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(T)	F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations	(R, T)
F002	The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(T)	F012	Quenching waste water treatment sludges from metal heat treating operations where cyanides are used in the process	(T)
F003	The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(I)*	F019	Wastewater treatment sludges from the chemical conversion coating of aluminum except from zirconium phosphating in aluminum can washing when such phosphating is an exclusive conversion coating process. Wastewater treatment sludges from the manufacturing of motor vehicles using a zinc phosphating process will not be subject to this listing at the point of generation if the wastes are not placed outside on the land prior to shipment to a landfill for disposal and are either: disposed in a Subtitle D municipal or industrial landfill unit that is equipped with a single clay liner and is permitted, licensed or otherwise authorized by the state; or disposed in a landfill unit subject to, or otherwise meeting, the landfill requirements in §258.40, §264.301 or §265.301. For the purposes of this listing, motor vehicle manufacturing is defined in paragraph (b)(4)(i) of this section and (b)(4)(ii) of this section describes the recordkeeping requirements for motor vehicle manufacturing facilities	(T)
F004	The following spent non-halogenated solvents: Cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(T)	F020	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of Hexachlorophene from highly purified 2,4,5-trichlorophenol.)	(H)
F005	The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	(I,T)	F021	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives	(H)
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) Sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum	(T)	F022	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions	(H)
F007	Spent cyanide plating bath solutions from electroplating operations	(R, T)	F023	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols. (This listing does not include wastes from equipment used only for the production or use of Hexachlorophene from highly purified 2,4,5-trichlorophenol.)	(H)
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process	(R, T)	F024	Process wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes, from the production of certain chlorinated aliphatic hydrocarbons by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution. (This listing does not include wastewaters, wastewater treatment sludges, spent catalysts, and wastes listed in §261.31 or §261.32.)	(T)
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process	(R, T)			

Regulations

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code	Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
F025	Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution	(T)	F037	Petroleum refinery primary oil/water/solids separation sludge—Any sludge generated from the gravitational separation of oil/water/solids during the storage or treatment of process wastewaters and oily cooling wastewaters from petroleum refineries. Such sludges include, but are not limited to, those generated in oil/water/solids separators; tanks and impoundments; ditches and other conveyances; sumps; and stormwater units receiving dry weather flow. Sludge generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges generated in aggressive biological treatment units as defined in §261.31(b)(2) (including sludges generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and K051 wastes are not included in this listing. This listing does include residuals generated from processing or recycling oil-bearing hazardous secondary materials excluded under §261.4(a)(12)(i), if those residuals are to be disposed of	(T)
F026	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions	(H)	F038	Petroleum refinery secondary (emulsified) oil/water/solids separation sludge—Any sludge and/or float generated from the physical and/or chemical separation of oil/water/solids in process wastewaters and oily cooling wastewaters from petroleum refineries. Such wastes include, but are not limited to, all sludges and floats generated in: induced air flotation (IAF) units, tanks and impoundments, and all sludges generated in DAF units. Sludges generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once-through cooling waters segregated for treatment from other process or oily cooling waters, sludges and floats generated in aggressive biological treatment units as defined in §261.31(b)(2) (including sludges and floats generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and F037, K048, and K051 wastes are not included in this listing	(T)
F027	Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing Hexachlorophene synthesized from prepurified 2,4,5-trichlorophenol as the sole component.)	(H)	F039	Leachate (liquids that have percolated through land disposed wastes) resulting from the disposal of more than one restricted waste classified as hazardous under subpart D of this part. (Leachate resulting from the disposal of one or more of the following EPA Hazardous Wastes and no other Hazardous Wastes retains its EPA Hazardous Waste Number(s): F020, F021, F022, F026, F027, and/or F028.)	(T)
F028	Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027	(T)			
F032	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations (except potentially cross-contaminated wastes that have had the F032 waste code deleted in accordance with §261.35 of this chapter or potentially cross-contaminated wastes that are otherwise currently regulated as hazardous wastes (i.e., F034 or F035), and where the generator does not resume or initiate use of chlorophenolic formulations). This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol	(T)			
F034	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol	(T)			
F035	Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol	(T)			

*(I,T) should be used to specify mixtures that are ignitable and contain toxic constituents.

(b) Listing Specific Definitions:(1) For the purposes of the F037 and F038 listings, oil/water/solids is defined as oil and/or water and/or solids.(2)(i) For the purposes of the F037 and F038 listings, aggressive biological treatment units are defined as units which employ one of the following four treatment methods: activated sludge; trickling filter; rotating biological contactor for the continuous accelerated biological oxidation of wastewaters; or high-rate aeration. High-rate aeration is a system of surface impoundments or tanks, in which intense mechanical aeration is used to completely mix the wastes, enhance biological activity, and (A) the units employs a minimum of 6 hp per million gallons of treatment volume; and

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either (B) the hydraulic retention time of the unit is no longer than 5 days; or (C) the hydraulic retention time is no longer than 30 days and the unit does not generate a sludge that is a hazardous waste by the Toxicity Characteristic.

(ii) Generators and treatment, storage and disposal facilities have the burden of proving that their sludges are exempt from listing as F037 and F038 wastes under this definition. Generators and treatment, storage and disposal facilities must maintain, in their operating or other onsite records, documents and data sufficient to prove that: (A) the unit is an aggressive biological treatment unit as defined in this subsection; and (B) the sludges sought to be exempted from the definitions of F037 and/or F038 were actually generated in the aggressive biological treatment unit.

(3)(i) For the purposes of the F037 listing, sludges are considered to be generated at the moment of deposition in the unit, where deposition is defined as at least a temporary cessation of lateral particle movement.

(ii) For the purposes of the F038 listing, (A) sludges are considered to be generated at the moment of deposition in the unit, where deposition is defined as at least a temporary cessation of lateral particle movement and (B) floats are considered to be generated at the moment they are formed in the top of the unit.

(4) For the purposes of the F019 listing, the following apply to wastewater treatment sludges from the manufacturing of motor vehicles using a zinc phosphating process.

(i) Motor vehicle manufacturing is defined to include the manufacture of automobiles and light trucks/utility vehicles (including light duty vans, pick-up trucks, mini-vans, and sport utility vehicles). Facilities must be engaged in manufacturing complete vehicles (body and chassis or unibody) or chassis only.

(ii) Generators must maintain in their on-site records documentation and information sufficient to prove that the wastewater treatment sludges to be exempted from the F019 listing meet the conditions of the listing. These records must include: the volume of waste generated and disposed of off site; documentation showing when the waste volumes were generated and sent off site; the name and address of the receiving facility; and documentation confirming receipt of the waste by the receiving facility. Generators must maintain these documents on site for no less than three years. The retention period for the documentation is automatically extended during the course of any enforcement action or as requested by the Regional Administrator or the state regulatory authority.

§261.32 Hazardous wastes from specific sources.

(a) The following solid wastes are listed hazardous wastes from specific sources unless they are excluded under §§260.20 and 260.22 and listed in Appendix IX.

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Wood preservation: K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol	(T)
Inorganic pigments:		
K002.....	Wastewater treatment sludge from the production of chrome yellow and orange pigments	(T)
K003.....	Wastewater treatment sludge from the production of molybdate orange pigments	(T)
K004.....	Wastewater treatment sludge from the production of zinc yellow pigments	(T)
K005.....	Wastewater treatment sludge from the production of chrome green pigments	(T)
K006.....	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated)	(T)
K007.....	Wastewater treatment sludge from the production of iron blue pigments	(T)
K008.....	Oven residue from the production of chrome oxide green pigments	(T)
Organic chemicals:		
K009.....	Distillation bottoms from the production of acetaldehyde from ethylene	(T)
K010.....	Distillation side cuts from the production of acetaldehyde from ethylene	(T)
K011.....	Bottom stream from the wastewater stripper in the production of acrylonitrile	(R, T)
K013.....	Bottom stream from the acetonitrile column in the production of acrylonitrile	(R, T)
K014.....	Bottoms from the acetonitrile purification column in the production of acrylonitrile	(T)
K015.....	Still bottoms from the distillation of benzyl chloride	(T)
K016.....	Heavy ends or distillation residues from the production of carbon tetrachloride	(T)
K017.....	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin	(T)
K018.....	Heavy ends from the fractionation column in ethyl chloride production	(T)
K019.....	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production	(T)
K020.....	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production	(T)
K021.....	Aqueous spent antimony catalyst waste from fluoromethanes production	(T)
K022.....	Distillation bottom tars from the production of phenol/acetone from cumene	(T)
K023.....	Distillation light ends from the production of phthalic anhydride from naphthalene	(T)
K024.....	Distillation bottoms from the production of phthalic anhydride from naphthalene	(T)
K025.....	Distillation bottoms from the production of nitrobenzene by the nitration of benzene	(T)
K026.....	Stripping still tails from the production of methyl ethyl pyridines	(T)
K027.....	Centrifuge and distillation residues from toluene diisocyanate production	(R, T)
K028.....	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane	(T)
K029.....	Waste from the product steam stripper in the production of 1,1,1-trichloroethane	(T)
K030.....	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene	(T)
K083.....	Distillation bottoms from aniline production	(T)
K085.....	Distillation or fractionation column bottoms from the production of chlorobenzenes	(T)
K093.....	Distillation light ends from the production of phthalic anhydride from ortho-xylene	(T)

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Industry and EPA hazardous waste No.	Hazardous waste	Hazard code	Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
K094.....	Distillation bottoms from the production of phthalic anhydride from ortho-xylene	(T)	K151.....	Wastewater treatment sludges, excluding neutralization and biological sludges, generated during the treatment of wastewaters from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups	(T)
K095.....	Distillation bottoms from the production of 1,1,1-trichloroethane	(T)			
K096.....	Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane	(T)	K156.....	Organic waste (including heavy ends, still bottoms, light ends, spent solvents, filtrates, and decantates) from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)	(T)
K103.....	Process residues from aniline extraction from the production of aniline	(T)			
K104.....	Combined wastewater streams generated from nitrobenzene/aniline production	(T)	K157.....	Wastewaters (including scrubber waters, condenser waters, washwaters, and separation waters) from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)	(T)
K105.....	Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes	(T)			
K107	Column bottoms from product separation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides.	(C, T)	K158.....	Bag house dusts and filter/separation solids from the production of carbamates and carbamoyl oximes. (This listing does not apply to wastes generated from the manufacture of 3-iodo-2-propynyl n-butylcarbamate.)	(T)
K108.....	Condensed column overheads from product separation and condensed reactor vent gases from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	(I,T)			
K109.....	Spent filter cartridges from product purification from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	(T)	K159.....	Organics from the treatment of thiocarbamate wastes	(T)
K110.....	Condensed column overheads from intermediate separation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	(T)	K161.....	Purification solids (including filtration, evaporation, and centrifugation solids), bag house dust and floor sweepings from the production of dithiocarbamate acids and their salts. (This listing does not include K125 or K126.)	(R,T)
K111.....	Product washwaters from the production of dinitrotoluene via nitration of toluene	(C,T)			
K112.....	Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)	K174.....	Wastewater treatment sludges from the production of ethylene dichloride or vinyl chloride monomer (including sludges that result from commingled ethylene dichloride or vinyl chloride monomer wastewater and other wastewater), unless the sludges meet the following conditions: (i) they are disposed of in a subtitle C or non-hazardous landfill licensed or permitted by the state or federal government; (ii) they are not otherwise placed on the land prior to final disposal; and (iii) the generator maintains documentation demonstrating that the waste was either disposed of in an on-site landfill or consigned to a transporter or disposal facility that provided a written commitment to dispose of the waste in an off-site landfill. Respondents in any action brought to enforce the requirements of subtitle C must, upon a showing by the government that the respondent managed wastewater treatment sludges from the production of vinyl chloride monomer or ethylene dichloride, demonstrate that they meet the terms of the exclusion set forth above. In doing so, they must provide appropriate documentation (e.g., contracts between the generator and the landfill owner/operator, invoices documenting delivery of waste to landfill, etc.) that the terms of the exclusion were met	(T)
K113.....	Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)			
K114.....	Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)			
K115.....	Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)			
K116.....	Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine	(T)			
K117.....	Wastewater from the reactor vent gas scrubber in the production of ethylene dibromide via bromination of ethene	(T)			
K118.....	Spent adsorbent solids from purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene	(T)			
K136.....	Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene	(T)			
K149.....	Distillation bottoms from the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups, (This waste does not include still bottoms from the distillation of benzyl chloride.)	(T)			
K150.....	Organic residuals, excluding spent carbon adsorbent, from the spent chlorine gas and hydrochloric acid recovery processes associated with the production of alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups	(T)	K175.....	Wastewater treatment sludges from the production of vinyl chloride monomer using mercuric chloride catalyst in an acetylene-based process	(T)

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Industry and EPA hazardous waste No.	Hazardous waste	Hazard code	Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
K181.....	Nonwastewaters from the production of dyes and/or pigments (including nonwastewaters commingled at the point of generation with nonwastewaters from other processes) that, at the point of generation, contain mass loadings of any of the constituents identified in paragraph (c) of this section that are equal to or greater than the corresponding paragraph (c) levels, as determined on a calendar year basis. These wastes will not be hazardous if the nonwastewaters are: (i) disposed in a Subtitle D landfill unit subject to the design criteria in §258.40, (ii) disposed in a Subtitle C landfill unit subject to either §264.301 or §265.301, (iii) disposed in other Subtitle D landfill units that meet the design criteria in §258.40, §264.301, or §265.301, or (iv) treated in a combustion unit that is permitted under Subtitle C, or an onsite combustion unit that is permitted under the Clean Air Act. For the purposes of this listing, dyes and/or pigments production is defined in paragraph (b)(1) of this section. Paragraph (d) of this section describes the process for demonstrating that a facility's nonwastewaters are not K181. This listing does not apply to wastes that are otherwise identified as hazardous under §§261.21-261.24 and 261.31-261.33 at the point of generation. Also, the listing does not apply to wastes generated before any annual mass loading limit is met	(T)	K038.....	Wastewater from the washing and stripping of phorate production	(T)
			K039.....	Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate	(T)
			K040.....	Wastewater treatment sludge from the production of phorate	(T)
			K041.....	Wastewater treatment sludge from the production of toxaphene	(T)
			K042.....	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T	(T)
			K043.....	2,6-Dichlorophenol waste from the production of 2,4-D	(T)
			K097.....	Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane	(T)
			K098.....	Untreated process wastewater from the production of toxaphene	(T)
			K099.....	Untreated wastewater from the production of 2,4-D	(T)
			K123.....	Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salt	(T)
			K124.....	Reactor vent scrubber water from the production of ethylenebisdithiocarbamic acid and its salts	(C, T)
			K125.....	Filtration, evaporation, and centrifugation solids from the production of ethylenebisdithiocarbamic acid and its salts	(T)
			K126.....	Baghouse dust and floor sweepings in milling and packaging operations from the production or formulation of ethylenebisdithiocarbamic acid and its salts	(T)
Inorganic chemicals:			K131.....	Wastewater from the reactor and spent sulfuric acid from the acid dryer from the production of methyl bromide	(C, T)
K071.....	Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used	(T)	K132.....	Spent absorbent and wastewater separator solids from the production of methyl bromide	(T)
K073.....	Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production	(T)	Explosives:		
K106.....	Wastewater treatment sludge from the mercury cell process in chlorine production	(T)	K044.....	Wastewater treatment sludges from the manufacturing and processing of explosives	(R)
K176.....	Baghouse filters from the production of antimony oxide, including filters from the production of intermediates (e.g., antimony metal or crude antimony oxide)	(E)	K045.....	Spent carbon from the treatment of wastewater containing explosives	(R)
K177.....	Slag from the production of antimony oxide that is speculatively accumulated or disposed, including slag from the production of intermediates (e.g., antimony metal or crude antimony oxide)	(T)	K046.....	Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds	(T)
K178.....	Residues from manufacturing and manufacturing-site storage of ferric chloride from acids formed during the production of titanium dioxide using the chloride-ilmenite process	(T)	K047.....	Pink/red water from TNT operations	(R)
Pesticides:			Petroleum refining:		
K031.....	By-product salts generated in the production of MSMA and cacodylic acid	(T)	K048.....	Dissolved air flotation (DAF) float from the petroleum refining industry	(T)
K032.....	Wastewater treatment sludge from the production of chlordane	(T)	K049.....	Slop oil emulsion solids from the petroleum refining industry	(T)
K033.....	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane	(T)	K050.....	Heat exchanger bundle cleaning sludge from the petroleum refining industry	(T)
K034.....	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane	(T)	K051.....	API separator sludge from the petroleum refining industry	(T)
K035.....	Wastewater treatment sludges generated in the production of creosote	(T)	K052.....	Tank bottoms (lead) from the petroleum refining industry	(T)
K036.....	Still bottoms from toluene reclamation distillation in the production of disulfoton	(T)	K169.....	Crude oil storage tank sediment from petroleum refining operations	(T)
K037.....	Wastewater treatment sludges from the production of disulfoton	(T)	K170.....	Clarified slurry oil tank sediment and/or in-line filter/separation solids from petroleum refining operations	(T)
			K171.....	Spent Hydrotreating catalyst from petroleum refining operations, including guard beds used to desulfurize feeds to other catalytic reactors (this listing does not include inert support media)	(I,T)

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Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
K172.....	Spent Hydrotreating catalyst from petroleum refining operations, including guard beds used to desulfurize feeds to other catalytic reactors (this listing does not include inert support media)	(I,T)
Iron and steel:		
K061.....	Emission control dust/sludge from the primary production of steel in electric furnaces	(T)
K062.....	Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry (SIC Codes 331 and 332)	(C,T)
Primary alu- minum:		
K088.....	Spent potliners from primary aluminum reduction	(T)
Secondary lead:		
K069.....	Emission control dust/sludge from secondary lead smelting. (Note: This listing is stayed administratively for sludge generated from secondary acid scrubber systems. The stay will remain in effect until further administrative action is taken. If EPA takes further action effecting this stay, EPA will publish a notice of the action in the Federal Register)	(T)
K100.....	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting	(T)

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Reserved

Regulations

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Veterinary pharmaceuticals: K084.....	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K101.....	Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K102.....	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
Ink formulation: K086.....	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead	(T)
Coking: K060.....	Ammonia still lime sludge from coking operations	(T)
K087.....	Decanter tank tar sludge from coking operations	(T)
K141.....	Process residues from the recovery of coal tar, including, but not limited to, collecting sump residues from the production of coke from coal or the recovery of coke by-products produced from coal. This listing does not include K087 (decanter tank tar sludges from coking operations)	(T)
K142.....	Tar storage tank residues from the production of coke from coal or from the recovery of coke by-products produced from coal	(T)
K143.....	Process residues from the recovery of light oil, including, but not limited to, those generated in stills, decanters, and wash oil recovery units from the recovery of coke by-products produced from coal	(T)
K144.....	Wastewater sump residues from light oil refining, including, but not limited to, intercepting or contamination sump sludges from the recovery of coke by-products produced from coal	(T)
K145.....	Residues from naphthalene collection and recovery operations from the recovery of coke by-products produced from coal	(T)
K147.....	Tar storage tank residues from coal tar refining	(T)
K148.....	Residues from coal tar distillation, including but not limited to, still bottoms	(T)

(b) **Listing Specific Definitions:** (1) For the purposes of the K181 listing, dyes and/or pigments production is defined to include manufacture of the following product classes: dyes, pigments, or FDA certified colors that are classified as azo, triarylmethane, perylene or anthraquinone classes. Azo products include azo, monoazo, diazo, triazo, polyazo, azoic, benzidine, and pyrazolone products. Triarylmethane products include both triarylmethane and triphenylmethane products. Wastes that are not generated at a dyes and/or pigments manufacturing site, such as wastes from the offsite use, formulation, and packaging of dyes and/or pigments, are not included in the K181 listing.

(c) **K181 Listing Levels.** Nonwastewaters containing constituents in amounts equal to or exceeding the fol-

lowing levels during any calendar year are subject to the K181 listing, unless the conditions in the K181 listing are met.

Constituent	Chemical abstracts No.	Mass levels (kg/yr)
Aniline	62-53-3	9,300
o-Anisidine	90-04-0	110
4-Chloroaniline.....	106-47-8	4,800
p-Cresidine	120-71-8	660
2,4-Dimethylaniline	95-68-1	100
1,2-Phenylenediamine	95-54-5	710
1,3-Phenylenediamine	108-45-2	1,200

(d) **Procedures for demonstrating that dyes and/or pigment nonwastewaters are not K181.** The procedures described in paragraphs (d)(1)–(d)(3) and (d)(5) of this section establish when nonwastewaters from the production of dyes/pigments would not be hazardous (these procedures apply to wastes that are not disposed in landfill units or treated in combustion units as specified in paragraph (a) of this section). If the nonwastewaters are disposed in landfill units or treated in combustion units as described in paragraph (a) of this section, then the nonwastewaters are not hazardous. In order to demonstrate that it is meeting the landfill disposal or combustion conditions contained in the K181 listing description, the generator must maintain documentation as described in paragraph (d)(4) of this section.

(1) *Determination based on no K181 constituents.* Generators that have knowledge (e.g., knowledge of constituents in wastes based on prior sampling and analysis data and/or information about raw materials used, production processes used, and reaction and degradation products formed) that their wastes contain none of the K181 constituents (see paragraph (c) of this section) can use their knowledge to determine that their waste is not K181. The generator must document the basis for all such determinations on an annual basis and keep each annual documentation for three years.

(2) *Determination for generated quantities of 1,000 MT/yr or less for wastes that contain K181 constituents.* If the total annual quantity of dyes and/or pigment nonwastewaters generated is 1,000 metric tons or less, the generator can use knowledge of the wastes (e.g., knowledge of constituents in wastes based on prior analytical data and/or information about raw materials used, production processes used, and reaction and degradation products formed) to conclude that annual mass loadings for the K181 constituents are below the listing levels of paragraph (c) of this section. To make this determination, the generator must:

(i) Each year document the basis for determining that the annual quantity of nonwastewaters expected to be generated will be less than 1,000 metric tons.

(ii) Track the actual quantity of nonwastewaters generated from January 1 through December 31 of each year. If, at any time within the year, the actual waste quantity exceeds 1,000 metric tons, the generator must comply with the requirements of paragraph (d)(3) of this section for the remainder of the year.

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(iii) Keep a running total of the K181 constituent mass loadings over the course of the calendar year.

(iv) Keep the following records on site for the three most recent calendar years in which the hazardous waste determinations are made:

(A) The quantity of dyes and/or pigment nonwastewaters generated.

(B) The relevant process information used.

(C) The calculations performed to determine annual total mass loadings for each K181 constituent in the nonwastewaters during the year.

(3) *Determination for generated quantities greater than 1,000 MT/yr for wastes that contain K181 constituents.* If the total annual quantity of dyes and/or pigment nonwastewaters generated is greater than 1,000 metric tons, the generator must perform all of the steps described in paragraphs ((d)(3)(i)–(d)(3)(xi) of this section) in order to make a determination that its waste is not K181.

(i) Determine which K181 constituents (see paragraph (c) of this section) are reasonably expected to be present in the wastes based on knowledge of the wastes (e.g., based on prior sampling and analysis data and/or information about raw materials used, production processes used, and reaction and degradation products formed).

(ii) If 1,2-phenylenediamine is present in the wastes, the generator can use either knowledge or sampling and analysis procedures to determine the level of this constituent in the wastes. For determinations based on use of knowledge, the generator must comply with the procedures for using knowledge described in paragraph (d)(2) of this section and keep the records described in paragraph (d)(2)(iv) of this section. For determinations based on sampling and analysis, the generator must comply with the sampling and analysis and recordkeeping requirements described below in this section.

(iii) Develop a waste sampling and analysis plan (or modify an existing plan) to collect and analyze representative waste samples for the K181 constituents reasonably expected to be present in the wastes. At a minimum, the plan must include:

(A) A discussion of the number of samples needed to characterize the wastes fully;

(B) The planned sample collection method to obtain representative waste samples;

(C) A discussion of how the sampling plan accounts for potential temporal and spatial variability of the wastes.

(D) A detailed description of the test methods to be used, including sample preparation, clean up (if necessary), and determinative methods.

(iv) Collect and analyze samples in accordance with the waste sampling and analysis plan.

(A) The sampling and analysis must be unbiased, precise, and representative of the wastes.

(B) The analytical measurements must be sufficiently sensitive, accurate and precise to support any claim that the constituent mass loadings are below the listing levels of paragraph (c) of this section.

(v) Record the analytical results.

(vi) Record the waste quantity represented by the sampling and analysis results.

(vii) Calculate constituent-specific mass loadings (product of concentrations and waste quantity).

(viii) Keep a running total of the K181 constituent mass loadings over the course of the calendar year.

(ix) Determine whether the mass of any of the K181 constituents listed in paragraph (c) of this section generated between January 1 and December 31 of any year is below the K181 listing levels.

(x) Keep the following records on site for the three most recent calendar years in which the hazardous waste determinations are made:

(A) The sampling and analysis plan.

(B) The sampling and analysis results (including QA/QC data)

(C) The quantity of dyes and/or pigment nonwastewaters generated.

(D) The calculations performed to determine annual mass loadings.

(xi) Nonhazardous waste determinations must be conducted annually to verify that the wastes remain nonhazardous.

(A) The annual testing requirements are suspended after three consecutive successful annual demonstrations that the wastes are nonhazardous. The generator can then use knowledge of the wastes to support subsequent annual determinations.

(B) The annual testing requirements are reinstated if the manufacturing or waste treatment processes generating the wastes are significantly altered, resulting in an increase of the potential for the wastes to exceed the listing levels.

(C) If the annual testing requirements are suspended, the generator must keep records of the process knowledge information used to support a nonhazardous determination. If testing is reinstated, a description of the process change must be retained.

(4) *Recordkeeping for the landfill disposal and combustion exemptions.* For the purposes of meeting the landfill disposal and combustion condition set out in the K181 listing description, the generator must maintain on site for three years documentation demonstrating that each shipment of waste was received by a landfill unit that is subject to or meets the landfill design standards set out in the listing description, or was treated in combustion units as specified in the listing description.

(5) *Waste holding and handling.* During the interim period, from the point of generation to completion of the hazardous waste determination, the generator is responsible for storing the wastes appropriately. If the wastes are determined to be hazardous and the generator has not complied with the subtitle C requirements during the interim period, the generator could be subject to an enforcement action for improper management.

Regulations

§261.33 Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof.

The following materials or items are hazardous wastes if and when they are discarded or intended to be discarded as described in §261.2(a)(2)(i), when they are mixed with waste oil or used oil or other material and applied to the land for dust suppression or road treatment, when they are otherwise applied to the land in lieu of their original intended use or when they are contained in products that are applied to the land in lieu of their original intended use, or when, in lieu of their original intended use, they are produced for use as (or as a component of) a fuel, distributed for use as a fuel, or burned as a fuel.

(a) Any commercial chemical product, or manufacturing chemical intermediate having the generic name listed in paragraph (e) or (f) of this section.

(b) Any off-specification commercial chemical product or manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in paragraph (e) or (f) of this section.

(c) Any residue remaining in a container or in an inner liner removed from a container that has held any commercial chemical product or manufacturing chemical intermediate having the generic name listed in paragraphs (e) or (f) of this section, unless the container is empty as defined in §261.7(b) of this chapter.

[*Comment:* Unless the residue is being beneficially used or reused, or legitimately recycled or reclaimed; or being accumulated, stored, transported or treated prior to such use, re-use, recycling or reclamation, EPA considers the residue to be intended for discard, and thus, a hazardous waste. An example of a legitimate re-use of the residue would be where the residue remains in the container and the container is used to hold the same commercial chemical product or manufacturing chemical intermediate it previously held. An example of the discard of the residue would be where the drum is sent to a drum reconditioner who reconditions the drum but discards the residue.]

(d) Any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having the generic name listed in paragraph (e) or (f) of this section, or any residue or contaminated soil, water or other debris resulting from the cleanup of a spill, into or on any land or water, of any off-specification chemical product and manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in paragraph (e) or (f) of this section.

[*Comment:* The phrase “commercial chemical product or manufacturing chemical intermediate having the generic name listed in . . .” refers to a chemical substance which is manufactured or formulated for commercial or manufacturing use which consists of the commercially pure grade of the chemical, any technical grades of the chemical that are produced or marketed, and all formulations in which the chemical is the sole active ingredient. It does not refer to a material, such as a manufacturing process waste, that contains any of the

substances listed in paragraph (e) or (f). Where a manufacturing process waste is deemed to be a hazardous waste because it contains a substance listed in paragraph (e) or (f), such waste will be listed in either §261.31 or §261.32 or will be identified as a hazardous waste by the characteristics set forth in subpart C of this part.]

(e) The commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products or manufacturing chemical intermediates referred to in paragraphs (a) through (d) of this section, are identified as acute hazardous wastes (H) and are subject to the small quantity exclusion defined in §261.5(e).

[*Comment:* For the convenience of the regulated community the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), and R (Reactivity). Absence of a letter indicates that the compound only is listed for acute toxicity. Wastes are first listed in alphabetical order by substance and then listed again in numerical order by Hazardous Waste Number.]

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste No.	Chemical abstracts No.	Substance
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-
P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone.
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid H ₃ AsO ₄
P012	1327-53-3	Arsenic oxide As ₂ O ₃
P011	1303-28-2	Arsenic oxide As ₂ O ₅
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-

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P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-	P191	644-64-4	Dimetilan.
P014	108-98-5	Benzenethiol	P047	1534-52-1	4,6-Dinitro-o-cresol, & salts
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.	P048	51-28-5	2,4-Dinitrophenol
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1).	P020	88-85-7	Dinoseb
P001	181-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%	P085	152-16-9	Diphosphoramidate, octamethyl-
P028	100-44-7	Benzyl chloride	P111	107-49-3	Diphosphoric acid, tetraethyl ester
P015	7440-41-7	Beryllium powder	P039	298-04-4	Disulfoton
P017	598-31-2	Bromoacetone	P049	541-53-7	Dithiobiuret
P018	357-57-3	Brucine	P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)- carbonyl]oxime.
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime	P050	115-29-7	Endosulfan
P021	592-01-8	Calcium cyanide	P088	145-73-3	Endothall
P021	592-01-8	Calcium cyanide Ca(CN) ₂	P051	72-20-8	Endrin
P189	55285-14-8	Carbamic acid, [(dibutylamino)- thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.	P051	72-20-8	Endrin, & metabolites
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethylamino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.	P042	51-43-4	Epinephrine
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H- pyrazol-5-yl ester.	P031	460-19-5	Ethanedinitrile
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester.	P194	23135-22-0	Ethanimidothioic acid, 2-(dimethylamino)-N- [[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P127	1563-66-2	Carbofuran.	P066	16752-77-5	Ethanimidothioic acid, N-[[[(methylamino)carbonyl]oxy]-, methyl ester
P022	75-15-0	Carbon disulfide	P101	107-12-0	Ethyl cyanide
P095	75-44-5	Carbonic dichloride	P054	151-56-4	Ethyleneimine
P189	55285-14-8	Carbosulfan.	P097	52-85-7	Famphur
P023	107-20-0	Chloroacetaldehyde	P056	7782-41-4	Fluorine
P024	106-47-8	p-Chloroaniline	P057	640-19-7	Fluoroacetamide
P026	5344-82-1	1-(o-Chlorophenyl)thiourea	P058	62-74-8	Fluoroacetic acid, sodium salt
P027	542-76-7	3-Chloropropionitrile	P198	23422-53-9	Formetanate hydrochloride.
P029	544-92-3	Copper cyanide	P197	17702-57-7	Formparanate.
P029	544-92-3	Copper cyanide Cu(CN)	P065	628-86-4	Fulminic acid, mercury(2+) salt (R,T)
P202	64-00-6	m-Cumenyl methylcarbamate.	P059	76-44-8	Heptachlor
P030		Cyanides (soluble cyanide salts), not otherwise specified	P062	757-58-4	Hexaethyl tetraphosphate
P031	460-19-5	Cyanogen	P116	79-19-6	Hydrazinecarbothioamide
P033	506-77-4	Cyanogen chloride	P068	60-34-4	Hydrazine, methyl-
P033	506-77-4	Cyanogen chloride (CN)Cl	P063	74-90-8	Hydrocyanic acid
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol	P063	74-90-8	Hydrogen cyanide
P016	542-88-1	Dichloromethyl ether	P096	7803-51-2	Hydrogen phosphide
P036	696-28-6	Dichlorophenylarsine	P060	465-73-6	Isodrin
P037	60-57-1	Dieldrin	P192	119-38-0	Isolan.
P038	692-42-2	Diethylarsine	P202	64-00-6	3-Isopropylphenyl N-methylcarbamate.
P041	311-45-5	Diethyl-p-nitrophenyl phosphate	P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate	P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S')-,
P043	55-91-4	Diisopropylfluorophosphate (DFP)	P196	15339-36-3	Manganese dimethyldithiocarbamate.
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a-,hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-	P092	62-38-4	Mercury, (acetato-O)phenyl-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a-,hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-	P065	628-86-4	Mercury fulminate (R,T)
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha, 2beta ,2aalpha, 3beta, 6beta, 6aalpha, 7beta, 7aalpha)-	P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P051	172-20-8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha, 2beta, 2abeta, 3alpha, 6alpha, 6abeta, 7beta, 7aalpha)-, & metabolites	P064	624-83-9	Methane, isocyanato-
P044	60-51-5	Dimethoate	P016	542-88-1	Methane, oxybis[chloro-
P046	122-09-8	alpha,alpha-Dimethylphenethylamine	P112	509-14-8	Methane, tetranitro- (R)
			P118	75-70-7	Methanethiol, trichloro-
			P198	23422-53-9	Methanimidamide, N,N-dimethyl-N'-[3- [[[(methylamino)-carbonyl]oxy]phenyl]-, monohydrochloride.
			P197	17702-57-7	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4- [[[(methylamino)carbonyl]oxy]phenyl]-
			P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10- hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
			P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-
			P199	2032-65-7	Methiocarb.
			P066	16752-77-5	Methomyl
			P068	60-34-4	Methyl hydrazine

Regulations

P064	624-83-9	Methyl isocyanate	P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P069	75-86-5	2-Methylacetonitrile	P204	57-47-6	Physostigmine.
P071	298-00-0	Methyl parathion	P188	57-64-7	Physostigmine salicylate.
P190	1129-41-5	Metolcarb.	P110	78-00-2	Plumbane, tetraethyl-
P128	315-8-4	Mexacarbonate.	P098	151-50-8	Potassium cyanide
P072	86-88-4	alpha-Naphthylthiourea	P098	151-50-8	Potassium cyanide K(CN)
P073	13463-39-3	Nickel carbonyl	P099	506-61-6	Potassium silver cyanide
P073	13463-39-3	Nickel carbonyl Ni(CO) ₄ , (T-4)-	P201	2631-37-0	Promecarb
P074	557-19-7	Nickel cyanide	P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P074	557-19-7	Nickel cyanide Ni(CN) ₂	P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime.
P075	154-11-5	Nicotine, & salts	P101	107-12-0	Propanenitrile
P076	10102-43-9	Nitric oxide	P027	542-76-7	Propanenitrile, 3-chloro-
P077	100-01-6	p-Nitroaniline	P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P078	10102-44-0	Nitrogen dioxide	P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P076	10102-43-9	Nitrogen oxide NO	P017	598-31-2	2-Propanone, 1-bromo-
P078	10102-44-0	Nitrogen oxide NO ₂	P102	107-19-7	Propargyl alcohol
P081	55-63-0	Nitroglycerine (R)	P003	107-02-8	2-Propenal
P082	62-75-9	N-Nitrosodimethylamine	P005	107-18-6	2-Propen-1-ol
P084	4549-40-0	N-Nitrosomethylvinylamine	P067	75-55-8	1,2-Propylenimine
P085	152-16-9	Octamethylpyrophosphoramide	P102	107-19-7	2-Propyn-1-ol
P087	20816-12-0	Osmium oxide OsO ₄ , (T-4)-	P008	504-24-5	4-Pyridinamine
P087	20816-12-0	Osmium tetroxide	P075	154-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-.
P194	23135-22-0	Oxamyl.	P114	12039-52-0	Selenious acid, dithallium(1+) salt
P089	56-38-2	Parathion	P103	630-10-4	Selenourea
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-	P104	506-64-9	Silver cyanide
P048	51-28-5	Phenol, 2,4-dinitro-	P104	506-64-9	Silver cyanide Ag(CN)
P047	1534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts	P105	26628-22-8	Sodium azide
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	P106	143-33-9	Sodium cyanide
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)	P106	143-33-9	Sodium cyanide Na(CN)
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).	P108	157-24-9	Strychnidin-10-one, & salts
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate	P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate.	P108	157-24-9	Strychnine, & salts
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate.	P115	7446-18-6	Sulfuric acid, dithallium(1+) salt
P092	62-38-4	Phenylmercury acetate	P109	3689-24-5	Tetraethyldithiopyrophosphate
P093	103-85-5	Phenylthiourea	P110	78-00-2	Tetraethyl lead
P094	298-02-2	Phorate	P111	107-49-3	Tetraethyl pyrophosphate
P095	75-44-5	Phosgene	P112	509-14-8	Tetranitromethane (R)
P096	7803-51-2	Phosphine	P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester	P113	1314-32-5	Thallic oxide
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester	P113	1314-32-5	Thallium oxide Tl ₂ O ₃
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester	P114	12039-52-0	Thallium(I) selenite
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester	P115	7446-18-6	Thallium(I) sulfate
P043	55-91-4	Phosphorofluoric acid, bis(1-methylethyl) ester	P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester	P045	39196-18-4	Thiofanox
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester	P049	541-53-7	Thioimidodicarbonic diamide [(H ₂ N)C(S)] ₂ NH
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester	P014	108-98-5	Thiophenol
			P116	79-19-6	Thiosemicarbazide
			P026	5344-82-1	Thiourea, (2-chlorophenyl)-
			P072	86-88-4	Thiourea, 1-naphthalenyl-
			P093	103-85-5	Thiourea, phenyl-
			P185	26419-73-8	Tirpate.
			P123	8001-35-2	Toxaphene

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P118	75-70-7	Trichloromethanethiol	P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P119	7803-55-6	Vanadic acid, ammonium salt	P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P120	1314-62-1	Vanadium oxide V_2O_5	P027	542-76-7	3-Chloropropionitrile
P120	1314-62-1	Vanadium pentoxide	P027	542-76-7	Propanenitrile, 3-chloro-
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-	P028	100-44-7	Benzene, (chloromethyl)-
P001	181-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%	P028	100-44-7	Benzyl chloride
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S')-,	P029	544-92-3	Copper cyanide
P121	557-21-1	Zinc cyanide	P029	544-92-3	Copper cyanide $Cu(CN)$
P121	557-21-1	Zinc cyanide $Zn(CN)_2$	P030		Cyanides (soluble cyanide salts), not otherwise specified
P122	1314-84-7	Zinc phosphide Zn_3P_2 , when present at concentrations greater than 10% (R,T)	P031	460-19-5	Cyanogen
P205	137-30-4	Ziram.	P031	460-19-5	Ethanedinitrile
P001	181-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%	P033	506-77-4	Cyanogen chloride
P001	181-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%	P033	506-77-4	Cyanogen chloride (CN)Cl
P002	591-08-2	Acetamide, -(aminothioxomethyl)-	P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P002	591-08-2	1-Acetyl-2-thiourea	P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P003	107-02-8	Acrolein	P036	696-28-6	Arsonous dichloride, phenyl-
P003	107-02-8	2-Propenal	P036	696-28-6	Dichlorophenylarsine
P004	309-00-2	Aldrin	P037	60-57-1	Dieldrin
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-	P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1alpha, 2beta, 2alpha, 3beta, 6beta, 6aalpha, 7beta, 7aalpha)-
P005	107-18-6	Allyl alcohol	P038	692-42-2	Arsine, diethyl-
P005	107-18-6	2-Propen-1-ol	P038	692-42-2	Diethylarsine
P006	20859-73-8	Aluminum phosphide (R,T)	P039	298-04-4	Disulfoton
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol	P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-	P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P008	504-24-5	4-Aminopyridine	P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P008	504-24-5	4-Pyridinamine	P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P009	131-74-8	Ammonium picrate (R)	P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)	P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P010	7778-39-4	Arsenic acid H_3AsO_4	P042	51-43-4	Epinephrine
P011	1303-28-2	Arsenic oxide As_2O_5	P043	55-91-4	Diisopropylfluorophosphate (DFP)
P011	1303-28-2	Arsenic pentoxide	P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P012	1327-53-3	Arsenic oxide As_2O_3	P044	60-51-5	Dimethoate
P012	1327-53-3	Arsenic trioxide	P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methyl amino)-2-oxoethyl] ester
P013	542-62-1	Barium cyanide	P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime
P014	108-98-5	Benzenethiol	P045	39196-18-4	Thiofanox
P014	108-98-5	Thiophenol	P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-alpha,alpha-Dimethylphenethylamine
P015	7440-41-7	Beryllium powder	P046	122-09-8	4,6-Dinitro-o-cresol, & salts
P016	542-88-1	Dichloromethyl ether	P047	1534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P016	542-88-1	Methane, oxybis[chloro-	P048	51-28-5	2,4-Dinitrophenol
P017	598-31-2	Bromoacetone	P048	51-28-5	Phenol, 2,4-dinitro-
P017	598-31-2	2-Propanone, 1-bromo-	P049	541-53-7	Dithiobiuret
P018	357-57-3	Brucine	P049	541-53-7	Thioimidodicarbonic diamide $[(H_2N)C(S)]_2NH$
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-	P050	115-29-7	Endosulfan
P020	88-85-7	Dinoseb	P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	P051	172-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1alpha, 2beta, 2abeta, 3alpha, 6alpha, 6abeta, 7beta, 7aalpha)-, & metabolites
P021	592-01-8	Calcium cyanide	P051	72-20-8	Endrin
P021	592-01-8	Calcium cyanide $Ca(CN)_2$	P051	72-20-8	Endrin, & metabolites
P022	75-15-0	Carbon disulfide	P054	151-56-4	Aziridine
P023	107-20-0	Acetaldehyde, chloro-	P054	151-56-4	Ethyleneimine
P023	107-20-0	Chloroacetaldehyde	P056	7782-41-4	Fluorine
P024	106-47-8	Benzenamine, 4-chloro-			
P024	106-47-8	p-Chloroaniline			

Regulations

P057	640-19-7	Acetamide, 2-fluoro-	P089	56-38-2	Parathion
P057	640-19-7	Fluoroacetamide	P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P058	62-74-8	Acetic acid, fluoro-, sodium salt	P092	62-38-4	Mercury, (acetato-O)phenyl-
P058	62-74-8	Fluoroacetic acid, sodium salt	P092	62-38-4	Phenylmercury acetate
P059	76-44-8	Heptachlor	P093	103-85-5	Phenylthiourea
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-	P093	103-85-5	Thiourea, phenyl-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4beta,5beta,8beta,8abeta)-	P094	298-02-2	Phorate
P060	465-73-6	Isodrin	P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P062	757-58-4	Hexaethyl tetraphosphate	P095	75-44-5	Carbonic dichloride
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester	P095	75-44-5	Phosgene
P063	74-90-8	Hydrocyanic acid	P096	7803-51-2	Hydrogen phosphide
P063	74-90-8	Hydrogen cyanide	P096	7803-51-2	Phosphine
P064	624-83-9	Methane, isocyanato-	P097	52-85-7	Famphur
P064	624-83-9	Methyl isocyanate	P097	52-85-7	Phosphorothioic acid, O-[4-(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P065	628-86-4	Fulminic acid, mercury(2+) salt (R,T)	P098	151-50-8	Potassium cyanide
P065	628-86-4	Mercury fulminate (R,T)	P098	151-50-8	Potassium cyanide K(CN)
P066	16752-77-5	Ethanimidothioic acid, N-[(methylamino)carbonyl]oxy]-, methyl ester	P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P066	16752-77-5	Methomyl	P099	506-61-6	Potassium silver cyanide
P067	75-55-8	Aziridine, 2-methyl-	P101	107-12-0	Ethyl cyanide
P067	75-55-8	1,2-Propylenimine	P101	107-12-0	Propanenitrile
P068	60-34-4	Hydrazine, methyl-	P102	107-19-7	Propargyl alcohol
P068	60-34-4	Methyl hydrazine	P102	107-19-7	2-Propyn-1-ol
P069	75-86-5	2-Methylacetonitrile	P103	630-10-4	Selenourea
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-	P104	506-64-9	Silver cyanide
P070	116-06-3	Aldicarb	P104	506-64-9	Silver cyanide Ag(CN)
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime	P105	26628-22-8	Sodium azide
P071	298-00-0	Methyl parathion	P106	143-33-9	Sodium cyanide
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester	P106	143-33-9	Sodium cyanide Na(CN)
P072	86-88-4	alpha-Naphthylthiourea	P108	1157-24-9	Strychnidin-10-one, & salts
P072	86-88-4	Thiourea, 1-naphthalenyl-	P108	1157-24-9	Strychnine, & salts
P073	13463-39-3	Nickel carbonyl	P109	3689-24-5	Tetraethyldithiopyrophosphate
P073	13463-39-3	Nickel carbonyl Ni(CO) ₄ , (T-4)-	P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P074	557-19-7	Nickel cyanide	P110	78-00-2	Plumbane, tetraethyl-
P074	557-19-7	Nickel cyanide Ni(CN) ₂	P110	78-00-2	Tetraethyl lead
P075	154-11-5	Nicotine, & salts	P111	107-49-3	Diphosphoric acid, tetraethyl ester
P075	154-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts	P111	107-49-3	Tetraethyl pyrophosphate
P076	10102-43-9	Nitric oxide	P112	509-14-8	Methane, tetranitro-(R)
P076	10102-43-9	Nitrogen oxide NO	P112	509-14-8	Tetranitromethane (R)
P077	100-01-6	Benzenamine, 4-nitro-	P113	1314-32-5	Thallic oxide
P077	100-01-6	p-Nitroaniline	P113	1314-32-5	Thallium oxide Tl ₂ O ₃
P078	10102-44-0	Nitrogen dioxide	P114	12039-52-0	Selenious acid, dithallium(1+) salt
P078	10102-44-0	Nitrogen oxide NO ₂	P114	12039-52-0	Tetraethyldithiopyrophosphate
P081	55-63-0	Nitroglycerine (R)	P115	7446-18-6	Thiodiphosphoric acid, tetraethyl ester
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)	P115	7446-18-6	Plumbane, tetraethyl-
P082	62-75-9	Methanamine, -methyl-N-nitroso-	P116	79-19-6	Tetraethyl lead
P082	62-75-9	N-Nitrosodimethylamine	P116	79-19-6	Thiosemicarbazide
P084	4549-40-0	N-Nitrosomethylvinylamine	P118	75-70-7	Methanethiol, trichloro-
P084	4549-40-0	Vinylamine, -methyl-N-nitroso-	P118	75-70-7	Trichloromethanethiol
P085	152-16-9	Diphosphoramidate, octamethyl-	P119	7803-55-6	Ammonium vanadate
P085	152-16-9	Octamethylpyrophosphoramidate	P119	7803-55-6	Vanadic acid, ammonium salt
P087	20816-12-0	Osmium oxide OsO ₄ , (T-4)-	P120	1314-62-1	Vanadium oxide V ₂ O ₅
P087	20816-12-0	Osmium tetroxide	P120	1314-62-1	Vanadium pentoxide
P088	145-73-3	Endothall			
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid			

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P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide $\text{Zn}(\text{CN})_2$
P122	1314-84-7	Zinc phosphide Zn_3P_2 , when present at concentrations greater than 10% (R,T)
P123	8001-35-2	Toxaphene
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P127	1563-66-2	Carbofuran
P128	315-8-4	Mexacarbamate
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)-carbonyl]oxime.
P185	26419-73-8	Tirpate
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1)
P188	57-64-7	Physostigmine salicylate
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl-7-benzofuran-yl ester
P189	55285-14-8	Carbosulfan
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester
P190	1129-41-5	Metolcarb
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethylamino)carbonyl]-5-methyl-1H-pyrazol-3-yl ester
P191	644-64-4	Dimetilan
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H-pyrazol-5-yl ester
P192	119-38-0	Isolan
P194	23135-22-0	Ethanimidthioic acid, 2-(dimethylamino)-N-[[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester
P194	23135-22-0	Oxamyl
P196	15339-36-3	Manganese, bis(dimethylcarbomodithioato-S,S')-,
P196	15339-36-3	Manganese dimethyldithiocarbamate
P197	17702-57-7	Formparanate
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4-[[[(methylamino)carbonyl]oxy]phenyl]-formetanate hydrochloride
P198	23422-53-9	Formetanate hydrochloride
P198	23422-53-9	Methanimidamide, N,N-dimethyl-N'-[3-[[[(methylamino)-carbonyl]oxy]phenyl]-monohydrochloride
P199	2032-65-7	Methiocarb
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate
P201	2631-37-0	Promecarb
P202	64-00-6	m-Cumenyl methylcarbamate
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate
P203	1646-88-4	Aldicarb sulfone
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime
P204	57-47-6	Physostigmine
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-
P205	137-30-4	Zinc, bis(dimethylcarbomodithioato-S,S')-,

P205	137-30-4	Ziram

¹CAS Number given for parent compound only.

(f) The commercial chemical products, manufacturing chemical intermediates, or off-specification commercial chemical products referred to in paragraphs (a) through (d) of this section, are identified as toxic wastes (T), unless otherwise designated and are subject to the small quantity generator exclusion defined in §261.5 (a) and (g).

[*Comment:* For the convenience of the regulated community, the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), R (Reactivity), I (Ignitability) and C (Corrosivity). Absence of a letter indicates that the compound is only listed for toxicity. Wastes are first listed in alphabetical order by substance and then listed again in numerical order by Hazardous Waste Number.]

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste No.	Chemical abstracts No.	Substance
U394	30558-43-1	A2213.
U001	75-07-0	Acetaldehyde (I)
U034	75-87-6	Acetaldehyde, trichloro-
U187	62-44-2	Acetamide, N-(4-ethoxyphenyl)-
U005	53-96-3	Acetamide, N-9H-fluoren-2-yl-
U240	¹ 94-75-7	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters
U112	141-78-6	Acetic acid ethyl ester (I)
U144	301-04-2	Acetic acid, lead(2+) salt
U214	563-68-8	Acetic acid, thallium(1+) salt
see F027	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-
U002	67-64-1	Acetone (I)
U003	75-05-8	Acetonitrile (I,T)
U004	98-86-2	Acetophenone
U005	53-96-3	2-Acetylaminofluorene
U006	75-36-5	Acetyl chloride (C,R,T)
U007	79-06-1	Acrylamide
U008	79-10-7	Acrylic acid (I)
U009	107-13-1	Acrylonitrile
U011	61-82-5	Amitrole
U012	62-53-3	Aniline (I,T)
U136	75-60-5	Arsinic acid, dimethyl-
U014	492-80-8	Auramine
U015	115-02-6	Azaserine
U010	50-07-7	Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione, 6-amino-8-[[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1alpha, 8beta,8aalpha,8balph)]-
U280	101-27-9	Barban.
U278	22781-23-3	Bendiocarb.
U364	22961-82-6	Bendiocarb phenol.
U271	17804-35-2	Benomyl.
U157	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U016	225-51-4	Benz[c]acridine
U017	98-87-3	Benzal chloride
U192	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U018	56-55-3	Benz[a]anthracene
U094	57-97-6	Benz[a]anthracene, 7,12-dimethyl-

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Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U012	62-53-3	Benzenamine (I,T)	U022	50-32-8	Benzo[a]pyrene
U014	492-80-8	Benzenamine, 4,4'-carbonimidoylbis[N,N-dimethyl-	U197	106-51-4	p-Benzoquinone
U049	3165-93-3	Benzenamine, 4-chloro-2-methyl-, hydrochloride	U023	98-07-7	Benzotrichloride (C,R,T)
U093	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-	U085	1464-53-5	2,2'-Bioxirane
U328	95-53-4	Benzenamine, 2-methyl-	U021	92-87-5	[1,1'-Biphenyl]-4,4'-diamine
U353	106-49-0	Benzenamine, 4-methyl-	U073	91-94-1	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-
U158	101-14-4	Benzenamine, 4,4'-methylenebis[2-chloro-	U091	119-90-4	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-
U222	636-21-5	Benzenamine, 2-methyl-, hydrochloride	U095	119-93-7	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-
U181	99-55-8	Benzenamine, 2-methyl-5-nitro-	U225	75-25-2	Bromoform
U019	71-43-2	Benzene (I,T)	U030	101-55-3	4-Bromophenyl phenyl ether
U038	510-15-6	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester	U128	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-	U172	924-16-3	1-Butanamine, N-butyl-N-nitroso-
U035	305-03-3	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-	U031	71-36-3	1-Butanol (I)
U037	108-90-7	Benzene, chloro-	U159	78-93-3	2-Butanone (I,T)
U221	25376-45-8	Benzenediamine, ar-methyl-	U160	1338-23-4	2-Butanone, peroxide (R,T)
U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester	U053	4170-30-3	2-Butenal
U069	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester	U074	764-41-0	2-Butene, 1,4-dichloro- (I,T)
U088	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester	U143	303-34-4	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]- 2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*)], 7aalpha]]-
U102	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester	U031	71-36-3	n-Butyl alcohol (I)
U107	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester	U136	75-60-5	Cacodylic acid
U070	95-50-1	Benzene, 1,2-dichloro-	U032	13765-19-0	Calcium chromate
U071	541-73-1	Benzene, 1,3-dichloro-	U372	10605-21-7	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester.
U072	106-46-7	Benzene, 1,4-dichloro-	U271	17804-35-2	Carbamic acid, 1-[[[butylamino]carbonyl]-1H-benzimidazol-2-yl]-, methyl ester.
U060	72-54-8	Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro-	U280	101-27-9	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester.
U017	98-87-3	Benzene, (dichloromethyl)-	U238	51-79-6	Carbamic acid, ethyl ester
U223	26471-62-5	Benzene, 1,3-diisocyanatomethyl- (R,T)	U178	615-53-2	Carbamic acid, methylnitroso-, ethyl ester
U239	1330-20-7	Benzene, dimethyl- (I)	U373	122-42-9	Carbamic acid, phenyl-, 1-methylethyl ester.
U201	108-46-3	1,3-Benzenediol	U409	23564-05-8	Carbamic acid, [1,2-phenylenebis(iminocarbonothioyl)]bis-, dimethyl ester.
U127	118-74-1	Benzene, hexachloro-	U097	79-44-7	Carbamic chloride, dimethyl-
U056	110-82-7	Benzene, hexahydro- (I)	U389	2303-17-5	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester.
U220	108-88-3	Benzene, methyl-	U387	52888-80-9	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester.
U105	121-14-2	Benzene, 1-methyl-2,4-dinitro-	U114	111-54-6	Carbamodithioic acid, 1,2-ethanediybis-, salts & esters
U106	606-20-2	Benzene, 2-methyl-1,3-dinitro-	U062	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester
U055	98-82-8	Benzene, (1-methylethyl)- (I)	U279	63-25-2	Carbaryl.
U169	98-95-3	Benzene, nitro-	U372	10605-21-7	Carbendazim.
U183	608-93-5	Benzene, pentachloro-	U367	1563-38-8	Carbofuran phenol.
U185	82-68-8	Benzene, pentachloronitro-	U215	6533-73-9	Carbonic acid, dithallium(1+) salt
U020	98-09-9	Benzenesulfonic acid chloride (C,R)	U033	353-50-4	Carbonic difluoride
U020	98-09-9	Benzenesulfonyl chloride (C,R)	U156	79-22-1	Carbonochloridic acid, methyl ester (I,T)
U207	95-94-3	Benzene, 1,2,4,5-tetrachloro-	U033	353-50-4	Carbon oxyfluoride (R,T)
U061	50-29-3	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-	U211	56-23-5	Carbon tetrachloride
U247	72-43-5	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy-	U034	75-87-6	Chloral
U023	98-07-7	Benzene, (trichloromethyl)-	U035	305-03-3	Chlorambucil
U234	99-35-4	Benzene, 1,3,5-trinitro-	U036	57-74-9	Chlordane, alpha & gamma isomers
U021	92-87-5	Benzidine	U026	494-03-1	Chlornaphazin
U278	22781-23-3	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate.	U037	108-90-7	Chlorobenzene
U364	22961-82-6	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,	U038	510-15-6	Chlorobenzilate
U203	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-	U039	59-50-7	p-Chloro-m-cresol
U141	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-	U042	110-75-8	2-Chloroethyl vinyl ether
U367	1563-38-8	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-	U044	67-66-3	Chloroform
U090	94-58-6	1,3-Benzodioxole, 5-propyl-			
U064	189-55-9	Benzo[rs]pentaphene			
U248	181-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts, when present at concentrations of 0.3% or less			

Vehicle Maintenance Pro

Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U046	107-30-2	Chloromethyl methyl ether	U099	540-73-8	1,2-Dimethylhydrazine
U047	91-58-7	beta-Chloronaphthalene	U101	105-67-9	2,4-Dimethylphenol
U048	95-57-8	o-Chlorophenol	U102	131-11-3	Dimethyl phthalate
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride	U103	77-78-1	Dimethyl sulfate
U032	13765-19-0	Chromic acid H ₂ CrO ₄ , calcium salt	U105	121-14-2	2,4-Dinitrotoluene
U050	218-01-9	Chrysene	U106	606-20-2	2,6-Dinitrotoluene
U051	.....	Creosote	U107	117-84-0	Di-n-octyl phthalate
U052	1319-77-3	Cresol (Cresylic acid)	U108	123-91-1	1,4-Dioxane
U053	4170-30-3	Crotonaldehyde	U109	122-66-7	1,2-Diphenylhydrazine
U055	98-82-8	Cumene (I)	U110	142-84-7	Dipropylamine (I)
U246	506-68-3	Cyanogen bromide (CN)Br	U111	621-64-7	Di-n-propylnitrosamine
U197	106-51-4	2,5-Cyclohexadiene-1,4-dione	U041	106-89-8	Epichlorohydrin
U056	110-82-7	Cyclohexane (I)	U001	75-07-0	Ethanal (I)
U129	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha, 2alpha, 3beta, 4alpha, 5alpha, 6beta)-	U404	121-44-8	Ethanamine, N,N-diethyl-
U057	108-94-1	Cyclohexanone (I)	U174	55-18-5	Ethanamine, N-ethyl-N-nitroso-
U130	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	U155	91-80-5	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-
U058	50-18-0	Cyclophosphamide	U067	106-93-4	Ethane, 1,2-dibromo-
U240	194-75-7	2,4-D, salts & esters	U076	75-34-3	Ethane, 1,1-dichloro-
U059	20830-81-3	Daunomycin	U077	107-06-2	Ethane, 1,2-dichloro-
U060	72-54-8	DDD	U131	67-72-1	Ethane, hexachloro-
U061	50-29-3	DDT	U024	111-91-1	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-
U062	2303-16-4	Diallate	U117	60-29-7	Ethane, 1,1'-oxybis-(I)
U063	53-70-3	Dibenz[a,h]anthracene	U025	111-44-4	Ethane, 1,1'-oxybis[2-chloro-
U064	189-55-9	Dibenzo[a,i]pyrene	U184	76-01-7	Ethane, pentachloro-
U066	96-12-8	1,2-Dibromo-3-chloropropane	U208	630-20-6	Ethane, 1,1,1,2-tetrachloro-
U069	84-74-2	Dibutyl phthalate	U209	79-34-5	Ethane, 1,1,2,2-tetrachloro-
U070	95-50-1	o-Dichlorobenzene	U218	62-55-5	Ethanethioamide
U071	541-73-1	m-Dichlorobenzene	U226	71-55-6	Ethane, 1,1,1-trichloro-
U072	106-46-7	p-Dichlorobenzene	U227	79-00-5	Ethane, 1,1,2-trichloro-
U073	91-94-1	3,3'-Dichlorobenzidine	U410	59669-26-0	Ethanimidothioic acid, N,N'- [thiobis[(methyl-imino) carbonyloxy]]bis-, dimethyl ester
U074	764-41-0	1,4-Dichloro-2-butene (I,T)	U394	30558-43-1	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester.
U075	75-71-8	Dichlorodifluoromethane	U359	110-80-5	Ethanol, 2-ethoxy-
U078	75-35-4	1,1-Dichloroethylene	U173	1116-54-7	Ethanol, 2,2'-(nitrosoimino)bis-
U079	156-60-5	1,2-Dichloroethylene	U395	5952-26-1	Ethanol, 2,2'-oxybis-, dicarbamate.
U025	111-44-4	Dichloroethyl ether	U004	98-86-2	Ethanone, 1-phenyl-
U027	108-60-1	Dichloroisopropyl ether	U043	75-01-4	Ethene, chloro-
U024	111-91-1	Dichloromethoxy ethane	U042	110-75-8	Ethene, (2-chloroethoxy)-
U081	120-83-2	2,4-Dichlorophenol	U078	75-35-4	Ethene, 1,1-dichloro-
U082	87-65-0	2,6-Dichlorophenol	U079	156-60-5	Ethene, 1,2-dichloro-, (E)-
U084	542-75-6	1,3-Dichloropropene	U210	127-18-4	Ethene, tetrachloro-
U085	1464-53-5	1,2:3,4-Diepoxybutane (I,T)	U228	79-01-6	Ethene, trichloro-
U108	123-91-1	1,4-Diethyleneoxide	U112	141-78-6	Ethyl acetate (I)
U028	117-81-7	Diethylhexyl phthalate	U113	140-88-5	Ethyl acrylate (I)
U395	5952-26-1	Diethylene glycol, dicarbamate.	U238	51-79-6	Ethyl carbamate (urethane)
U086	1615-80-1	N,N'-Diethylhydrazine	U117	60-29-7	Ethyl ether (I)
U087	3288-58-2	O,O-Diethyl S-methyl dithiophosphate	U114	1111-54-6	Ethylenebisdithiocarbamic acid, salts & esters
U088	84-66-2	Diethyl phthalate	U067	106-93-4	Ethylene dibromide
U089	56-53-1	Diethylstilbesterol	U077	107-06-2	Ethylene dichloride
U090	94-58-6	Dihydrosafrole	U359	110-80-5	Ethylene glycol monoethyl ether
U091	119-90-4	3,3'-Dimethoxybenzidine	U115	75-21-8	Ethylene oxide (I,T)
U092	124-40-3	Dimethylamine (I)	U116	96-45-7	Ethylenethiourea
U093	60-11-7	p-Dimethylaminoazobenzene	U076	75-34-3	Ethylidene dichloride
U094	57-97-6	7,12-Dimethylbenz[a]anthracene	U118	97-63-2	Ethyl methacrylate
U095	119-93-7	3,3'-Dimethylbenzidine	U119	62-50-0	Ethyl methanesulfonate
U096	80-15-9	alpha, alpha-Dimethylbenzylhydroperoxide (R)	U120	206-44-0	Fluoranthene
U097	79-44-7	Dimethylcarbamoyl chloride	U122	50-00-0	Formaldehyde
U098	57-14-7	1,1-Dimethylhydrazine	U123	64-18-6	Formic acid (C,T)
			U124	110-00-9	Furan (I)
			U125	98-01-1	2-Furancarboxaldehyde (I)
				108-31-6	2,5-Furandione
				109-99-9	Furan, tetrahydro-(I)
				98-01-1	Furfural (I)

Regulations

Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U124	110-00-9	Furfuran (I)	U155	91-80-5	Methapyrilene
U206	18883-66-4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoareido)-, D-	U142	143-50-0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5a,5b,6-decachlorooctahydro-
U206	18883-66-4	D-Glucose, 2-deoxy-2-[[methylnitrosoamino]-carbonyl]amino]-	U247	72-43-5	Methoxychlor
U126	765-34-4	Glycidylaldehyde	U154	67-56-1	Methyl alcohol (I)
U163	70-25-7	Guanidine, N-methyl-N'-nitro-N-nitroso-	U029	74-83-9	Methyl bromide
U127	118-74-1	Hexachlorobenzene	U186	504-60-9	1-Methylbutadiene (I)
U128	87-68-3	Hexachlorobutadiene	U045	74-87-3	Methyl chloride (I,T)
U130	77-47-4	Hexachlorocyclopentadiene	U156	79-22-1	Methyl chlorocarbonate (I,T)
U131	67-72-1	Hexachloroethane	U226	71-55-6	Methyl chloroform
U132	70-30-4	Hexachlorophene	U157	56-49-5	3-Methylcholanthrene
U243	1888-71-7	Hexachloropropene	U158	101-14-4	4,4'-Methylenebis(2-chloroaniline)
U133	302-01-2	Hydrazine (R,T)	U068	74-95-3	Methylene bromide
U086	1615-80-1	Hydrazine, 1,2-diethyl-	U080	75-09-2	Methylene chloride
U098	57-14-7	Hydrazine, 1,1-dimethyl-	U159	78-93-3	Methyl ethyl ketone (MEK) (I,T)
U099	540-73-8	Hydrazine, 1,2-dimethyl-	U160	1338-23-4	Methyl ethyl ketone peroxide (R,T)
U109	122-66-7	Hydrazine, 1,2-diphenyl-	U138	74-88-4	Methyl iodide
U134	7664-39-3	Hydrofluoric acid (C,T)	U161	108-10-1	Methyl isobutyl ketone (I)
U134	7664-39-3	Hydrogen fluoride (C,T)	U162	80-62-6	Methyl methacrylate (I,T)
U135	7783-06-4	Hydrogen sulfide	U161	108-10-1	4-Methyl-2-pentanone (I)
U135	7783-06-4	Hydrogen sulfide H ₂ S	U164	56-04-2	Methylthiouracil
U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethyl- (R)	U010	50-07-7	Mitomycin C
U116	96-45-7	2-Imidazolidinethione	U059	20830-81-3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl]oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-
U137	193-39-5	Indeno[1,2,3-cd]pyrene	U167	134-32-7	1-Naphthalenamine
U190	85-44-9	1,3-Isobenzofurandione	U168	91-59-8	2-Naphthalenamine
U140	78-83-1	Isobutyl alcohol (I,T)	U026	494-03-1	Naphthalenamine, N,N'-bis(2-chloroethyl)-
U141	120-58-1	Isosafrole	U165	91-20-3	Naphthalene
U142	143-50-0	Kepone	U047	91-58-7	Naphthalene, 2-chloro-
U143	303-34-4	Lasiocarpine	U166	130-15-4	1,4-Naphthalenedione
U144	301-04-2	Lead acetate	U236	72-57-1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)bis[5-amino-4-hydroxy]-, tetrasodium salt
U146	1335-32-6	Lead, bis(acetato-O)tetrahydroxytri-	U279	63-25-2	1-Naphthalenol, methylcarbamate.
U145	7446-27-7	Lead phosphate	U166	130-15-4	1,4-Naphthoquinone
U146	1335-32-6	Lead subacetate	U167	134-32-7	alpha-Naphthylamine
U129	58-89-9	Lindane	U168	91-59-8	beta-Naphthylamine
U163	70-25-7	MNNG	U217	10102-45-1	Nitric acid, thallium(1+) salt
U147	108-31-6	Maleic anhydride	U169	98-95-3	Nitrobenzene (I,T)
U148	123-33-1	Maleic hydrazide	U170	100-02-7	p-Nitrophenol
U149	109-77-3	Malononitrile	U171	79-46-9	2-Nitropropane (I,T)
U150	148-82-3	Melphalan	U172	924-16-3	N-Nitrosodi-n-butylamine
U151	7439-97-6	Mercury	U173	1116-54-7	N-Nitrosodiethanolamine
U152	126-98-7	Methacrylonitrile (I, T)	U174	55-18-5	N-Nitrosodiethylamine
U092	124-40-3	Methanamine, N-methyl- (I)	U176	759-73-9	N-Nitroso-N-ethylurea
U029	74-83-9	Methane, bromo-	U177	684-93-5	N-Nitroso-N-methylurea
U045	74-87-3	Methane, chloro- (I, T)	U178	615-53-2	N-Nitroso-N-methylurethane
U046	107-30-2	Methane, chloromethoxy-	U179	100-75-4	N-Nitrosopiperidine
U068	74-95-3	Methane, dibromo-	U180	930-55-2	N-Nitrosopyrrolidine
U080	75-09-2	Methane, dichloro-	U181	99-55-8	5-Nitro-o-toluidine
U075	75-71-8	Methane, dichlorodifluoro-	U193	1120-71-4	1,2-Oxathiolane, 2,2-dioxide
U138	74-88-4	Methane, iodo-	U058	50-18-0	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U119	62-50-0	Methanesulfonic acid, ethyl ester	U115	75-21-8	Oxirane (I,T)
U211	56-23-5	Methane, tetrachloro-	U126	765-34-4	Oxiranecarboxyaldehyde
U153	74-93-1	Methanethiol (I, T)	U041	106-89-8	Oxirane, (chloromethyl)-
U225	75-25-2	Methane, tribromo-	U182	123-63-7	Paraldehyde
U044	67-66-3	Methane, trichloro-	U183	608-93-5	Pentachlorobenzene
U121	75-69-4	Methane, trichlorofluoro-	U184	76-01-7	Pentachloroethane
U036	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-	U185	82-68-8	Pentachloronitrobenzene (PCNB)
U154	67-56-1	Methanol (I)	See F027	87-86-5	Pentachlorophenol

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Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U161	108-10-1	Pentanol, 4-methyl-	U164	56-04-2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thio-
U186	504-60-9	1,3-Pentadiene (I)	U180	930-55-2	Pyrrrolidine, 1-nitroso-
U187	62-44-2	Phenacetin	U200	50-55-5	Reserpine
U188	108-95-2	Phenol	U201	108-46-3	Resorcinol
U048	95-57-8	Phenol, 2-chloro-	U203	94-59-7	Safrole
U039	59-50-7	Phenol, 4-chloro-3-methyl-	U204	7783-00-8	Selenious acid
U081	120-83-2	Phenol, 2,4-dichloro-	U204	7783-00-8	Selenium dioxide
U082	87-65-0	Phenol, 2,6-dichloro-	U205	7488-56-4	Selenium sulfide
U089	56-53-1	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-	U205	7488-56-4	Selenium sulfide SeS ₂ (R,T)
U101	105-67-9	Phenol, 2,4-dimethyl-	U015	115-02-6	L-Serine, diazoacetate (ester)
U052	1319-77-3	Phenol, methyl-	See F027	93-72-1	Silvex (2,4,5-TP)
U132	70-30-4	Phenol, 2,2'-methylenebis[3,4,6-trichloro-	U206	18883-66-4	Streptozotocin
U411	114-26-1	Phenol, 2-(1-methylethoxy)-, methylcarbamate.	U103	77-78-1	Sulfuric acid, dimethyl ester
U170	100-02-7	Phenol, 4-nitro-	U189	1314-80-3	Sulfur phosphide (R)
See F027	87-86-5	Phenol, pentachloro-	See F027	93-76-5	2,4,5-T
See F027	58-90-2	Phenol, 2,3,4,6-tetrachloro-	U207	95-94-3	1,2,4,5-Tetrachlorobenzene
See F027	95-95-4	Phenol, 2,4,5-trichloro-	U208	630-20-6	1,1,1,2-Tetrachloroethane
See F027	88-06-2	Phenol, 2,4,6-trichloro-	U209	79-34-5	1,1,2,2-Tetrachloroethane
U150	148-82-3	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-	U210	127-18-4	Tetrachloroethylene
U145	7446-27-7	Phosphoric acid, lead(2+) salt (2:3)	See F027	58-90-2	2,3,4,6-Tetrachlorophenol
U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl S-methyl ester	U213	109-99-9	Tetrahydrofuran (I)
U189	1314-80-3	Phosphorus sulfide (R)	U214	563-68-8	Thallium(I) acetate
U190	85-44-9	Phthalic anhydride	U215	6533-73-9	Thallium(I) carbonate
U191	109-06-8	2-Picoline	U216	7791-12-0	Thallium(I) chloride
U179	100-75-4	Piperidine, 1-nitroso-	U216	7791-12-0	thallium chloride TICI
U192	23950-58-5	Pronamide	U217	10102-45-1	Thallium(I) nitrate
U194	107-10-8	1-Propanamine (I,T)	U218	62-55-5	Thioacetamide
U111	621-64-7	1-Propanamine, N-nitroso-N-propyl-	U410	59669-26-0	Thiodicarb.
U110	142-84-7	1-Propanamine, N-propyl- (I)	U153	74-93-1	Thiomethanol (I,T)
U066	96-12-8	Propane, 1,2-dibromo-3-chloro-	U244	137-26-8	Thioperoxydicarbonic diamide [(H ₂ N)C(S)] ₂ S ₂ , tetramethyl-
U083	78-87-5	Propane, 1,2-dichloro-	U409	23564-05-8	Thiophanate-methyl.
U149	109-77-3	Propanedinitrile	U219	62-56-6	Thiourea
U171	79-46-9	Propane, 2-nitro- (I,T)	U244	137-26-8	Thiram
U027	108-60-1	Propane, 2,2'-oxybis[2-chloro-	U220	108-88-3	Toluene
U193	1120-71-4	1,3-Propane sultone	U221	25376-45-8	Toluenediamine
See F027	93-72-1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-	U223	26471-62-5	Toluene diisocyanate (R,T)
U235	126-72-7	1-Propanol, 2,3-dibromo-, phosphate (3:1)	U328	95-53-4	o-Toluidine
U140	78-83-1	1-Propanol, 2-methyl- (I,T)	U353	106-49-0	p-Toluidine
U002	67-64-1	2-Propanone (I)	U222	636-21-5	o-Toluidine hydrochloride
U007	79-06-1	2-Propenamide	U389	2303-17-5	Triallate.
U084	542-75-6	1-Propene, 1,3-dichloro-	U011	61-82-5	1H-1,2,4-Triazol-3-amine
U243	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-	U226	71-55-6	1,1,1-Trichloroethane
U009	107-13-1	2-Propenenitrile	U227	79-00-5	1,1,2-Trichloroethane
U152	126-98-7	2-Propenenitrile, 2-methyl- (I,T)	U228	79-01-6	Trichloroethylene
U008	79-10-7	2-Propenoic acid (I)	U121	75-69-4	Trichloromonofluoromethane
U113	140-88-5	2-Propenoic acid, ethyl ester (I)	See F027	95-95-4	2,4,5-Trichlorophenol
U118	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester	See F027	88-06-2	2,4,6-Trichlorophenol
U162	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)			
U373	122-42-9	Propham.			
U411	114-26-1	Propoxur.			
U387	52888-80-9	Prosulfocarb.			
U194	107-10-8	n-Propylamine (I,T)			
U083	78-87-5	Propylene dichloride			
U148	123-33-1	3,6-Pyridazinedione, 1,2-dihydro-			
U196	110-86-1	Pyridine			
U191	109-06-8	Pyridine, 2-methyl-			
U237	66-75-1	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-			

Regulations

Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U404	121-44-8	Triethylamine.	U027	108-60-1	Dichloroisopropyl ether
U234	99-35-4	1,3,5-Trinitrobenzene (R,T)	U027	108-60-1	Propane, 2,2'-oxybis[2-chloro-
U182	123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-	U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U235	126-72-7	Tris(2,3-dibromopropyl) phosphate	U028	117-81-7	Diethylhexyl phthalate
U236	72-57-1	Trypan blue	U029	74-83-9	Methane, bromo-
U237	66-75-1	Uracil mustard	U029	74-83-9	Methyl bromide
U176	759-73-9	Urea, N-ethyl-N-nitroso-	U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U177	684-93-5	Urea, N-methyl-N-nitroso-	U030	101-55-3	4-Bromophenyl phenyl ether
U043	75-01-4	Vinyl chloride	U031	71-36-3	1-Butanol (I)
U248	¹ 81-81-2	Warfarin, & salts, when present at concentrations of 0.3% or less	U031	71-36-3	n-Butyl alcohol (I)
U239	1330-20-7	Xylene (I)	U032	13765-19-0	Calcium chromate
U200	50-55-5	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methyl ester, (3beta, 16beta, 17alpha, 18beta, 20alpha)-	U032	13765-19-0	Chromic acid H2CrO4, calcium salt
U249	1314-84-7	Zinc phosphide Zn3P2, when present at concentrations of 10% or less	U033	353-50-4	Carbonic difluoride
U001	75-07-0	Acetaldehyde (I)	U033	353-50-4	Carbon oxyfluoride (R,T)
U001	75-07-0	Ethanal (I)	U034	75-87-6	Acetaldehyde, trichloro-
U002	67-64-1	Acetone (I)	U034	75-87-6	Chloral
U002	67-64-1	2-Propanone (I)	U035	305-03-3	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-
U003	75-05-8	Acetonitrile (I,T)	U035	305-03-3	Chlorambucil
U004	98-86-2	Acetophenone	U036	57-74-9	Chlordane, alpha & gamma isomers
U004	98-86-2	Ethanone, 1-phenyl-	U036	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
U005	53-96-3	Acetamide, -9H-fluoren-2-yl-	U037	108-90-7	Benzene, chloro-
U005	53-96-3	2-Acetylaminofluorene	U037	108-90-7	Chlorobenzene
U006	75-36-5	Acetyl chloride (C,R,T)	U038	510-15-6	Benzenecetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester
U007	79-06-1	Acrylamide	U038	510-15-6	Chlorobenzilate
U007	79-06-1	2-Propenamide	U039	59-50-7	p-Chloro-m-cresol
U008	79-10-7	Acrylic acid (I)	U039	59-50-7	Phenol, 4-chloro-3-methyl-
U008	79-10-7	2-Propenoic acid (I)	U041	106-89-8	Epichlorohydrin
U009	107-13-1	Acrylonitrile	U041	106-89-8	Oxirane, (chloromethyl)-
U009	107-13-1	2-Propenenitrile	U042	110-75-8	2-Chloroethyl vinyl ether
U010	50-07-7	Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione, 6-amino-8-[[[aminocarbonyl]oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha, 8beta,8aalpha,8balph)]-	U042	110-75-8	Ethene, (2-chloroethoxy)-
U010	50-07-7	Mitomycin C	U043	75-01-4	Ethene, chloro-
U011	61-82-5	Amitrole	U043	75-01-4	Vinyl chloride
U011	61-82-5	1H-1,2,4-Triazol-3-amine	U044	67-66-3	Chloroform
U012	62-53-3	Aniline (I,T)	U044	67-66-3	Methane, trichloro-
U012	62-53-3	Benzenamine (I,T)	U045	74-87-3	Methane, chloro- (I,T)
U014	492-80-8	Auramine	U045	74-87-3	Methyl chloride (I,T)
U014	492-80-8	Benzenamine, 4,4'-carbonimidoylbis[N,N-dimethyl-	U046	107-30-2	Chloromethyl methyl ether
U015	115-02-6	Azaserine	U046	107-30-2	Methane, chloromethoxy-
U015	115-02-6	L-Serine, diazoacetate (ester)	U047	91-58-7	beta-Chloronaphthalene
U016	225-51-4	Benz[c]acridine	U047	91-58-7	Naphthalene, 2-chloro-
U017	98-87-3	Benzal chloride	U048	95-57-8	o-Chlorophenol
U017	98-87-3	Benzene, (dichloromethyl)-	U048	95-57-8	Phenol, 2-chloro-
U018	56-55-3	Benz[a]anthracene	U049	3165-93-3	Benzenamine, 4-chloro-2-methyl-, hydrochloride
U019	71-43-2	Benzene (I,T)	U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U020	98-09-9	Benzenesulfonic acid chloride (C,R)	U050	218-01-9	Chrysene
U020	98-09-9	Benzenesulfonyl chloride (C,R)	U051	.....	Creosote
U021	92-87-5	Benzidine	U052	1319-77-3	Cresol (Cresylic acid)
U021	92-87-5	[1,1'-Biphenyl]-4,4'-diamine	U052	1319-77-3	Phenol, methyl-
U022	50-32-8	Benzo[a]pyrene	U053	4170-30-3	2-Butenal
U023	98-07-7	Benzene, (trichloromethyl)-	U053	4170-30-3	Crotonaldehyde
U023	98-07-7	Benzotrichloride (C,R,T)	U055	98-82-8	Benzene, (1-methylethyl)-(I)
U024	111-91-1	Dichloromethoxy ethane	U055	98-82-8	Cumene (I)
U024	111-91-1	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-	U056	110-82-7	Benzene, hexahydro-(I)
U025	111-44-4	Dichloroethyl ether	U056	110-82-7	Cyclohexane (I)
U025	111-44-4	Ethane, 1,1'-oxybis[2-chloro-	U057	108-94-1	Cyclohexanone (I)
U026	494-03-1	Chlornaphazin	U058	50-18-0	Cyclophosphamide
U026	494-03-1	Naphthalenamine, N,N'-bis(2-chloroethyl)-			

Vehicle Maintenance Pro

Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U058	50-18-0	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide	U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U059	20830-81-3	Daunomycin	U088	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
U059	20830-81-3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl]oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-	U088	84-66-2	Diethyl phthalate
U060	72-54-8	Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro-	U089	56-53-1	Diethylstilbesterol
U060	72-54-8	DDD	U089	56-53-1	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U061	50-29-3	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-	U090	94-58-6	1,3-Benzodioxole, 5-propyl-
U061	50-29-3	DDT	U090	94-58-6	Dihydrosafrole
U062	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-di chloro-2-propenyl) ester	U091	119-90-4	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-
U062	2303-16-4	Diallate	U091	119-90-4	3,3'-Dimethoxybenzidine
U063	53-70-3	Dibenz[a,h]anthracene	U092	124-40-3	Dimethylamine (l)
U064	189-55-9	Benzo[rs]pentaphene	U092	124-40-3	Methanamine, -methyl-(l)
U064	189-55-9	Dibenzo[a,i]pyrene	U093	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-
U066	96-12-8	1,2-Dibromo-3-chloropropane	U093	60-11-7	p-Dimethylaminoazobenzene
U066	96-12-8	Propane, 1,2-dibromo-3-chloro-	U094	57-97-6	Benz[a]anthracene, 7,12-dimethyl-
U067	106-93-4	Ethane, 1,2-dibromo-	U094	57-97-6	7,12-Dimethylbenz[a]anthracene
U067	106-93-4	Ethylene dibromide	U095	119-93-7	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-
U068	74-95-3	Methane, dibromo-	U095	119-93-7	3,3'-Dimethylbenzidine
U068	74-95-3	Methylene bromide	U096	80-15-9	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U069	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester	U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethyl-(R)
U069	84-74-2	Dibutyl phthalate	U097	79-44-7	Carbamic chloride, dimethyl-
U070	95-50-1	Benzene, 1,2-dichloro-	U097	79-44-7	Dimethylcarbamoyl chloride
U070	95-50-1	o-Dichlorobenzene	U098	57-14-7	1,1-Dimethylhydrazine
U071	541-73-1	Benzene, 1,3-dichloro-	U098	57-14-7	Hydrazine, 1,1-dimethyl-
U071	541-73-1	m-Dichlorobenzene	U099	540-73-8	1,2-Dimethylhydrazine
U072	106-46-7	Benzene, 1,4-dichloro-	U099	540-73-8	Hydrazine, 1,2-dimethyl-
U072	106-46-7	p-Dichlorobenzene	U101	105-67-9	2,4-Dimethylphenol
U073	91-94-1	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-	U101	105-67-9	Phenol, 2,4-dimethyl-
U073	91-94-1	3,3'-Dichlorobenzidine	U102	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
U074	764-41-0	2-Butene, 1,4-dichloro-(l,T)	U102	131-11-3	Dimethyl phthalate
U074	764-41-0	1,4-Dichloro-2-butene (l,T)	U103	77-78-1	Dimethyl sulfate
U075	75-71-8	Dichlorodifluoromethane	U103	77-78-1	Sulfuric acid, dimethyl ester
U075	75-71-8	Methane, dichlorodifluoro-	U105	121-14-2	Benzene, 1-methyl-2,4-dinitro-
U076	75-34-3	Ethane, 1,1-dichloro-	U105	121-14-2	2,4-Dinitrotoluene
U076	75-34-3	Ethylidene dichloride	U106	606-20-2	Benzene, 2-methyl-1,3-dinitro-
U077	107-06-2	Ethane, 1,2-dichloro-	U106	606-20-2	2,6-Dinitrotoluene
U077	107-06-2	Ethylene dichloride	U107	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester
U078	75-35-4	1,1-Dichloroethylene	U107	117-84-0	Di-n-octyl phthalate
U078	75-35-4	Ethene, 1,1-dichloro-	U108	123-91-1	1,4-Diethyleneoxide
U079	156-60-5	1,2-Dichloroethylene	U108	123-91-1	1,4-Dioxane
U079	156-60-5	Ethene, 1,2-dichloro-, (E)-	U109	122-66-7	1,2-Diphenylhydrazine
U080	75-09-2	Methane, dichloro-	U109	122-66-7	Hydrazine, 1,2-diphenyl-
U080	75-09-2	Methylene chloride	U110	142-84-7	Dipropylamine (l)
U081	120-83-2	2,4-Dichlorophenol	U110	142-84-7	1-Propanamine, N-propyl-(l)
U081	120-83-2	Phenol, 2,4-dichloro-	U111	621-64-7	Di-n-propylnitrosamine
U082	87-65-0	2,6-Dichlorophenol	U111	621-64-7	1-Propanamine, N-nitroso-N-propyl-
U082	87-65-0	Phenol, 2,6-dichloro-	U112	141-78-6	Acetic acid ethyl ester (l)
U083	78-87-5	Propane, 1,2-dichloro-	U112	141-78-6	Ethyl acetate (l)
U083	78-87-5	Propylene dichloride	U113	140-88-5	Ethyl acrylate (l)
U084	542-75-6	1,3-Dichloropropene	U113	140-88-5	2-Propenoic acid, ethyl ester (l)
U084	542-75-6	1-Propene, 1,3-dichloro-	U114	111-54-6	Carbamodithioic acid, 1,2-ethanediybis-, salts & esters
U085	1464-53-5	2,2'-Bioxirane	U114	111-54-6	Ethylenebisdithiocarbamic acid, salts & esters
U085	1464-53-5	1,2:3,4-Diepoxybutane (l,T)	U115	75-21-8	Ethylene oxide (l,T)
U086	1615-80-1	N,N'-Diethylhydrazine	U115	75-21-8	Oxirane (l,T)
U086	1615-80-1	Hydrazine, 1,2-diethyl-	U116	96-45-7	Ethylenethiourea
U087	3288-58-2	O,O-Diethyl S-methyl dithiophosphate	U116	96-45-7	2-Imidazolidinethione
			U117	60-29-7	Ethane, 1,1'-oxybis-(l)
			U117	60-29-7	Ethyl ether (l)
			U118	97-63-2	Ethyl methacrylate
			U118	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester
			U119	62-50-0	Ethyl methanesulfonate
			U119	62-50-0	Methanesulfonic acid, ethyl ester
			U120	206-44-0	Fluoranthene
			U121	75-69-4	Methane, trichlorofluoro-
			U121	75-69-4	Trichloromonofluoromethane
			U122	50-00-0	Formaldehyde

Regulations

Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U123	64-18-6	Formic acid (C,T)	U152	126-98-7	2-Propenenitrile, 2-methyl- (I,T)
U124	110-00-9	Furan (I)	U153	74-93-1	Methanethiol (I,T)
U124	110-00-9	Furfuran (I)	U153	74-93-1	Thiomethanol (I,T)
U125	98-01-1	2-Furancarboxaldehyde (I)	U154	67-56-1	Methanol (I)
U125	98-01-1	Furfural (I)	U154	67-56-1	Methyl alcohol (I)
U126	765-34-4	Glycidylaldehyde	U155	91-80-5	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-
U126	765-34-4	Oxiranecarboxyaldehyde	U155	91-80-5	Methapyrilene
U127	118-74-1	Benzene, hexachloro-	U156	79-22-1	Carbonochloridic acid, methyl ester (I,T)
U127	118-74-1	Hexachlorobenzene	U156	79-22-1	Methyl chlorocarbonate (I,T)
U128	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	U157	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U128	87-68-3	Hexachlorobutadiene	U157	56-49-5	3-Methylcholanthrene
U129	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha, 2alpha, 3beta, 4alpha, 5alpha, 6beta)-	U158	101-14-4	Benzenamine, 4,4'-methylenebis[2-chloro-4,4'-Methylenebis(2-chloroaniline)]
U129	58-89-9	Lindane	U158	101-14-4	2-Butanone (I,T)
U130	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	U159	78-93-3	Methyl ethyl ketone (MEK) (I,T)
U130	77-47-4	Hexachlorocyclopentadiene	U159	78-93-3	2-Butanone, peroxide (R,T)
U131	67-72-1	Ethane, hexachloro-	U160	1338-23-4	Methyl ethyl ketone peroxide (R,T)
U131	67-72-1	Hexachloroethane	U161	108-10-1	Methyl isobutyl ketone (I)
U132	70-30-4	Hexachlorophene	U161	108-10-1	4-Methyl-2-pentanone (I)
U132	70-30-4	Phenol, 2,2'-methylenebis[3,4,6-trichloro-	U161	108-10-1	Pentanol, 4-methyl-
U133	302-01-2	Hydrazine (R,T)	U162	80-62-6	Methyl methacrylate (I,T)
U134	7664-39-3	Hydrofluoric acid (C,T)	U162	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U134	7664-39-3	Hydrogen fluoride (C,T)	U163	70-25-7	Guanidine, -methyl-N'-nitro-N-nitroso-
U135	7783-06-4	Hydrogen sulfide	U163	70-25-7	MNNG
U135	7783-06-4	Hydrogen sulfide H ₂ S	U164	56-04-2	Methylthiouracil
U136	75-60-5	Arsinic acid, dimethyl-	U164	56-04-2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thio-
U136	75-60-5	Cacodylic acid	U165	91-20-3	Naphthalene
U137	193-39-5	Indeno[1,2,3-cd]pyrene	U166	130-15-4	1,4-Naphthalenedione
U138	74-88-4	Methane, iodo-	U166	130-15-4	1,4-Naphthoquinone
U138	74-88-4	Methyl iodide	U167	134-32-7	1-Naphthalenamine
U140	78-83-1	Isobutyl alcohol (I,T)	U167	134-32-7	alpha-Naphthylamine
U140	78-83-1	1-Propanol, 2-methyl- (I,T)	U168	91-59-8	2-Naphthalenamine
U141	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-	U168	91-59-8	beta-Naphthylamine
U141	120-58-1	Isosafrole	U169	98-95-3	Benzene, nitro-
U142	143-50-0	Kepone	U169	98-95-3	Nitrobenzene (I,T)
U142	143-50-0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5a,5b,6-decachlorooctahydro-	U170	100-02-7	p-Nitrophenol
U143	303-34-4	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*)], 7aalpha]]-	U170	100-02-7	Phenol, 4-nitro-
U143	303-34-4	Lasiocarpine	U171	79-46-9	2-Nitropropane (I,T)
U144	301-04-2	Acetic acid, lead(2+) salt	U171	79-46-9	Propane, 2-nitro- (I,T)
U144	301-04-2	Lead acetate	U172	924-16-3	1-Butanamine, N-butyl-N-nitroso-
U145	7446-27-7	Lead phosphate	U172	924-16-3	N-Nitrosodi-n-butylamine
U145	7446-27-7	Phosphoric acid, lead(2+) salt (2:3)	U173	1116-54-7	Ethanol, 2,2'-(nitrosoimino)bis-
U146	1335-32-6	Lead, bis(acetato-O)tetrahydroxytri-	U173	1116-54-7	N-Nitrosodiethanolamine
U146	1335-32-6	Lead subacetate	U174	55-18-5	Ethanamine, -ethyl-N-nitroso-
U147	108-31-6	2,5-Furandione	U174	55-18-5	N-Nitrosodiethylamine
U147	108-31-6	Maleic anhydride	U176	759-73-9	N-Nitroso-N-ethylurea
U148	123-33-1	Maleic hydrazide	U176	759-73-9	Urea, N-ethyl-N-nitroso-
U148	123-33-1	3,6-Pyridazinedione, 1,2-dihydro-	U177	684-93-5	N-Nitroso-N-methylurea
U149	109-77-3	Malononitrile	U177	684-93-5	Urea, N-methyl-N-nitroso-
U149	109-77-3	Propanedinitrile	U178	615-53-2	Carbamic acid, methylnitroso-, ethyl ester
U150	148-82-3	Melphalan	U178	615-53-2	N-Nitroso-N-methylurethane
U150	148-82-3	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-	U179	100-75-4	N-Nitrosopiperidine
U151	7439-97-6	Mercury	U179	100-75-4	Piperidine, 1-nitroso-
U152	126-98-7	Methacrylonitrile (I,T)	U180	930-55-2	N-Nitrosopyrrolidine
			U180	930-55-2	Pyrrolidine, 1-nitroso-
			U181	99-55-8	Benzenamine, 2-methyl-5-nitro-
			U181	99-55-8	5-Nitro-o-toluidine
			U182	123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-
			U182	123-63-7	Paraldehyde
			U183	608-93-5	Benzene, pentachloro-
			U183	608-93-5	Pentachlorobenzene
			U184	76-01-7	Ethane, pentachloro-

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Hazardous waste No.	Chemical abstracts No.	Substance	Hazardous waste No.	Chemical abstracts No.	Substance
U184	76-01-7	Pentachloroethane	U215	6533-73-9	Thallium(I) carbonate
U185	82-68-8	Benzene, pentachloronitro-	U216	7791-12-0	Thallium(I) chloride
U185	82-68-8	Pentachloronitrobenzene (PCNB)	U216	7791-12-0	Thallium chloride TICl
U186	504-60-9	1-Methylbutadiene (I)	U217	10102-45-1	Nitric acid, thallium(1+) salt
U186	504-60-9	1,3-Pentadiene (I)	U217	10102-45-1	Thallium(I) nitrate
U187	62-44-2	Acetamide, -(4-ethoxyphenyl)-	U218	62-55-5	Ethanethioamide
U187	62-44-2	Phenacetin	U218	62-55-5	Thioacetamide
U188	108-95-2	Phenol	U219	62-56-6	Thiourea
U189	1314-80-3	Phosphorus sulfide (R)	U220	108-88-3	Benzene, methyl-
U189	1314-80-3	Sulfur phosphide (R)	U220	108-88-3	Toluene
U190	85-44-9	1,3-Isobenzofurandione	U221	25376-45-8	Benzenediamine, ar-methyl-
U190	85-44-9	Phthalic anhydride	U221	25376-45-8	Toluenediamine
U191	109-06-8	2-Picoline	U222	636-21-5	Benzenamine, 2-methyl-, hydrochloride
U191	109-06-8	Pyridine, 2-methyl-	U222	636-21-5	o-Toluidine hydrochloride
U192	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-	U223	26471-62-5	Benzene, 1,3-diisocyanatomethyl- (R,T)
U192	23950-58-5	Pronamide	U223	26471-62-5	Toluene diisocyanate (R,T)
U193	1120-71-4	1,2-Oxathiolane, 2,2-dioxide	U225	75-25-2	Bromoform
U193	1120-71-4	1,3-Propane sultone	U225	75-25-2	Methane, tribromo-
U194	107-10-8	1-Propanamine (I,T)	U226	71-55-6	Ethane, 1,1,1-trichloro-
U194	107-10-8	n-Propylamine (I,T)	U226	71-55-6	Methyl chloroform
U196	110-86-1	Pyridine	U226	71-55-6	1,1,1-Trichloroethane
U197	106-51-4	p-Benzoquinone	U227	79-00-5	Ethane, 1,1,2-trichloro-
U197	106-51-4	2,5-Cyclohexadiene-1,4-dione	U227	79-00-5	1,1,2-Trichloroethane
U200	50-55-5	Reserpine	U228	79-01-6	Ethene, trichloro-
U200	50-55-5	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methyl ester,(3beta, 16beta, 17alpha, 18beta, 20alpha)-	U228	79-01-6	Trichloroethylene
U201	108-46-3	1,3-Benzenediol	U234	99-35-4	Benzene, 1,3,5-trinitro-
U201	108-46-3	Resorcinol	U234	99-35-4	1,3,5-Trinitrobenzene (R,T)
U203	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-	U235	126-72-7	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U203	94-59-7	Safrole	U235	126-72-7	Tris(2,3-dibromopropyl) phosphate
U204	7783-00-8	Selenious acid	U236	72-57-1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)bis(5-amino-4-hydroxy)-, tetrasodium salt
U204	7783-00-8	Selenium dioxide	U236	72-57-1	Trypan blue
U205	7488-56-4	Selenium sulfide	U237	66-75-1	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U205	7488-56-4	Selenium sulfide Se ₂ (R,T)	U237	66-75-1	Uracil mustard
U206	18883-66-4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoareido)-, D-	U238	51-79-6	Carbamic acid, ethyl ester
U206	18883-66-4	D-Glucose, 2-deoxy-2-[(methylnitrosoamino)-carbonyl]amino]-	U238	51-79-6	Ethyl carbamate (urethane)
U206	18883-66-4	Streptozotocin	U239	1330-20-7	Benzene, dimethyl- (I,T)
U207	95-94-3	Benzene, 1,2,4,5-tetrachloro-	U239	1330-20-7	Xylene (I)
U207	95-94-3	1,2,4,5-Tetrachlorobenzene	U240	194-75-7	Acetic acid, (2,4-dichlorophenoxy)-, salts & esters
U208	630-20-6	Ethane, 1,1,1,2-tetrachloro-	U240	194-75-7	2,4-D, salts & esters
U208	630-20-6	1,1,1,2-Tetrachloroethane	U243	1888-71-7	Hexachloropropene
U209	79-34-5	Ethane, 1,1,2,2-tetrachloro-	U243	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
U209	79-34-5	1,1,2,2-Tetrachloroethane	U244	137-26-8	Thioperoxydicarbonic diamide [(H ₂ N)C(S)] ₂ S ₂ , tetramethyl-
U210	127-18-4	Ethene, tetrachloro-	U244	137-26-8	Thiram
U210	127-18-4	Tetrachloroethylene	U246	506-68-3	Cyanogen bromide (CN)Br
U211	56-23-5	Carbon tetrachloride	U247	72-43-5	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis(4-methoxy-
U211	56-23-5	Methane, tetrachloro-	U247	72-43-5	Methoxychlor
U213	109-99-9	Furan, tetrahydro-(I)			
U213	109-99-9	Tetrahydrofuran (I)			
U214	563-68-8	Acetic acid, thallium(1+) salt			
U214	563-68-8	Thallium(I) acetate			
U215	6533-73-9	Carbonic acid, dithallium(1+) salt			

Regulations

Hazardous waste No.	Chemical abstracts No.	Substance
U248	¹ 81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts, when present at concentrations of 0.3% or less
U248	¹ 81-81-2	Warfarin, & salts, when present at concentrations of 0.3% or less
U249	1314-84-7	Zinc phosphide Zn ₃ P ₂ , when present at concentrations of 10% or less
U271	17804-35-2	Benomyl
U271	17804-35-2	Carbamic acid, [1-[(butylamino)carbonyl]-1H-benzimidazol-2-yl]-, methyl ester
U278	22781-23-3	Bendiocarb
U278	22781-23-3	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate
U279	63-25-2	Carbaryl
U279	63-25-2	1-Naphthalenol, methylcarbamate
U280	101-27-9	Barban
U280	101-27-9	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester
U328	95-53-4	Benzenamine, 2-methyl-
U328	95-53-4	o-Toluidine
U353	106-49-0	Benzenamine, 4-methyl-
U353	106-49-0	p-Toluidine
U359	110-80-5	Ethanol, 2-ethoxy-
U359	110-80-5	Ethylene glycol monoethyl ether
U364	22961-82-6	Bendiocarb phenol
U364	22961-82-6	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,
U367	1563-38-8	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-
U367	1563-38-8	Carbofuran phenol
U372	10605-21-7	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester
U372	10605-21-7	Carbendazim
U373	122-42-9	Carbamic acid, phenyl-, 1-methylethyl ester
U373	122-42-9	Propham
U387	52888-80-9	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester
U387	52888-80-9	Prosulfocarb
U389	2303-17-5	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester
U389	2303-17-5	Triallate
U394	30558-43-1	A2213
U394	30558-43-1	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester
U395	5952-26-1	Diethylene glycol, dicarbamate
U395	5952-26-1	Ethanol, 2,2'-oxybis-, dicarbamate
U404	121-44-8	Ethanamine, N,N-diethyl-
U404	121-44-8	Triethylamine
U409	23564-05-8	Carbamic acid, [1,2-phenylenebis(iminocarbonothioyl)]bis-, dimethyl ester
U409	23564-05-8	Thiophanate-methyl
U410	59669-26-0	Ethanimidothioic acid, N,N'-[thiobis[(methylimino)carbonyloxy]]bis-, dimethyl ester
U410	59669-26-0	Thiodicarb
U411	114-26-1	Phenol, 2-(1-methylethoxy)-, methylcarbamate
U411	114-26-1	Propoxur
See F027	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-
See F027	87-86-5	Pentachlorophenol

Hazardous waste No.	Chemical abstracts No.	Substance
See F027	87-86-5	Phenol, pentachloro-
See F027	58-90-2	Phenol, 2,3,4,6-tetrachloro-
See F027	95-95-4	Phenol, 2,4,5-trichloro-
See F027	88-06-2	Phenol, 2,4,6-trichloro-
See F027	93-72-1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-
See F027	93-72-1	Silvex (2,4,5-TP)
See F027	93-76-5	2,4,5-T
See F027	58-90-2	2,3,4,6-Tetrachlorophenol
See F027	95-95-4	2,4,5-Trichlorophenol
See F027	88-06-2	2,4,6-Trichlorophenol

¹CAS Number given for parent compound only.

§261.35 Deletion of Certain Hazardous Waste Codes Following Equipment Cleaning and Replacement.

(a) Wastes from wood preserving processes at plants that do not resume or initiate use of chlorophenolic preservatives will not meet the listing definition of F032 once the generator has met all of the requirements of paragraphs (b) and (c) of this section. These wastes may, however, continue to meet another hazardous waste listing description or may exhibit one or more of the hazardous waste characteristics.

(b) Generators must either clean or replace all process equipment that may have come into contact with chlorophenolic formulations or constituents thereof, including, but not limited to, treatment cylinders, sumps, tanks, piping systems, drip pads, fork lifts, and trams, in a manner that minimizes or eliminates the escape of hazardous waste or constituents, leachate, contaminated drippage, or hazardous waste decomposition products to the ground water, surface water, or atmosphere.

(1) Generators shall do one of the following:

(i) Prepare and follow an equipment cleaning plan and clean equipment in accordance with this section;

(ii) Prepare and follow an equipment replacement plan and replace equipment in accordance with this section; or

(iii) Document cleaning and replacement in accordance with this section, carried out after termination of use of chlorophenolic preservations.

(2) Cleaning Requirements.

(i) Prepare and sign a written equipment cleaning plan that describes:

- (A) The equipment to be cleaned;
- (B) How the equipment will be cleaned;
- (C) The solvent to be used in cleaning;
- (D) How solvent rinses will be tested; and
- (E) How cleaning residues will be disposed.

(ii) Equipment must be cleaned as follows:

(A) Remove all visible residues from process equipment;

(B) Rinse process equipment with an appropriate solvent until dioxins and dibenzofurans are not detected in the final solvent rinse.

(iii) Analytical requirements.

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(A) Rinses must be tested by using an appropriate method.

(B) "Not detected" means at or below the following lower method calibration limits (MCLs): The 2,3,7,8-TCDD-based MCL—0.01 parts per trillion (ppt), sample weight of 1000 g, IS spiking level of 1 ppt, final extraction volume of 10-50 µL. For other congeners—multiply the values by 1 for TCDF/PeCDD/PeCDF, by 2.5 for HxCDD/HxCDF/HpCDD/HpCDF, and by 5 for OCDD/OCDF.

(iv) The generator must manage all residues from the cleaning process as F032 waste.

(3) Replacement requirements.

(i) Prepare and sign a written equipment replacement plan that describes:

(A) The equipment to be replaced;

(B) How the equipment will be replaced; and

(C) How the equipment will be disposed.

(ii) The generator must manage the discarded equipment as F032 waste.

(4) Documentation requirements.

(i) Document that previous equipment cleaning and/or replacement was performed in accordance with this section and occurred after cessation of use of chlorophenolic preservatives.

(c) The generator must maintain the following records documenting the cleaning and replacement as part of the facility's operating record:

(1) The name and address of the facility;

(2) Formulations previously used and the date on which their use ceased in each process at the plant;

(3) Formulations currently used in each process at the plant;

(4) The equipment cleaning or replacement plan;

(5) The name and address of any persons who conducted the cleaning and replacement;

(6) The dates on which cleaning and replacement were accomplished;

(7) The dates of sampling and testing;

(8) A description of the sample handling and preparation techniques, including techniques used for extraction, containerization, preservation, and chain-of-custody of the samples;

(9) A description of the tests performed, the date the tests were performed, and the results of the tests;

(10) The name and model numbers of the instrument(s) used in performing the tests;

(11) QA/QC documentation; and

(12) The following statement signed by the generator or his authorized representative:

I certify under penalty of law that all process equipment required to be cleaned or replaced under 40 CFR 261.35 was cleaned or replaced as represented in the equipment cleaning and replacement plan and accompanying documentation. I am aware that there are significant penalties for providing false information, including the possibility of fine or imprisonment.

Subpart E—Exclusions/Exemptions

§261.38 Exclusion of comparable fuel and syngas fuel.

(a) **Specifications for excluded fuels.** Wastes that meet the specifications for comparable fuel or syngas fuel under paragraphs (a)(1) or (a)(2) of this section, respectively, and the other requirements of this section, are not solid wastes.

(1) *Comparable fuel specifications.*—(i) *Physical specifications.*—(A) *Heating value.* The heating value must exceed 5,000 Btu/lbs. (11,500 J/g).

(B) *Viscosity.* The viscosity must not exceed: 50 cS, as-fired.

(ii) *Constituent specifications.* For compounds listed in Table 1 to this section, the specification levels and, where non-detect is the specification, minimum required detection limits are: (see Table 1 of this section).

(2) *Synthesis gas fuel specifications.*—Synthesis gas fuel (i.e., syngas fuel) that is generated from hazardous waste must:

(i) Have a minimum Btu value of 100 Btu/Scf;

(ii) Contain less than 1 ppmv of total halogen;

(iii) Contain less than 300 ppmv of total nitrogen other than diatomic nitrogen (N₂);

(iv) Contain less than 200 ppmv of hydrogen sulfide; and

(v) Contain less than 1 ppmv of each hazardous constituent in the target list of appendix VIII constituents of this part.

(3) *Blending to meet the specifications.* (i) Hazardous waste shall not be blended to meet the comparable fuel specification under paragraph (a)(1) of this section, except as provided by paragraph (a)(3)(ii) of this section:

(ii) *Blending to meet the viscosity specification.* A hazardous waste blended to meet the viscosity specification for comparable fuel shall:

(A) As generated and prior to any blending, manipulation, or processing, meet the constituent and heating value specifications of paragraphs (a)(1)(i)(A) and (a)(1)(ii) of this section;

(B) Be blended at a facility that is subject to the applicable requirements of parts 264, 265, or 267 or §262.34 of this chapter; and

(C) Not violate the dilution prohibition of paragraph (a)(6) of this section.

(4) *Treatment to meet the comparable fuel specifications.* (i) A hazardous waste may be treated to meet the specifications for comparable fuel set forth in paragraph (a)(1) of this section provided the treatment:

(A) Destroys or removes the constituents listed in the specification or raises the heating value by removing or destroying hazardous constituents or materials;

(B) Is performed at a facility that is subject to the applicable requirements of parts 264, 265, or 267, or §262.34 of this chapter; and

(C) Does not violate the dilution prohibition of paragraph (a)(6) of this section.

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(ii) Residuals resulting from the treatment of a hazardous waste listed in subpart D of this part to generate a comparable fuel remain a hazardous waste.

(5) *Generation of a syngas fuel.* (i) A syngas fuel can be generated from the processing of hazardous wastes to meet the exclusion specifications of paragraph (a)(2) of this section provided the processing:

(A) Destroys or removes the constituents listed in the specification or raises the heating value by removing or destroying constituents or materials;

(B) Is performed at a facility that is subject to the applicable requirements of parts 264, 265, or 267, or §262.34 of this chapter or is an exempt recycling unit pursuant to §261.6(c); and

(C) Does not violate the dilution prohibition of paragraph (a)(6) of this section.

(ii) Residuals resulting from the treatment of a hazardous waste listed in subpart D of this part to generate a syngas fuel remain a hazardous waste.

(6) *Dilution prohibition.* No generator, transporter, handler, or owner or operator of a treatment, storage, or disposal facility shall in any way dilute a hazardous waste to meet the specifications of paragraphs (a)(1)(i)(A) or (a)(1)(ii) of this section for comparable fuel, or paragraph (a)(2) of this section for syngas.

(b) **Implementation.**—(1) *General.*—(i) Wastes that meet the specifications provided by paragraph (a) of this section for comparable fuel or syngas fuel are excluded from the definition of solid waste provided that the conditions under this section are met. For purposes of this section, such materials are called excluded fuel; the person claiming and qualifying for the exclusion is called the excluded fuel generator and the person burning the excluded fuel is called the excluded fuel burner.

(ii) The person who generates the excluded fuel must claim the exclusion by complying with the conditions of this section and keeping records necessary to document compliance with those conditions.

(2) *Notices.*(i) *Notices to State RCRA and CAA Directors in authorized States or regional RCRA and CAA Directors in unauthorized States.* (A) The generator must submit a one-time notice, except as provided by paragraph (b)(2)(i)(C) of this section, to the Regional or State RCRA and CAA Directors, in whose jurisdiction the exclusion is being claimed and where the excluded fuel will be burned, certifying compliance with the conditions of the exclusion and providing the following documentation:

(1) The name, address, and RCRA ID number of the person/facility claiming the exclusion;

(2) The applicable EPA Hazardous Waste Code(s) that would otherwise apply to the excluded fuel;

(3) The name and address of the units meeting the requirements of paragraphs (b)(3) and (c) of this section, that will burn the excluded fuel;

(4) An estimate of the average and maximum monthly and annual quantity of material for which an exclusion would be claimed, except as provided by paragraph (b)(2)(i)(C) of this section; and

(5) The following statement, which shall be signed and submitted by the person claiming the exclusion or his authorized representative:

Under penalty of criminal and civil prosecution for making or submitting false statements, representations, or omissions, I certify that the requirements of 40 CFR 261.38 have been met for all comparable fuels identified in this notification. Copies of the records and information required at 40 CFR 261.38(b)(8) are available at the generator's facility. Based on my inquiry of the individuals immediately responsible for obtaining the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

(B) If there is a substantive change in the information provided in the notice required under this paragraph, the generator must submit a revised notification.

(C) Excluded fuel generators must include an estimate of the average and maximum monthly and annual quantity of material for which an exclusion would be claimed only in notices submitted after December 19, 2008 for newly excluded fuel or for revised notices as required by paragraph (b)(2)(i)(B) of this section.

(ii) *Public notice.* Prior to burning an excluded fuel, the burner must publish in a major newspaper of general circulation local to the site where the fuel will be burned, a notice entitled "Notification of Burning a Fuel Excluded Under the Resource Conservation and Recovery Act" and containing the following information:

(A) Name, address, and RCRA ID number of the generating facility(ies);

(B) Name and address of the burner and identification of the unit(s) that will burn the excluded fuel;

(C) A brief, general description of the manufacturing, treatment, or other process generating the excluded fuel;

(D) An estimate of the average and maximum monthly and annual quantity of the excluded fuel to be burned; and

(E) Name and mailing address of the Regional or State Directors to whom the generator submitted a claim for the exclusion.

(3) *Burning.* The exclusion applies only if the fuel is burned in the following units that also shall be subject to Federal/State/local air emission requirements, including all applicable requirements implementing section 112 of the Clean Air Act:

(i) Industrial furnaces as defined in §260.10 of this chapter;

(ii) Boilers, as defined in §260.10 of this chapter, that are further defined as follows:

(A) Industrial boilers located on the site of a facility engaged in a manufacturing process where substances are transformed into new products, including the component parts of products, by mechanical or chemical processes; or

(B) Utility boilers used to produce electric power, steam, heated or cooled air, or other gases or fluids for sale;

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(iii) Hazardous waste incinerators subject to regulation under subpart O of parts 264 or 265 of this chapter and applicable CAA MACT standards.

(iv) Gas turbines used to produce electric power, steam, heated or cooled air, or other gases or fluids for sale.

(4) *Fuel analysis plan for generators.* The generator of an excluded fuel shall develop and follow a written fuel analysis plan which describes the procedures for sampling and analysis of the material to be excluded. The plan shall be followed and retained at the site of the generator claiming the exclusion.

(i) At a minimum, the plan must specify:

(A) The parameters for which each excluded fuel will be analyzed and the rationale for the selection of those parameters;

(B) The test methods which will be used to test for these parameters;

(C) The sampling method which will be used to obtain a representative sample of the excluded fuel to be analyzed;

(D) The frequency with which the initial analysis of the excluded fuel will be reviewed or repeated to ensure that the analysis is accurate and up to date; and

(E) If process knowledge is used in the determination, any information prepared by the generator in making such determination.

(ii) For each analysis, the generator shall document the following:

(A) The dates and times that samples were obtained, and the dates the samples were analyzed;

(B) The names and qualifications of the person(s) who obtained the samples;

(C) A description of the temporal and spatial locations of the samples;

(D) The name and address of the laboratory facility at which analyses of the samples were performed;

(E) A description of the analytical methods used, including any clean-up and sample preparation methods;

(F) All quantitation limits achieved and all other quality control results for the analysis (including method blanks, duplicate analyses, matrix spikes, *etc.*), laboratory quality assurance data, and the description of any deviations from analytical methods written in the plan or from any other activity written in the plan which occurred;

(G) All laboratory results demonstrating whether the exclusion specifications have been met; and

(H) All laboratory documentation that support the analytical results, unless a contract between the claimant and the laboratory provides for the documentation to be maintained by the laboratory for the period specified in paragraph (b)(9) of this section and also provides for the availability of the documentation to the claimant upon request.

(iii) Syngas fuel generators shall submit for approval, prior to performing sampling, analysis, or any management of an excluded syngas fuel, a fuel analysis plan containing the elements of paragraph (b)(4)(i) of this section to the appropriate regulatory authority. The approval

of fuel analysis plans must be stated in writing and received by the facility prior to sampling and analysis to demonstrate the exclusion of a syngas. The approval of the fuel analysis plan may contain such provisions and conditions as the regulatory authority deems appropriate.

(5) *Excluded fuel sampling and analysis.* (i) *General.* For wastes for which an exclusion is claimed under the specifications provided by paragraphs (a)(1) or (a)(2) of this section, the generator of the waste must test for all the constituents in appendix VIII to this part, except those that the generator determines, based on testing or knowledge, should not be present in the fuel. The generator is required to document the basis of each determination that a constituent with an applicable specification should not be present. The generator may not determine that any of the following categories of constituents with a specification in Table 1 to this section should not be present:

(A) A constituent that triggered the toxicity characteristic for the constituents that were the basis for listing the hazardous secondary material as a hazardous waste, or constituents for which there is a treatment standard for the waste code in 40 CFR 268.40;

(B) A constituent detected in previous analysis of the waste;

(C) Constituents introduced into the process that generates the waste; or

(D) Constituents that are byproducts or side reactions to the process that generates the waste.

Note to paragraph (b)(5): Any claim under this section must be valid and accurate for all hazardous constituents; a determination not to test for a hazardous constituent will not shield a generator from liability should that constituent later be found in the excluded fuel above the exclusion specifications.

(ii) *Use of process knowledge.* For each waste for which the comparable fuel or syngas exclusion is claimed where the generator of the excluded fuel is not the original generator of the hazardous waste, the generator of the excluded fuel may not use process knowledge pursuant to paragraph (b)(5)(i) of this section and must test to determine that all of the constituent specifications of paragraphs (a)(1) and (a)(2) of this section, as applicable, have been met.

(iii) The excluded fuel generator may use any reliable analytical method to demonstrate that no constituent of concern is present at concentrations above the specification levels. It is the responsibility of the generator to ensure that the sampling and analysis are unbiased, precise, and representative of the excluded fuel. For the fuel to be eligible for exclusion, a generator must demonstrate that:

(A) The 95% upper confidence limit of the mean concentration for each constituent of concern is not above the specification level; and

(B) The analyses could have detected the presence of the constituent at or below the specification level.

(iv) Nothing in this paragraph preempts, overrides or otherwise negates the provision in §262.11 of this chapter, which requires any person who generates a solid waste to determine if that waste is a hazardous waste.

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(v) In an enforcement action, the burden of proof to establish conformance with the exclusion specification shall be on the generator claiming the exclusion.

(vi) The generator must conduct sampling and analysis in accordance with the fuel analysis plan developed under paragraph (b)(4) of this section.

(vii) *Viscosity condition for comparable fuel.* (A) Excluded comparable fuel that has not been blended to meet the kinematic viscosity specification shall be analyzed as-generated.

(B) If hazardous waste is blended to meet the kinematic viscosity specification for comparable fuel, the generator shall:

(1) Analyze the hazardous waste as-generated to ensure that it meets the constituent and heating value specifications of paragraph (a)(1) of this section; and

(2) After blending, analyze the fuel again to ensure that the blended fuel meets all comparable fuel specifications.

(viii) Excluded fuel must be re-tested, at a minimum, annually and must be retested after a process change that could change its chemical or physical properties in a manner than may affect conformance with the specifications.

(6) (Reserved)

(7) *Speculative accumulation.* Excluded fuel must not be accumulated speculatively, as defined in §261.1(c)(8).

(8) *Operating record.* The generator must maintain an operating record on site containing the following information:

(i) All information required to be submitted to the implementing authority as part of the notification of the claim:

(A) The owner/operator name, address, and RCRA ID number of the person claiming the exclusion;

(B) For each excluded fuel, the EPA Hazardous Waste Codes that would be applicable if the material were discarded; and

(C) The certification signed by the person claiming the exclusion or his authorized representative.

(ii) A brief description of the process that generated the excluded fuel. If the comparable fuel generator is not the generator of the original hazardous waste, provide a brief description of the process that generated the hazardous waste;

(iii) The monthly and annual quantities of each fuel claimed to be excluded;

(iv) Documentation for any claim that a constituent is not present in the excluded fuel as required under paragraph (b)(5)(i) of this section;

(v) The results of all analyses and all detection limits achieved as required under paragraph (b)(4) of this section;

(vi) If the comparable fuel was generated through treatment or blending, documentation of compliance with the applicable provisions of paragraphs (a)(3) and (a)(4) of this section;

(vii) If the excluded fuel is to be shipped off-site, a certification from the burner as required under paragraph (b)(10) of this section;

(viii) The fuel analysis plan and documentation of all sampling and analysis results as required by paragraph (b)(4) of this section; and

(ix) If the generator ships excluded fuel off-site for burning, the generator must retain for each shipment the following information on-site:

(A) The name and address of the facility receiving the excluded fuel for burning;

(B) The quantity of excluded fuel shipped and delivered;

(C) The date of shipment or delivery;

(D) A cross-reference to the record of excluded fuel analysis or other information used to make the determination that the excluded fuel meets the specifications as required under paragraph (b)(4) of this section; and

(E) A one-time certification by the burner as required under paragraph (b)(10) of this section.

(9) *Records retention.* Records must be maintained for a period of three years.

(10) *Burner certification to the generator.* Prior to submitting a notification to the State and Regional Directors, a generator of excluded fuel who intends to ship the excluded fuel off-site for burning must obtain a one-time written, signed statement from the burner:

(i) Certifying that the excluded fuel will only be burned in an industrial furnace, industrial boiler, utility boiler, or hazardous waste incinerator, as required under paragraph (b)(3) of this section;

(ii) Identifying the name and address of the facility that will burn the excluded fuel; and

(iii) Certifying that the State in which the burner is located is authorized to exclude wastes as excluded fuel under the provisions of this section.

(11) *Ineligible waste codes.* Wastes that are listed as hazardous waste because of the presence of dioxins or furans, as set out in appendix VII of this part, are not eligible for these exclusions, and any fuel produced from or otherwise containing these wastes remains a hazardous waste subject to the full RCRA hazardous waste management requirements.

(12) *Regulatory status of boiler residues.* Burning excluded fuel that was otherwise a hazardous waste listed under §§261.31 through 261.33 does not subject boiler residues, including bottom ash and emission control residues, to regulation as derived-from hazardous wastes.

(13) *Residues in containers and tank systems upon cessation of operations.* (i) Liquid and accumulated solid residues that remain in a container or tank system for more than 90 days after the container or tank system ceases to be operated for storage or transport of excluded fuel product are subject to regulation under parts 262 through 265, 267, 268, 270, 271, and 124 of this chapter.

(ii) Liquid and accumulated solid residues that are removed from a container or tank system after the container or tank system ceases to be operated for storage or transport of excluded fuel product are solid wastes subject to regulation as hazardous waste if the waste exhibits a characteristic of hazardous waste under §§261.21 through 261.24 or if the fuel were otherwise a

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hazardous waste listed under §§261.31 through 261.33 when the exclusion was claimed.

(iii) Liquid and accumulated solid residues that are removed from a container or tank system and which do not meet the specifications for exclusion under paragraphs (a)(1) or (a)(2) of this section are solid wastes subject to regulation as hazardous waste if:

(A) The waste exhibits a characteristic of hazardous waste under §§261.21 through 261.24; or

(B) The fuel were otherwise a hazardous waste listed under §§261.31 through 261.33. The hazardous waste code for the listed waste applies to these liquid and accumulated solid residues.

(14) *Waiver of RCRA Closure Requirements.* Interim status and permitted storage and combustion units, and generator storage units exempt from the permit requirements under §262.34 of this chapter, are not subject to the closure requirements of 40 CFR Parts 264, 265, and 267 provided that the storage and combustion unit has been used to manage only hazardous waste that is subsequently excluded under the conditions of this section, and that afterward will be used only to manage fuel excluded under this section.

(15) *Spills and leaks.* (i) Excluded fuel that is spilled or leaked and that therefore no longer meets the conditions of the exclusion is discarded and must be managed as a hazardous waste if it exhibits a characteristic of hazardous waste under §§261.21 through 261.24 or if the fuel were otherwise a hazardous waste listed in §§261.31 through 261.33.

(ii) For excluded fuel that would have otherwise been a hazardous waste listed in §§261.31 through 261.33 and which is spilled or leaked, the hazardous waste code for the listed waste applies to the spilled or leaked material.

(16) Nothing in this section preempts, overrides, or otherwise negates the provisions in CERCLA Section 103, which establish reporting obligations for releases of hazardous substances, or the Department of Transportation requirements for hazardous materials in 49 CFR parts 171 through 180.

(c) **Failure to comply with the conditions of the exclusion.** An excluded fuel loses its exclusion if any person managing the fuel fails to comply with the conditions of the exclusion under this section, and the material must be managed as hazardous waste from the point of generation. In such situations, EPA or an authorized State agency may take enforcement action under RCRA section 3008(a).

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Table 1 to § 261.38--Detection and Detection Limit Values for Comparable Fuel Specification

Chemical name	CAS No.	Concentration Limit (mg/kg at 10,000 Btu/lb)	Minimum Required Detection Limit (mg/kg)
Total Nitrogen as N.....	NA	4900	.....
Total Halogens as Cl.....	NA	540	.....
Total Organic Halogens as Cl.....	NA	(^a)	.....
Polychlorinated biphenyls, total [Aroclors, total]	1336-36-3	ND	1.4
Cyanide, total.....	57-12-5	ND	1
Metals:			
Antimony, total.....	7440-36-0	12	.....
Arsenic, total.....	7440-38-2	0.23	.....
Barium, total.....	7440-39-3	23	.....
Beryllium, total.....	7440-41-7	1.2	.....
Cadmium, total.....	7440-43-9	1.2	.....
Chromium, total.....	7440-47-3	2.3	.....
Cobalt.....	7440-48-4	4.6	.....
Lead, total.....	7439-92-1	31	.....
Manganese.....	7439-96-5	1.2	.....
Mercury, total.....	7439-97-6	0.25	.....
Nickel, total.....	7440-02-0	58	.....
Selenium, total.....	7782-49-2	0.23	.....
Silver, total.....	7440-22-4	2.3	.....
Thallium, total.....	7440-28-0	23	.....
Hydrocarbons:			
Benzo[a]anthracene.....	56-55-3	2400	.....
Benzene.....	71-43-2	4100	.....
Benzo[b]fluoranthene.....	205-99-2	2400	.....
Benzo[k]fluoranthene.....	207-08-9	2400	.....
Benzo[a]pyrene.....	50-32-8	2400	.....
Chrysene.....	218-01-9	2400	.....
Dibenzo[a,h]anthracene.....	52-70-3	2400	.....
7,12-Dimethylbenz[a]anthracene.....	57-97-6	2400	.....
Fluoranthene.....	206-44-0	2400	.....
Indeno(1,2,3-cd)pyrene.....	193-39-5	2400	.....
3-Methylcholanthrene.....	56-49-5	2400	.....
Naphthalene.....	91-20-3	3200	.....
Toluene.....	108-88-3	36000	.....
Oxygenates:			
Acetophenone.....	98-86-1	2400	.....
Acrolein.....	107-02-8	39	.....
Allyl alcohol.....	107-18-6	30	.....
Bis(2-ethylhexyl)phthalate [Di-2-ethylhexyl phthalate]	117-81-7	2400	.....
Butyl benzyl phthalate.....	85-68-7	2400	.....
o-Cresol [2-Methyl phenol].....	95-48-7	2400	.....
m-Cresol [3-Methyl phenol].....	108-39-4	2400	
p-Cresol [4-Methyl phenol].....	106-44-5	2400	
Di-n-butyl phthalate.....	84-74-2	2400	

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Diethyl phthalate.....	84-66-2	2400	
2,4-Dimethylphenol.....	105-67-9	2400	
Dimethyl phthalate.....	131-11-3	2400	
Di-n-octyl phthalate.....	117-84-0	2400	.....
Endothall.....	145-73-3	100	.....
Ethyl methacrylate.....	97-63-2	39	.....
2-Ethoxyethanol [Ethylene glycol monoethyl ether]	110-80-5	100	.....
Isobutyl alcohol.....	78-83-1	39	.....
Isosafrole.....	120-58-1	2400	.....
Methyl ethyl ketone [2-Butanone].....	78-93-3	39	.....
Methyl methacrylate.....	80-62-6	39	.....
1,4-Naphthoquinone.....	130-15-4	2400	.....
Phenol.....	108-95-2	2400	.....
Propargyl alcohol [2-Propyn-1-ol].....	107-19-7	30	.....
Safrole.....	94-59-7	2400	.....
Sulfonated Organics:			
Carbon disulfide.....	75-15-0	ND	39
Disulfoton.....	298-04-4	ND	2400
Ethyl methanesulfonate.....	62-50-0	ND	2400
Methyl methanesulfonate.....	66-27-3	ND	2400
Phorate.....	298-02-2	ND	2400
1,3-Propane sultone.....	1120-71-4	ND	100
Tetraethyldithiopyrophosphate [Sulfotepp].....	3689-24-5	ND	2400
Thiophenol [Benzenethiol].....	108-98-5	ND	30
O,O,O-Triethyl phosphorothioate.....	126-68-1	ND	2400
Nitrogenated Organics:			
Acetonitrile [Methyl cyanide].....	75-05-8	ND	39
2-Acetylaminofluorene [2-AAF].....	53-96-3	ND	2400
Acrylonitrile.....	107-13-1	ND	39
4-Aminobiphenyl.....	92-67-1	ND	2400
4-Aminopyridine.....	504-24-5	ND	100
Aniline.....	62-53-3	ND	2400
Benzidine.....	92-87-5	ND	2400
Dibenz[a,j]acridine.....	224-42-0	ND	2400
O,O-Diethyl O-pyrazinyl phosphorothioate [Thionazin]	297-97-2	ND	2400
Dimethoate.....	60-51-5	ND	2400
p-(Dimethylamino) azobenzene [4-Dime thylaminoazobenzene]	60-11-7	ND	2400
3,3[prime]-Dimethylbenzidine.....	119-93-7	ND	2400
α,α-Dimethylphenethylamine.....	122-09-8	ND	2400
3,3[prime]-Dimethoxybenzidine.....	119-90-4	ND	100
1,3-Dinitrobenzene [m-Dinitrobenzene].....	99-65-0	ND	2400
4,6-Dinitro-o-cresol.....	534-52-1	ND	2400
2,4-Dinitrophenol.....	51-28-5	ND	2400
2,4-Dinitrotoluene.....	121-14-2	ND	2400
2,6-Dinitrotoluene.....	606-20-2	ND	2400
Dinoseb [2-sec-Butyl-4,6-dinitrophenol].....	88-85-7	ND	2400
Diphenylamine.....	122-39-4	ND	2400
Ethyl carbamate [Urethane].....	51-79-6	ND	100
Ethylenethiourea (2-Imidazolidinethione).....	96-45-7	ND	110

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Famphur.....	52-85-7	ND	2400
Methacrylonitrile.....	126-98-7	ND	39
Methapyrilene.....	91-80-5	ND	2400
Methomyl.....	16752-77-5	ND	57
2-Methylactonitrile, [Acetone cyanohydrin]....	75-86-5	ND	100
Methyl parathion.....	298-00-0	ND	2400
MNNG (N-Metyl-N-nitroso-N[prime]-nitroguanidine)	70-25-7	ND	110
1-Naphthylamine, [α -Naphthylamine].....	134-32-7	ND	2400
2-Naphthylamine, [β -Naphthylamine].....	91-59-8	ND	2400
Nicotine.....	54-11-5	ND	100
4-Nitroaniline, [p-Nitroaniline].....	100-01-6	ND	2400
Nitrobenzene.....	98-96-3	ND	2400
p-Nitrophenol, [p-Nitrophenol].....	100-02-7	ND	2400
5-Nitro-o-toluidine.....	99-55-8	ND	2400
N-Nitrosodi-n-butylamine.....	924-16-3	ND	2400
N-Nitrosodiethylamine.....	55-18-5	ND	2400
N-Nitrosodiphenylamine, [Diphenylnitrosamine]..	86-30-6	ND	2400
N-Nitroso-N-methylethylamine.....	10595-95-6	ND	2400
N-Nitrosomorpholine.....	59-89-2	ND	2400
N-Nitrosopiperidine.....	100-75-4	ND	2400
N-Nitrosopyrrolidine.....	930-55-2	ND	2400
2-Nitropropane.....	79-46-9	ND	2400
Parathion.....	56-38-2	ND	2400
Phenacetin.....	62-44-2	ND	2400
1,4-Phenylene diamine, [p-Phenylenediamine]....	106-50-3	ND	2400
N-Phenylthiourea.....	103-85-5	ND	57
2-Picoline [alpha-Picoline].....	109-06-8	ND	2400
Propylthioracil, [6-Propyl-2-thiouracil].....	51-52-5	ND	100
Pyridine.....	110-86-1	ND	2400
Strychnine.....	57-24-9	ND	100
Thioacetamide.....	62-55-5	ND	57
Thiofanox.....	39196-18-4	ND	100
Thiourea.....	62-56-6	ND	57
Toluene-2,4-diamine [2,4-Diaminotoluene].....	95-80-7	ND	57
Toluene-2,6-diamine [2,6-Diaminotoluene].....	823-40-5	ND	57
o-Toluidine.....	95-53-4	ND	2400
p-Toluidine.....	106-49-0	ND	100
1,3,5-Trinitrobenzene, [sym-Trinitrobenzene]....	99-35-4	ND	2400
Halogenated Organics:			
Allyl chloride.....	107-05-1	ND	39
Aramite.....	140-57-8	ND	2400
Benzal chloride [Dichloromethyl benzene].....	98-87-3	ND	100
Benzyl chloride.....	100-44-77	ND	100
bis(2-Chloroethyl)ether [Dichoroethyl ether]...	111-44-4	ND	2400
Bromoform [Tribromomethane].....	75-25-2	ND	39
Bromomethane [Methyl bromide].....	74-83-9	ND	39
4-Bromophenyl phenyl ether [p-Bromo diphenyl ether]	101-55-3	ND	2400
Carbon tetrachloride.....	56-23-5	ND	39
Chlordane.....	57-74-9	ND	14

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p-Chloroaniline.....	106-47-8	ND	2400
Chlorobenzene.....	108-90-7	ND	39
Chlorobenzilate.....	510-15-6	ND	2400
p-Chloro-m-cresol.....	59-50-7	ND	2400
2-Chloroethyl vinyl ether.....	110-75-8	ND	39
Chloroform.....	67-66-3	ND	39
Chloromethane [Methyl chloride].....	74-87-3	ND	39
2-Chloronaphthalene [beta-Chloronaphthalene]...	91-58-7	ND	2400
2-Chlorophenol [o-Chlorophenol].....	95-57-8	ND	2400
Chloroprene [2-Chloro-1,3-butadiene].....	1126-99-8	ND	39
2,4-D [2,4-Dichlorophenoxyacetic acid].....	94-75-7	ND	7
Diallate.....	2303-16-4	ND	3400
1,2-Dibromo-3-chloropropane.....	96-12-8	ND	39
1,2-Dichlorobenzene [o-Dichlorobenzene].....	95-50-1	ND	2400
1,3-Dichlorobenzene [m-Dichlorobenzene].....	541-73-1	ND	2400
1,4-Dichlorobenzene [p-Dichlorobenzene].....	106-46-7	ND	2400
3,3[prime]-Dichlorobenzidine.....	91-94-1	ND	2400
Dichlorodifluoromethane [CFC-12].....	75-71-8	ND	39
1,2-Dichloroethane [Ethylene dichloride].....	107-06-2	ND	39
1,1-Dichloroethylene [Vinylidene chloride].....	75-35-4	ND	39
Dichloromethoxy ethane [Bis(2-chloroethoxy)methane]	111-91-1	ND	2400
2,4-Dichlorophenol.....	120-83-2	ND	2400
2,6-Dichlorophenol.....	87-65-0	ND	2400
1,2-Dichloropropane [Propylene dichloride].....	78-87-5	ND	39
cis-1,3-Dichloropropylene.....	10061-01-5	ND	39
trans-1,3-Dichloropropylene.....	10061-02-6	ND	39
1,3-Dichloro-2-propanol.....	96-23-1	ND	30
Endosulfan I.....	959-98-8	ND	1.4
Endosulfan II.....	33213-65-9	ND	1.4
Endrin.....	72-20-8	ND	1.4
Endrin aldehyde.....	7421-93-4	ND	1.4
Endrin Ketone.....	53494-70-5	ND	1.4
Epichlorohydrin [1-Chloro-2,3-epoxy propane]...	106-89-8	ND	30
Ethylidene dichloride [1,1-Dichloroethane].....	75-34-3	ND	39
2-Fluoroacetamide.....	640-19-7	ND	100
Heptachlor.....	76-44-8	ND	1.4
Heptachlor epoxide.....	1024-57-3	ND	2.8
Hexachlorobenzene.....	118-74-1	ND	2400
Hexachloro-1,3-butadiene [Hexachlorobutadiene].	87-68-3	ND	2400
Hexachlorocyclopentadiene.....	77-47-4	ND	2400
Hexachloroethane.....	67-72-1	ND	2400
Hexachlorophene.....	70-30-4	ND	59000
Hexachloropropene [Hexachloropropylene].....	1888-71-7	ND	2400
Isodrin.....	465-73-6	ND	2400
Kepone [Chlordecone].....	143-50-0	ND	4700
Lindane [gamma-BHC] [gamma-Hexachlorocyclohexane].....	58-89-9	ND	1.4
Methylene chloride [Dichloromethane].....	75-09-2	ND	39
4,4[prime]-Methylene-bis(2-chloroaniline).....	101-14-4	ND	100
Methyl iodide [Iodomethane].....	74-88-4	ND	39

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Pentachlorobenzene.....	608-93-5	ND	2400
Pentachloroethane.....	76-01-7	ND	39
Pentachloronitrobenzene [PCNB] [Quintobenzene] [Quintozene].	82-68-8	ND	2400
Pentachlorophenol.....	87-88-5	ND	2400
Pronamide.....	23950-58-5	ND	2400
Silvex [2,4,5-Trichlorophenoxypropionic acid]..	93-72-1	ND	7
2,3,7,8-Tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD]	1746-01-6	ND	30
1,2,4,5-Tetrachlorobenzene.....	95-94-3	ND	2400
1,1,2,2-Tetrachloroethane.....	79-35-4	ND	39
Tetrachloroethylene [Perchloroethylene].....	127-18-4	ND	39
2,3,4,6-Tetrachlorophenol.....	58-90-2	ND	2400
1,2,4-Trichlorobenzene.....	120-82-1	ND	2400
1,1,1-Trichloroethane [Methyl chloroform].....	71-56-6	ND	39
1,1,2-Trichloroethane [Vinyl trichloride].....	79-00-5	ND	39
Trichloroethylene.....	79-01-6	ND	39
Trichlorofluoromethane [Trichloromonofluoromethane].....	75-69-4	ND	39
2,4,5-Trichlorophenol.....	95-95-4	ND	2400
2,4,6-Trichlorophenol.....	88-06-2	ND	2400
1,2,3-Trichloropropane.....	96-18-4	ND	39
Vinyl Chloride.....	75-01-4	ND	39

Notes:

NA--Not Applicable.

ND--Nondetect.

(^a) 25 or individual halogenated organics listed below.

§261.39 Conditional Exclusion for Used, Broken Cathode Ray Tubes (CRTs) and Processed CRT Glass Undergoing Recycling.

Used, broken CRTs are not solid wastes if they meet the following conditions:

(a) **Prior to processing:** These materials are not solid wastes if they are destined for recycling and if they meet the following requirements:

- (1) *Storage.* The broken CRTs must be either:
 - (i) Stored in a building with a roof, floor, and walls, or
 - (ii) Placed in a container (*i.e.*, a package or a vehicle) that is constructed, filled, and closed to minimize releases to the environment of CRT glass (including fine solid materials).
- (2) *Labeling.* Each container in which the used, broken CRT is contained must be labeled or marked clearly with one of the following phrases: "Used cathode ray tube(s)—contains leaded glass" or "Leaded glass from televisions or computers." It must also be labeled: "Do not mix with other glass materials."

(3) *Transportation.* The used, broken CRTs must be transported in a container meeting the requirements of paragraphs (a)(1)(ii) and (2) of this section.

(4) *Speculative accumulation and use constituting disposal.* The used, broken CRTs are subject to the limitations on speculative accumulation as defined in paragraph (c)(8) of this section. If they are used in a manner constituting disposal, they must comply with the applicable requirements of part 266, subpart C instead of the requirements of this section.

(5) *Exports.* In addition to the applicable conditions specified in paragraphs (a)(1)-(4) of this section, export-

ers of used, broken CRTs must comply with the following requirements:

(i) Notify EPA of an intended export before the CRTs are scheduled to leave the United States. A complete notification should be submitted sixty (60) days before the initial shipment is intended to be shipped off-site. This notification may cover export activities extending over a twelve (12) month or lesser period. The notification must be in writing, signed by the exporter, and include the following information:

(A) Name, mailing address, telephone number and EPA ID number (if applicable) of the exporter of the CRTs.

(B) The estimated frequency or rate at which the CRTs are to be exported and the period of time over which they are to be exported.

(C) The estimated total quantity of CRTs specified in kilograms.

(D) All points of entry to and departure from each foreign country through which the CRTs will pass.

(E) A description of the means by which each shipment of the CRTs will be transported (*e.g.*, mode of transportation vehicle (air, highway, rail, water, etc.), type(s) of container (drums, boxes, tanks, etc.)).

[Editor's Note: Paragraph (a)(5)(i)(F) is revised effective December 26, 2014.]

(F) The name and address of the recycler and any alternate recycler.

(G) A description of the manner in which the CRTs will be recycled in the foreign country that will be receiving the CRTs.

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(H) The name of any transit country through which the CRTs will be sent and a description of the approximate length of time the CRTs will remain in such country and the nature of their handling while there.

(ii) Notifications submitted by mail should be sent to the following mailing address: Office of Enforcement and Compliance Assurance, Office of Federal Activities, International Compliance Assurance Division, (Mail Code 2254A), Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460. Hand-delivered notifications should be sent to: Office of Enforcement and Compliance Assurance, Office of Federal Activities, International Compliance Assurance Division, (Mail Code 2254A), Environmental Protection Agency, Ariel Rios Bldg., Room 6144, 1200 Pennsylvania Ave., NW., Washington, DC. In both cases, the following shall be prominently displayed on the front of the envelope: "Attention: Notification of Intent to Export CRTs."

(iii) Upon request by EPA, the exporter shall furnish to EPA any additional information which a receiving country requests in order to respond to a notification.

(iv) EPA will provide a complete notification to the receiving country and any transit countries. A notification is complete when EPA receives a notification which EPA determines satisfies the requirements of paragraph (a)(5)(i) of this section. Where a claim of confidentiality is asserted with respect to any notification information required by paragraph (a)(5)(i) of this section, EPA may find the notification not complete until any such claim is resolved in accordance with 40 CFR 260.2.

(v) The export of CRTs is prohibited unless the receiving country consents to the intended export. When the receiving country consents in writing to the receipt of the CRTs, EPA will forward an Acknowledgment of Consent to Export CRTs to the exporter. Where the receiving country objects to receipt of the CRTs or withdraws a prior consent, EPA will notify the exporter in writing. EPA will also notify the exporter of any responses from transit countries.

(vi) When the conditions specified on the original notification change, the exporter must provide EPA with a written renotification of the change, except for changes to the telephone number in paragraph (a)(5)(i)(A) of this section and decreases in the quantity indicated pursuant to paragraph (a)(5)(i)(C) of this section. The shipment cannot take place until consent of the receiving country to the changes has been obtained (except for changes to information about points of entry and departure and transit countries pursuant to paragraphs (a)(5)(i)(D) and (a)(5)(i)(H) of this section) and the exporter of CRTs receives from EPA a copy of the Acknowledgment of Consent to Export CRTs reflecting the receiving country's consent to the changes.

(vii) A copy of the Acknowledgment of Consent to Export CRTs must accompany the shipment of CRTs. The shipment must conform to the terms of the Acknowledgment.

(viii) If a shipment of CRTs cannot be delivered for any reason to the recycler or the alternate recycler, the exporter of CRTs must renotify EPA of a change in the

conditions of the original notification to allow shipment to a new recycler in accordance with paragraph (a)(5)(vi) of this section and obtain another Acknowledgment of Consent to Export CRTs.

(ix) Exporters must keep copies of notifications and Acknowledgments of Consent to Export CRTs for a period of three years following receipt of the Acknowledgment.

[Editor's Note: Paragraphs (a)(5)(x) and (a)(5)(xi) are added effective December 26, 2014.]

(x) CRT exporters must file with EPA no later than March 1 of each year, an annual report summarizing the quantities (in kilograms), frequency of shipment, and ultimate destination(s) (*i.e.*, the facility or facilities where the recycling occurs) of all used CRTs exported during the previous calendar year. Such reports must also include the following:

(A) The name, EPA ID number (if applicable), and mailing and site address of the exporter;

(B) The calendar year covered by the report;

(C) A certification signed by the CRT exporter that states:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

(xi) Annual reports must be submitted to the office specified in paragraph (a)(5)(ii) of this section. Exporters must keep copies of each annual report for a period of at least three years from the due date of the report.

(b) **Requirements for used CRT processing:** Used, broken CRTs undergoing CRT processing as defined in §260.10 of this chapter are not solid wastes if they meet the following requirements:

(1) *Storage.* Used, broken CRTs undergoing processing are subject to the requirement of paragraph (a)(4) of this section.

(b)(2) *Processing.*

(i) All activities specified in paragraphs (2) and (3) of the definition of "CRT processing" in §260.10 of this chapter must be performed within a building with a roof, floor, and walls; and (ii) No activities may be performed that use temperatures high enough to volatilize lead from CRTs.

(c) **Processed CRT glass sent to CRT glass making or lead smelting:** Glass from used CRTs that is destined for recycling at a CRT glass manufacturer or a lead smelter after processing is not a solid waste unless it is speculatively accumulated as defined in §261.1(c)(8).

(d) **Use constituting disposal:** Glass from used CRTs that is used in a manner constituting disposal must comply with the requirements of 40 CFR part 266, subpart C instead of the requirements of this section.

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§261.40 Conditional Exclusion for Used, Intact Cathode Ray Tubes (CRTs) Exported for Recycling.

Used, intact CRTs exported for recycling are not solid wastes if they meet the notice and consent conditions of §261.39(a)(5), and if they are not speculatively accumulated as defined in §261.1(c)(8).

[67 FR 78731 Dec. 26, 2002; 68 FR 8553 Feb. 24, 2003; 71 FR 42949, July 28, 2006]

§261.41 Notification and Recordkeeping for Used, Intact Cathode Ray Tubes (CRTs) Exported for Reuse.

[Editor's Note: This section is revised effective December 26, 2014.]

(a) Persons who export used, intact CRTs for reuse must send a one-time notification to the Regional Administrator. The notification must include a statement that the notifier plans to export used, intact CRTs for reuse, the notifier's name, address, and EPA ID number (if applicable) and the name and phone number of a contact person.

(b) Persons who export used, intact CRTs for reuse must keep copies of normal business records, such as contracts, demonstrating that each shipment of exported CRTs will be reused. This documentation must be retained for a period of at least three years from the date the CRTs were exported.

Appendix I to Part 261—Representative Sampling Methods

The methods and equipment used for sampling waste materials will vary with the form and consistency of the waste materials to be sampled. Samples collected using the sampling protocols listed below, for sampling waste with properties similar to the indicated materials, will be considered by the Agency to be representative of the waste.

Extremely viscous liquid—ASTM Standard D140–70 Crushed or powdered material—ASTM Standard D346–75 Soil or rock-like material—ASTM Standard D420–69 Soil-like material—ASTM Standard D1452–65

Fly Ash-like material—ASTM Standard D2234–76 [ASTM Standards are available from ASTM, 1916 Race St., Philadelphia, PA 19103]

Containerized liquid waste—"COLIWASA."

Liquid waste in pits, ponds, lagoons, and similar reservoirs—"Pond Sampler."

This manual also contains additional information on application of these protocols.

Appendix II to Part 261 [Reserved]

Appendix III to Part 261 [Reserved]

Appendix IV to Part 261 [Reserved for Radioactive Waste Test Methods]

Appendix V to Part 261 [Reserved for Infectious Waste Treatment Specifications]

Appendix VI to Part 261 [Reserved for Etiologic Agents]

Appendix VII to Part 261-Basis for Listing Hazardous Waste

EPA hazardous waste No.	Hazardous constituents for which listed
F001	Tetrachloroethylene, methylene chloride trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, chlorinated fluorocarbons.
F002	Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane.
F003	N.A.
F004	Cresols and cresylic acid, nitrobenzene.
F005	Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, 2-ethoxyethanol, benzene, 2-nitropropane.
F006	Cadmium, hexavalent chromium, nickel, cyanide (complexed).
F007	Cyanide (salts).
F008	Cyanide (salts).
F009	Cyanide (salts).
F010	Cyanide (salts).
F011	Cyanide (salts).
F012	Cyanide (complexed).
F019	Hexavalent chromium, cyanide (complexed).
F020	Tetra- and pentachlorodibenzo- <i>p</i> -dioxins; tetra and pentachlorodi-benzofurans; tri- and tetrachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.
F021	Penta- and hexachlorodibenzo- <i>p</i> -dioxins; penta- and hexachlorodibenzofurans; pentachlorophenol and its derivatives.
F022	Tetra-, penta-, and hexachlorodibenzo- <i>p</i> -dioxins; tetra-, penta-, and hexachlorodibenzofurans.
F023	Tetra-, and pentachlorodibenzo- <i>p</i> -dioxins; tetra- and pentachlorodibenzofurans; tri- and tetrachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.
F024	Chloromethane, dichloromethane, trichloromethane, carbon tetrachloride, chloroethylene, 1,1-dichloroethane, 1,2-dichloroethane, trans-1,2-dichloroethylene, 1,1-dichloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, 1,1,1,2-tetra-chloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, pentachloroethane, hexachloroethane, allyl chloride (3-chloropropene), dichloropropene, dichloropropene, 2-chloro-1,3-butadiene, hexachloro-1,3-butadiene, hexachlorocyclopentadiene, hexachlorocyclohexane, benzene, chlorobenzene, dichlorobenzenes, 1,2,4-trichlorobenzene, tetrachlorobenzene, pentachlorobenzene, hexachlorobenzene, toluene, naphthalene.

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EPA hazardous waste No.	Hazardous constituents for which listed
F025	Chloromethane; Dichloromethane; Trichloromethane; Carbon tetrachloride; Chloroethylene; 1,1-Dichloroethane; 1,2-Dichloroethane; trans-1,2-Dichloroethylene; 1,1-Dichloroethylene; 1,1,1-Trichloroethane; 1,1,2-Trichloroethane; Trichloroethylene; 1,1,1,2-Tetrachloroethane; 1,1,2,2-Tetrachloroethane; Tetrachloroethylene; Pentachloroethane; Hexachloroethane; Allyl chloride (3-Chloropropene); Dichloropropane; Dichloropropene; 2-Chloro-1,3-butadiene; Hexachloro-1,3-butadiene; Hexachlorocyclopentadiene; Benzene; Chlorobenzene; Dichlorobenzene; 1,2,4-Trichlorobenzene; Tetrachlorobenzene; Pentachlorobenzene; Hexachlorobenzene; Toluene; Naphthalene.
F026	Tetra-, penta-, and hexachlorodibenzo- <i>p</i> -dioxins; tetra-, penta-, and hexachlorodibenzofurans.
F027	Tetra-, penta-, and hexachlorodibenzo- <i>p</i> -dioxins; tetra-, penta-, and hexachlorodibenzofurans; tri-, tetra-, and pentachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.
F028	Tetra-, penta-, and hexachlorodibenzo- <i>p</i> -dioxins; tetra-, penta-, and hexachlorodibenzofurans; tri-, tetra-, and pentachlorophenols and their chlorophenoxy derivative acids, esters, ethers, amine and other salts.
F032	Benz(a)anthracene, benzo(a)pyrene, dibenz(a,h)-anthracene, indeno(1,2,3-cd)pyrene, pentachlorophenol, arsenic, chromium, tetra-, penta-, hexa-, heptachlorodibenzo- <i>p</i> -dioxins, tetra-, penta-, hexa-, heptachlorodibenzofurans.
F034	Benz(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, arsenic, chromium.
F035	Arsenic, chromium, lead.
F037	Benzene, benzo(a)pyrene, chrysene, lead, chromium.
F038	Benzene, benzo(a)pyrene, chrysene, lead, chromium.
F039	All constituents for which treatment standards are specified for multi-source leachate (wastewaters and nonwastewaters) under 40 CFR 268.43, Table CCW.
K001	Pentachlorophenol, phenol, 2-chlorophenol, <i>p</i> -chloro-m-cresol, 2,4-dimethylphenyl, 2,4-dinitrophenol, trichlorophenols, tetrachlorophenols, 2,4-dinitrophenol, creosote, chrysene, naphthalene, fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benz(a)anthracene, dibenz(a)anthracene, acenaphthalene.
K002	Hexavalent chromium, lead
K003	Hexavalent chromium, lead.
K004	Hexavalent chromium.
K005	Hexavalent chromium, lead.
K006	Hexavalent chromium.
K007	Cyanide (complexed), hexavalent chromium.
K008	Hexavalent chromium.
K009	Chloroform, formaldehyde, methylene chloride, methyl chloride, paraldehyde, formic acid.
K010	Chloroform, formaldehyde, methylene chloride, methyl chloride, paraldehyde, formic acid, chloroacetaldehyde.
K011	Acrylonitrile, acetonitrile, hydrocyanic acid.
K013	Hydrocyanic acid, acrylonitrile, acetonitrile.
K014	Acetonitrile, acrylamide.
K015	Benzyl chloride, chlorobenzene, toluene, benzotrichloride.
K016	Hexachlorobenzene, hexachlorobutadiene, carbon tetrachloride, hexachloroethane, perchloroethylene.
K017	Epichlorohydrin, chloroethers [bis(chloromethyl) ether and bis (2-chloroethyl) ethers], trichloropropane, dichloropropanols.
K018	1,2-dichloroethane, trichloroethylene, hexachlorobutadiene, hexachlorobenzene.

EPA hazardous waste No.	Hazardous constituents for which listed
K019	Ethylene dichloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, tetrachloroethanes (1,1,2,2-tetrachloroethane and 1,1,1,2-tetrachloroethane), trichloroethylene, tetrachloroethylene, carbon tetrachloride, chloroform, vinyl chloride, vinylidene chloride.
K020	Ethylene dichloride, 1,1,1-trichloroethane, 1,1,2-trichloroethane, tetrachloroethanes (1,1,2,2-tetrachloroethane and 1,1,1,2-tetrachloroethane), trichloroethylene, tetrachloroethylene, carbon tetrachloride, chloroform, vinyl chloride, vinylidene chloride.
K021	Antimony, carbon tetrachloride, chloroform.
K022	Phenol, tars (polycyclic aromatic hydrocarbons).
K023	Phthalic anhydride, maleic anhydride.
K024	Phthalic anhydride, 1,4-naphthoquinone.
K025	Meta-dinitrobenzene, 2,4-dinitrotoluene.
K026	Paraldehyde, pyridines, 2-picoline.
K027	Toluene diisocyanate, toluene-2, 4-diamine.
K028	1,1,1-trichloroethane, vinyl chloride.
K029	1,2-dichloroethane, 1,1,1-trichloroethane, vinyl chloride, vinylidene chloride, chloroform.
K030	Hexachlorobenzene, hexachlorobutadiene, hexachloroethane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, ethylene dichloride.
K031	Arsenic.
K032	Hexachlorocyclopentadiene.
K033	Hexachlorocyclopentadiene.
K034	Hexachlorocyclopentadiene.
K035	Creosote, chrysene, naphthalene, fluoranthene benzo(b) fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd) pyrene, benzo(a)anthracene, dibenzo(a)anthracene, acenaphthalene.
K036	Toluene, phosphorodithioic and phosphorothioic acid esters.
K037	Toluene, phosphorodithioic and phosphorothioic acid esters.
K038	Phorate, formaldehyde, phosphorodithioic and phosphorothioic acid esters.
K039	Phosphorodithioic and phosphorothioic acid esters.
K040	Phorate, formaldehyde, phosphorodithioic and phosphorothioic acid esters.
K041	Toxaphene.
K042	Hexachlorobenzene, ortho-dichlorobenzene.
K043	2,4-dichlorophenol, 2,6-dichlorophenol, 2,4,6-trichlorophenol.
K044	N.A.
K045	N.A.
K046	Lead.
K047	N.A.
K048	Hexavalent chromium, lead.
K049	Hexavalent chromium, lead.
K050	Hexavalent chromium.
K051	Hexavalent chromium, lead.
K052	Lead.
K060	Cyanide, naphthalene, phenolic compounds, arsenic.
K061	Hexavalent chromium, lead, cadmium.
K062	Hexavalent chromium, lead.
K069	Hexavalent chromium, lead, cadmium.
K071	Mercury.
K073	Chloroform, carbon tetrachloride, hexachloroethane, trichloroethane, tetrachloroethylene, dichloroethylene, 1,1,2,2-tetrachloroethane.
K083	Aniline, diphenylamine, nitrobenzene, phenylenediamine.
K084	Arsenic.

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EPA hazardous waste No.	Hazardous constituents for which listed
K085	Benzene, dichlorobenzenes, trichlorobenzenes, tetrachlorobenzenes, pentachlorobenzene, hexachlorobenzene, benzyl chloride.
K086	Lead, hexavalent chromium.
K087	Phenol, naphthalene.
K088	Cyanide (complexes).
K093	Phthalic anhydride, maleic anhydride.
K094	Phthalic anhydride.
K095	1,1,2-trichloroethane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane.
K096	1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane.
K097	Chlordane, heptachlor.
K098	Toxaphene.
K099	2,4-dichlorophenol, 2,4,6-trichlorophenol.
K100	Hexavalent chromium, lead, cadmium.
K101	Arsenic.
K102	Arsenic.
K103	Aniline, nitrobenzene, phenylenediamine.
K104	Aniline, benzene, diphenylamine, nitrobenzene, phenylenediamine.
K105	Benzene, monochlorobenzene, dichlorobenzenes, 2,4,6-trichlorophenol.
K106	Mercury.
K107	1,1-Dimethylhydrazine (UDMH).
K108	1,1-Dimethylhydrazine (UDMH).
K109	1,1-Dimethylhydrazine (UDMH).
K110	1,1-Dimethylhydrazine (UDMH).
K111	2,4-Dinitrotoluene.
K112	2,4-Toluenediamine, o -toluidine, p -toluidine, aniline.
K113	2,4-Toluenediamine, o -toluidine, p -toluidine, aniline.
K114	2,4-Toluenediamine, o -toluidine, p -toluidine.
K115	2,4-Toluenediamine.
K116	Carbon tetrachloride, tetrachloroethylene, chloroform, phosphene.
K117	Ethylene dibromide.
K118	Ethylene dibromide.
K123	Ethylene thiourea.
K124	Ethylene thiourea.
K125	Ethylene thiourea.
K126	Ethylene thiourea.
K131	Dimethyl sulfate, methyl bromide.
K132	Methyl bromide.
K136	Ethylene dibromide.
K141	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.
K142	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.
K143	Benzene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene.
K144	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene.
K145	Benzene, benz(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, naphthalene.
K147	Benzene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.

EPA hazardous waste No.	Hazardous constituents for which listed
K148	Benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene.
K149	Benzotrachloride, benzyl chloride, chloroform, chloromethane, chlorobenzene, 1,4-dichlorobenzene, hexachlorobenzene, pentachlorobenzene, 1,2,4,5-tetrachlorobenzene, toluene.
K150	Carbon tetrachloride, chloroform, chloromethane, 1,4-dichlorobenzene, hexachlorobenzene, pentachlorobenzene, 1,2,4,5-tetrachlorobenzene, 1,1,2,2-tetrachloroethane, tetrachloroethylene, 1,2,4-trichlorobenzene.
K151	Benzene, carbon tetrachloride, chloroform, hexachlorobenzene, pentachlorobenzene, toluene, 1,2,4,5-tetrachlorobenzene, tetrachloroethylene.
K156	Benomyl, carbaryl, carbendazim, carbofuran, carbosulfan, formaldehyde, methylene chloride, triethylamine.
K157	Carbon tetrachloride, formaldehyde, methyl chloride, methylene chloride, pyridine, triethylamine.
K158	Benomyl, carbendazim, carbofuran, carbosulfan, chloroform, methylene chloride.
K159	Benzene, butylate, eptc, molinate, pebulate, vernolate.
K161	Antimony, arsenic, metam-sodium, ziram.
K169	Benzene.
K170	Benzo(a)pyrene, dibenz(a,h)anthracene, benzo (a) anthracene, benzo (b)fluoranthene, benzo(k)fluoranthene, 3-methylcholanthrene, 7, 12-dimethylbenz(a)anthracene.
K171	Benzene, arsenic.
K172	Benzene, arsenic.
K174	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD), 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF), 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,6,7,8,9-HpCDF), HxCDDs (All Hexachlorodibenzo-p-dioxins), HxCDFs (All Hexachlorodibenzofurans), PeCDDs (All Pentachlorodibenzo-p-dioxins), OCDD (1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin, OCDF (1,2,3,4,6,7,8,9-Octachlorodibenzofuran), PeCDFs (All Pentachlorodibenzofurans), TCDDs (All tetrachlorodibenzo-p-dioxins), TCDFs (All tetrachlorodibenzofurans).
K175	Mercury
K176	Arsenic, Lead.
K177	Antimony.
K178	Thallium.
K181	Aniline, o-anisidine, 4-chloroaniline, p-cresidine, 2,4-dimethylaniline, 1,2-phenylenediamine, 1,3-phenylenediamine.

N.A.-Waste is hazardous because it fails the test for the characteristic of ignitability, corrosivity, or reactivity.

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Appendix VIII to Part 261—Hazardous Constituents

Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
A2213	Ethanimidothioic acid, 2- (dimethylamino) -N-hydroxy-2-oxo-, methyl ester	30558-43-1	U394
Acetonitrile	Same	75-05-8	U003
Acetophenone	Ethanone, 1-phenyl-	98-86-2	U004
2-Acetylaminofluorene	Acetamide, N-9H-fluorene-2-yl-	53-96-3	U005
Acetyl chloride	Same	75-36-5	U006
1-Acetyl-2-thiourea	Acetamide, N-(aminothioxomethyl)-	591-08-2	P002
Acrolein	2-Propenal	107-02-8	P003
Acrylamide	2-Propenamide	79-06-1	U007
Acrylonitrile	2-Propenenitrile	107-13-1	U009
Aflatoxins	Same	1402-68-2	
Aldicarb	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime	116-06-3	P070
Aldicarb sulfone	Propanal, 2-methyl-2- (methylsulfonyl) -, O-[(methylamino) carbonyl] oxime	1646-88-4	P203
Aldrin	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha, 8abeta)-	309-00-2	P004
Allyl alcohol	2-Propen-1-ol	107-18-6	P005
Allyl chloride	1-Propane, 3-chloro	107-05-1	
Aluminum phosphide	Same	20859-73-8	P006
4-Aminobiphenyl	[1,1'-Biphenyl]-4-amine	92-67-1	
5-(Aminomethyl)-3-isoxazolol	3(2H)-Isoxazolone, 5-(aminomethyl)-	2763-96-4	P007
4-Aminopyridine	4-Pyridinamine	504-24-5	P008
Amitrole	1H-1,2,4-Triazol-3-amine	61-82-5	U011
Ammonium vanadate	Vanadic acid, ammonium salt	7803-55-6	P119
Aniline	Benzenamine	62-53-3	U012
o-Anisidine (2-methoxyaniline)	Benzenamine, 2-Methoxy-	90-04-0	
Antimony	Same	7440-36-0	
Antimony compounds, N.O.S. ¹			
Aramite	Sulfurous acid, 2-chloroethyl 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester	140-57-8	
Arsenic	Same	7440-38-2	
Arsenic compounds, N.O.S. ¹			

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Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
Arsenic acid	Arsenic acid H_3AsO_4	7778-39-4	P010
Arsenic pentoxide	Arsenic oxide As_2O_5	1303-28-2	P011
Arsenic trioxide	Arsenic oxide As_2O_3	1327-53-3	P012
Auramine	Benzenamine, 4,4'-carbonimidoylbis[N,N-dimethyl	492-80-8	U014
Azaserine	L-Serine, diazoacetate (ester)	115-02-6	U015
Barban	Carbamic acid, (3-chlorophenyl) -, 4-chloro-2-butynyl ester	101-27-9	U280
Barium	Same	7440-39-3	
Barium compounds, N.O.S. ¹			
Barium cyanide	Same	542-62-1	P013
Bendiocarb	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate	22781-23-3	U278
Bendiocarb phenol	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,	22961-82-6	U364
Benomyl	Carbamic acid, [1- [(butylamino) carbonyl]- 1H-benzimidazol-2-yl] -, methyl ester	17804-35-2	U271
Benz[c]acridine	Same	225-51-4	U016
Benz[a]anthracene	Same	56-55-3	U018
Benzal chloride	Benzene, (dichloromethyl)-	98-87-3	U017
Benzene	Same	71-43-2	U019
Benzeneearsonic acid	Arsonic acid, phenyl-	98-05-5	
Benzidine	[1,1'-Biphenyl]-4,4'-diamine	92-87-5	U021
Benzo[b]fluoranthene	Benz[e]acephenanthrylene	205-99-2	
Benzo[j]fluoranthene	Same	205-82-3	
Benzo[k]fluoranthene	Same	207-08-9	
Benzo[a]pyrene	Same	50-32-8	U022
p-Benzoquinone	2,5-Cyclohexadiene-1,4-dione	106-51-4	U197
Benzo[trichloride	Benzene, (trichloromethyl)-	98-07-7	U023
Benzyl chloride	Benzene, (chloromethyl)-	100-44-7	P028
Beryllium powder	Same	7440-41-7	P015
Beryllium compounds, N.O.S. ¹			
Bis(pentamethylene)-thiuram tetrasulfide	Piperidine, 1,1'-(tetrathiodicarbonothioyl)-bis-	120-54-7	
Bromoacetone	2-Propanone, 1-bromo-	598-31-2	P017
Bromoform	Methane, tribromo-	75-25-2	U225
4-Bromophenyl phenyl ether	Benzene, 1-bromo-4-phenoxy-	101-55-3	U030
Brucine	Strychnidin-10-one, 2,3-dimethoxy-	357-57-3	P018
Butyl benzyl phthalate	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester	85-68-7	
Butylate	Carbamothioic acid, bis(2-methylpropyl)-, S-ethyl ester	2008-41-5	
Cacodylic acid	Arsinic acid, dimethyl-	75-60-5	U136
Cadmium	Same	7440-43-9	
Cadmium compounds, N.O.S. ¹			
Calcium chromate	Chromic acid H_2CrO_4 , calcium salt	13765-19-0	U032
Calcium cyanide	Calcium cyanide $Ca(CN)_2$	592-01-8	P021
Carbaryl	1-Naphthalenol, methylcarbamate	63-25-2	U279
Carbendazim	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester	10605-21-7	U372
Carbofuran	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate	1563-66-2	P127
Carbofuran phenol	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-	1563-38-8	U367
Carbon disulfide	Same	75-15-0	P022
Carbon oxyfluoride	Carbonic difluoride	353-50-4	U033
Carbon tetrachloride	Methane, tetrachloro-	56-23-5	U211
Carbosulfan	Carbamic acid, [(dibutylamino) thio] methyl-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester	55285-14-8	P189
Chloral	Acetaldehyde, trichloro-	75-87-6	U034
Chlorambucil	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-	305-03-3	U035
Chlordane	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-	57-74-9	U036
Chlordane (alpha and gamma isomers)			U036
Chlorinated benzenes, N.O.S. ¹			
Chlorinated ethane, N.O.S. ¹			
Chlorinated fluorocarbons, N.O.S. ¹			

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Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
Chlorinated naphthalene, N.O.S. ¹			
Chlorinated phenol, N.O.S. ¹			
Chlornaphazin	Naphthalenamine, N,N'-bis(2-chloroethyl)-	494-03-1	U026
Chloroacetaldehyde	Acetaldehyde, chloro-	107-20-0	P023
Chloroalkyl ethers, N.O.S. ¹			
p-Chloroaniline	Benzenamine, 4-chloro-	106-47-8	P024
Chlorobenzene	Benzene, chloro-	108-90-7	U037
Chlorobenzilate	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester	510-15-6	U038
p-Chloro-m-cresol	Phenol, 4-chloro-3-methyl-	59-50-7	U039
2-Chloroethyl vinyl ether	Ethene, (2-chloroethoxy)-	110-75-8	U042
Chloroform	Methane, trichloro-	67-66-3	U044
Chloromethyl methyl ether	Methane, chloromethoxy-	107-30-2	U046
beta-Chloronaphthalene	Naphthalene, 2-chloro-	91-58-7	U047
o-Chlorophenol	Phenol, 2-chloro-	95-57-8	U048
1-(o-Chlorophenyl)thiourea	Thiourea, (2-chlorophenyl)-	5344-82-1	P026
Chloroprene	1,3-Butadiene, 2-chloro-	126-99-8	
3-Chloropropionitrile	Propanenitrile, 3-chloro-	542-76-7	P027
Chromium	Same	7440-47-3	
Chromium compounds, N.O.S. ¹			
Chrysene	Same	218-01-9	U050
Citrus red No. 2	2-Naphthalenol, 1-[(2,5-dimethoxyphenyl)azo]-	6358-53-8	
Coal tar creosote	Same	8007-45-2	
Copper cyanide	Copper cyanide CuCN	544-92-3	P029
Copper dimethyldithiocarbamate	Copper, bis(dimethylcarbamoithioato-S,S')-,	137-29-1	
Creosote	Same		U051
p-Cresidine	2-Methoxy-5-methylbenzenamine	120-71-8	
Cresol (Cresylic acid)	Phenol, methyl-	1319-77-3	U052
Crotonaldehyde	2-Butenal	4170-30-3	U053
m-Cumenyl methylcarbamate	Phenol, 3-(methylethyl)-, methyl carbamate	64-00-6	P202
Cyanides (soluble salts and complexes) N.O.S. ¹			P030
Cyanogen	Ethanedinitrile	460-19-5	P031
Cyanogen bromide	Cyanogen bromide (CN)Br	506-68-3	U246
Cyanogen chloride	Cyanogen chloride (CN)Cl	506-77-4	P033
Cycasin	beta-D-Glucopyranoside, (methyl-ONN-azoxy)methyl	14901-08-7	
Cycloate	Carbamothioic acid, cyclohexylethyl-, S-ethyl ester	1134-23-2	
2-Cyclohexyl-4,6-dinitrophenol	Phenol, 2-cyclohexyl-4,6-dinitro-	131-89-5	P034
Cyclophosphamide	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide	50-18-0	U058
2,4-D	Acetic acid, (2,4-dichlorophenoxy)-	94-75-7	U240
2,4-D, salts, esters			U240
Daunomycin	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-	20830-81-3	U059
Dazomet	2H-1,3,5-thiadiazine-2-thione, tetrahydro-3,5-dimethyl	533-74-4	
DDD	Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro-	72-54-8	U060
DDE	Benzene, 1,1'-(dichloroethenylidene)bis[4-chloro-	72-55-9	
DDT	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-	50-29-3	U061
Diallate	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester	2303-16-4	U062
Dibenz[a,h]acridine	Same	226-36-8	
Dibenz[a,j]acridine	Same	224-42-0	
Dibenz[a,h]anthracene	Same	53-70-3	U063
7H-Dibenzo[c,g]carbazole	Same	194-59-2	
Dibenzo[a,e]pyrene	Naphtho[1,2,3,4-def]chrysene	192-65-4	
Dibenzo[a,h]pyrene	Dibenzo[b,def]chrysene	189-64-0	
Dibenzo[a,i]pyrene	Benzo[rs]pentaphene	189-55-9	U064

Regulations

Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
1,2-Dibromo-3-chloropropane	Propane, 1,2-dibromo-3-chloro-	96-12-8	U066
Dibutyl phthalate	1,2-Benzenedicarboxylic acid, dibutyl ester	84-74-2	U069
o-Dichlorobenzene	Benzene, 1,2-dichloro-	95-50-1	U070
m-Dichlorobenzene	Benzene, 1,3-dichloro-	541-73-1	U071
p-Dichlorobenzene	Benzene, 1,4-dichloro-	106-46-7	U072
Dichlorobenzene, N.O.S. ¹	Benzene, dichloro-	25321-22-6	
3,3'-Dichlorobenzidine	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-	91-94-1	U073
1,4-Dichloro-2-butene	2-Butene, 1,4-dichloro-	764-41-0	U074
Dichlorodifluoromethane	Methane, dichlorodifluoro-	75-71-8	U075
Dichloroethylene, N.O.S. ¹	Dichloroethylene	25323-30-2	
1,1-Dichloroethylene	Ethene, 1,1-dichloro-	75-35-4	U078
1,2-Dichloroethylene	Ethene, 1,2-dichloro-, (E)-	156-60-5	U079
Dichloroethyl ether	Ethane, 1,1'-oxybis[2-chloro-	111-44-4	U025
Dichloroisopropyl ether	Propane, 2,2'-oxybis[2-chloro-	108-60-1	U027
Dichloromethoxy ethane	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-	111-91-1	U024
Dichloromethyl ether	Methane, oxybis[chloro-	542-88-1	P016
2,4-Dichlorophenol	Phenol, 2,4-dichloro-	120-83-2	U081
2,6-Dichlorophenol	Phenol, 2,6-dichloro-	87-65-0	U082
Dichlorophenylarsine	Arsonous dichloride, phenyl-	696-28-6	P036
Dichloropropane, N.O.S. ¹	Propane, dichloro-	26638-19-7	
Dichloropropanol, N.O.S. ¹	Propanol, dichloro-	26545-73-3	
Dichloropropene, N.O.S. ¹	1-Propene, dichloro-	26952-23-8	
1,3-Dichloropropene	1-Propene, 1,3-dichloro-	542-75-6	U084
Dieldrin	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta,7aalpha)-	60-57-1	P037
1,2:3,4-Diepoxybutane	2,2'-Bioxirane	1464-53-5	U085
Diethylarsine	Arsine, diethyl-	692-42-2	P038
Diethylene glycol, dicarbamate	Ethanol, 2,2'-oxybis-, dicarbamate	5952-26-1	U395
1,4-Diethyleneoxide	1,4-Dioxane	123-91-1	U108
Diethylhexyl phthalate	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester	117-81-7	U028
N,N'-Diethylhydrazine	Hydrazine, 1,2-diethyl-	1615-80-1	U086
O,O-Diethyl S-methyl dithiophosphate	Phosphorodithioic acid, O,O-diethyl S-methyl ester	3288-58-2	U087
Diethyl-p-nitrophenyl phosphate	Phosphoric acid, diethyl 4-nitrophenyl ester	311-45-5	P041
Diethyl phthalate	1,2-Benzenedicarboxylic acid, diethyl ester	84-66-2	U088
O,O-DiethylO-pyrazinylphosphoro-thioate	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester	297-97-2	P040
Diethylstilbesterol	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-	56-53-1	U089
Dihydrosafrole	1,3-Benzodioxole, 5-propyl-	94-58-6	U090
Diisopropylfluorophosphate (DFP)	Phosphorofluoridic acid, bis(1-methylethyl) ester	55-91-4	P043
Dimethoate	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester	60-51-5	P044
3,3'-Dimethoxybenzidine	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-	119-90-4	U091
p-Dimethylaminoazobenzene	Benzenamine, N,N-dimethyl-4-(phenylazo)-	60-11-7	U093
2,4-Dimethylaniline (2,4-xylydine)	Benzenamine, 2,4-dimethyl-	95-68-1	
7,12-Dimethylbenz[a]anthracene	Benz[a]anthracene, 7,12-dimethyl-	57-97-6	U094
3,3'-Dimethylbenzidine	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-	119-93-7	U095
Dimethylcarbamoyl chloride	Carbamic chloride, dimethyl-	79-44-7	U097
1,1-Dimethylhydrazine	Hydrazine, 1,1-dimethyl-	57-14-7	U098
1,2-Dimethylhydrazine	Hydrazine, 1,2-dimethyl-	540-73-8	U099
alpha,alpha-Dimethylphenethylamine	Benzeneethanamine, alpha,alpha-dimethyl-	122-09-8	P046
2,4-Dimethylphenol	Phenol, 2,4-dimethyl-	105-67-9	U101
Dimethyl phthalate	1,2-Benzenedicarboxylic acid, dimethyl ester	131-11-3	U102
Dimethyl sulfate	Sulfuric acid, dimethyl ester	77-78-1	U103
Dimetilan	Carbamic acid, dimethyl-, 1-[(dimethylamino) carbonyl]-5-methyl-1H-pyrazol-3-yl ester	644-64-4	P191
Dinitrobenzene, N.O.S. ¹	Benzene, dinitro-	25154-54-5	
4,6-Dinitro-o-cresol	Phenol, 2-methyl-4,6-dinitro-	534-52-1	P047

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Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
4,6-Dinitro-o-cresol salts			P047
2,4-Dinitrophenol	Phenol, 2,4-dinitro-	51-28-5	P048
2,4-Dinitrotoluene	Benzene, 1-methyl-2,4-dinitro-	121-14-2	U105
2,6-Dinitrotoluene	Benzene, 2-methyl-1,3-dinitro-	606-20-2	U106
Dinoseb	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	88-85-7	P020
Di-n-octyl phthalate	1,2-Benzenedicarboxylic acid, dioctyl ester	117-84-0	U017
Diphenylamine	Benzenamine, N-phenyl-	122-39-4	
1,2-Diphenylhydrazine	Hydrazine, 1,2-diphenyl-	122-66-7	U109
Di-n-propylnitrosamine	1-Propanamine, N-nitroso-N-propyl-	621-64-7	U111
Disulfiram	Thioperoxydicarbonic diamide, tetraethyl	97-77-8	
Disulfoton	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester	298-04-4	P039
Dithiobiuret	Thioimidodicarbonic diamide [(H ₂ N)C(S)] ₂ NH	541-53-7	P049
Endosulfan	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a- hexahydro-, 3-oxide	115-29-7	P050
Endothall	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	145-73-3	P088
Endrin	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octa-hydro-, (1aalpha,2beta,2abeta,3alpha,6alpha, 6abeta,7beta,7aalpha)-	72-20-8	P051
Endrin metabolites			P051
Epichlorohydrin	Oxirane, (chloromethyl)-	106-89-8	U041
Epinephrine	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-	51-43-4	P042
EPTC	Carbamothioic acid, dipropyl-, S-ethyl ester	759-94-4	
Ethyl carbamate (urethane)	Carbamic acid, ethyl ester	51-79-6	U238
Ethyl cyanide	Propanenitrile	107-12-0	P101
Ethyl Ziram	Zinc, bis(diethylcarbamodithioato-S,S')-	14324-55-1	
Ethylenebisdithiocarbamic acid	Carbamodithioic acid, 1,2-ethanediybis-	111-54-6	U114
Ethylenebisdithiocarbamic acid, salts and esters			U114
Ethylene dibromide	Ethane, 1,2-dibromo-	106-93-4	U067
Ethylene dichloride	Ethane, 1,2-dichloro-	107-06-2	U077
Ethylene glycol monoethyl ether	Ethanol, 2-ethoxy-	110-80-5	U359
Ethyleneimine	Aziridine	151-56-4	P054
Ethylene oxide	Oxirane	75-21-8	U115
Ethylenethiourea	2-Imidazolidinethione	96-45-7	U116
Ethylidene dichloride	Ethane, 1,1-dichloro-	75-34-3	U076
Ethyl methacrylate	2-Propenoic acid, 2-methyl-, ethyl ester	97-63-2	U118
Ethyl methanesulfonate	Methanesulfonic acid, ethyl ester	62-50-0	U119
Famphur	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester	52-85-7	P097
Ferbam	Iron, tris(dimethylcarbamodithioato-S,S')-,	14484-64-1	
Fluoranthene	Same	206-44-0	U120
Fluorine	Same	7782-41-4	P056
Fluoroacetamide	Acetamide, 2-fluoro-	640-19-7	P057
Fluoroacetic acid, sodium salt	Acetic acid, fluoro-, sodium salt	62-74-8	P058
Formaldehyde	Same	50-00-0	U122
Formetanate hydrochloride	Methanimidamide, N,N-dimethyl-N'-[3-[(methylamino) carbonyl]oxy]phenyl]-, monohydrochloride	23422-53-9	P198
Formic acid	Same	64-18-6	U123
Formparanate	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4-[(methylamino) carbonyl]oxy]phenyl]-	17702-57-7	P197
Glycidylaldehyde	Oxiranecarboxyaldehyde	765-34-4	U126
Halomethanes, N.O.S. ¹			
Heptachlor	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-	76-44-8	P059
Heptachlor epoxide	2,5-Methano-2H-indeno[1,2-b]oxirene, 2,3,4,5,6,7,7-heptachloro-1a,1b,5,5a,6,6a-hexa- hydro-, (1aalpha,1bbeta,2alpha,5alpha, 5abeta,6beta,6aalpha)-	1024-57-3	
Heptachlor epoxide (alpha, beta, and gamma isomers)			

Regulations

Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
Heptachlorodibenzofurans			
Heptachlorodibenzo-p-dioxins			
Hexachlorobenzene	Benzene, hexachloro-	118-74-1	U127
Hexachlorobutadiene	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	87-68-3	U128
Hexachlorocyclopentadiene	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	77-47-4	U130
Hexachlorodibenzo-p-dioxins			
Hexachlorodibenzofurans			
Hexachloroethane	Ethane, hexachloro-	67-72-1	U131
Hexachlorophene	Phenol, 2,2'-methylenebis[3,4,6-trichloro-	70-30-4	U132
Hexachloropropene	1-Propene, 1,1,2,3,3,3-hexachloro-	1888-71-7	U243
Hexaethyl tetraphosphate	Tetraphosphoric acid, hexaethyl ester	757-58-4	P062
Hydrazine	Same	302-01-2	U133
Hydrogen cyanide	Hydrocyanic acid	74-90-8	P063
Hydrogen fluoride	Hydrofluoric acid	7664-39-3	U134
Hydrogen sulfide	Hydrogen sulfide H ₂ S	7783-06-4	U135
Indeno[1,2,3-cd]pyrene	Same	193-39-5	U137
3-Iodo-2-propynyl n-butylcarbamate	Carbamic acid, butyl-, 3-iodo-2-propynyl ester	55406-53-6	
Isobutyl alcohol	1-Propanol, 2-methyl-	78-83-1	U140
Isodrin	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-	465-73-6	P060
Isolan	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H-pyrazol-5-yl ester	119-38-0	P192
Isosafrole	1,3-Benzodioxole, 5-(1-propenyl)-	120-58-1	U141
Kepone	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5a,5b,6-decachlorooctahydro-	143-50-0	U142
Lasiocarpine	2-Butenoic acid, 2-methyl-, 7-[[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*),7aalpha]]-	303-34-4	U143
Lead	Same	7439-92-1	
Lead compounds, N.O.S. ¹			
Lead acetate	Acetic acid, lead(2+) salt	301-04-2	U144
Lead phosphate	Phosphoric acid, lead(2+) salt (2:3)	7446-27-7	U145
Lead subacetate	Lead, bis(acetato-O)tetrahydroxytri-	1335-32-6	U146
Lindane	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-	58-89-9	U129
Maleic anhydride	2,5-Furandione	108-31-6	U147
Maleic hydrazide	3,6-Pyridazinedione, 1,2-dihydro-	123-33-1	U148
Malononitrile	Propanedinitrile	109-77-3	U149
Manganese dimethyldithiocarbamate	Manganese, bis(dimethylcarbamodithioato-S,S')-,	15339-36-3	P196
Melphalan	L-Phenylalanine, 4-[bis(2-chloroethyl)aminol]-	148-82-3	U150
Mercury	Same	7439-97-6	U151
Mercury compounds, N.O.S. ¹			
Mercury fulminate	Fulminic acid, mercury(2+) salt	628-86-4	P065
Metam Sodium	Carbamodithioic acid, methyl-, monosodium salt	137-42-8	
Methacrylonitrile	2-Propenenitrile, 2-methyl-	126-98-7	U152
Methapyrilene	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-	91-80-5	U155
Methiocarb	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate	2032-65-7	P199
Methomyl	Ethanimidothioic acid, N-[[[(methylamino)carbonyl]oxy]-, methyl ester	16752-77-5	P066
Methoxychlor	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy-	72-43-5	U247
Methyl bromide	Methane, bromo-	74-83-9	U029
Methyl chloride	Methane, chloro-	74-87-3	U045
Methyl chlorocarbonate	Carbonochloridic acid, methyl ester	79-22-1	U156
Methyl chloroform	Ethane, 1,1,1-trichloro-	71-55-6	U226
3-Methylcholanthrene	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-	56-49-5	U157
4,4'-Methylenebis(2-chloroaniline)	Benzenamine, 4,4'-methylenebis[2-chloro-	101-14-4	U158

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Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
Methylene bromide	Methane, dibromo-	74-95-3	U068
Methylene chloride	Methane, dichloro-	75-09-2	U080
Methyl ethyl ketone (MEK)	2-Butanone	78-93-3	U159
Methyl ethyl ketone peroxide	2-Butanone, peroxide	1338-23-4	U160
Methyl hydrazine	Hydrazine, methyl-	60-34-4	P068
Methyl iodide	Methane, iodo-	74-88-4	U138
Methyl isocyanate	Methane, isocyanato-	624-83-9	P064
2-Methylacetonitrile	Propanenitrile, 2-hydroxy-2-methyl-	75-86-5	P069
Methyl methacrylate	2-Propenoic acid, 2-methyl-, methyl ester	80-62-6	U162
Methyl methanesulfonate	Methanesulfonic acid, methyl ester	66-27-3	
Methyl parathion	Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester	298-00-0	P071
Methylthiouracil	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-	56-04-2	U164
Metolcarb	Carbamic acid, methyl-, 3-methylphenyl ester	1129-41-5	P190
Mexacarbate	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)	315-18-4	P128
Mitomycin C	Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione, 6-amino-8-[[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha,8beta,8aalp,8balp)]-]	50-07-7	U010
MNNG	Guanidine, N-methyl-N'-nitro-N-nitroso-	70-25-7	U163
Molinate	1H-Azepine-1-carbothioic acid, hexahydro-, S-ethyl ester	2212-67-1	
Mustard gas	Ethane, 1,1'-thiobis[2-chloro-	505-60-2	
Naphthalene	Same	91-20-3	U165
1,4-Naphthoquinone	1,4-Naphthalenedione	130-15-4	U166
alpha-Naphthylamine	1-Naphthalenamine	134-32-7	U167
beta-Naphthylamine	2-Naphthalenamine	91-59-8	U168
alpha-Naphthylthiourea	Thiourea, 1-naphthalenyl-	86-88-4	P072
Nickel	Same	7440-02-0	
Nickel compounds, N.O.S. ¹			
Nickel carbonyl	Nickel carbonyl Ni(CO) ₄ , (T-4)-	13463-39-3	P073
Nickel cyanide	Nickel cyanide Ni(CN) ₂	557-19-7	P074
Nicotine	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-	54-11-5	P075
Nicotine salts			P075
Nitric oxide	Nitrogen oxide NO	10102-43-9	P076
p-Nitroaniline	Benzenamine, 4-nitro-	100-01-6	P077
Nitrobenzene	Benzene, nitro-	98-95-3	U169
Nitrogen dioxide	Nitrogen oxide NO ₂	10102-44-0	P078
Nitrogen mustard	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl-	51-75-2	
Nitrogen mustard, hydrochloride salt			
Nitrogen mustard N-oxide	Ethanamine, 2-chloro-N-(2-chloroethyl)-N-methyl-, N-oxide	126-85-2	
Nitrogen mustard, N-oxide, hydro- chloride salt			
Nitroglycerin	1,2,3-Propanetriol, trinitrate	55-63-0	P081
p-Nitrophenol	Phenol, 4-nitro-	100-02-7	U170
2-Nitropropane	Propane, 2-nitro-	79-46-9	U171
Nitrosamines, N.O.S. ¹		35576-91-1	
N-Nitrosodi-n-butylamine	1-Butanamine, N-butyl-N-nitroso-	924-16-3	U172
N-Nitrosodiethanolamine	Ethanol, 2,2'-(nitrosoimino)bis-	1116-54-7	U173
N-Nitrosodiethylamine	Ethanamine, N-ethyl-N-nitroso-	55-18-5	U174
N-Nitrosodimethylamine	Methanamine, N-methyl-N-nitroso-	62-75-9	P082
N-Nitroso-N-ethylurea	Urea, N-ethyl-N-nitroso-	759-73-9	U176
N-Nitrosomethylethylamine	Ethanamine, N-methyl-N-nitroso-	10595-95-6	
N-Nitroso-N-methylurea	Urea, N-methyl-N-nitroso-	684-93-5	U177
N-Nitroso-N-methylurethane	Carbamic acid, methylnitroso-, ethyl ester	615-53-2	U178
N-Nitrosomethylvinylamine	Vinylamine, N-methyl-N-nitroso-	4549-40-0	P084
N-Nitrosomorpholine	Morpholine, 4-nitroso-	59-89-2	
N-Nitrosornicotine	Pyridine, 3-(1-nitroso-2-pyrrolidinyl)-, (S)-	16543-55-8	
N-Nitrosopiperidine	Piperidine, 1-nitroso-	100-75-4	U179
N-Nitrosopyrrolidine	Pyrrolidine, 1-nitroso-	930-55-2	U180

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Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
N-Nitrososarcosine	Glycine, N-methyl-N-nitroso-	13256-22-9	
5-Nitro-o-toluidine	Benzenamine, 2-methyl-5-nitro-	99-55-8	U181
Octachlorodibenzo-p-dioxin (OCDD)	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	3268-87-9	
Octachlorodibenzofuran (OCDF)	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	39001-02-0	
Octamethylpyrophosphoramidate	Diphosphoramidate, octamethyl-	152-16-9	P085
Osmium tetroxide	Osmium oxide OsO ₄ , (T-4)-	20816-12-0	P087
Oxamyl	Ethanimidothioc acid, 2-(dimethylamino)-N-[[[(methylamino)carbonyl]oxy]-2-oxo-, methyl ester	23135-22-0	P194
Paraldehyde	1,3,5-Trioxane, 2,4,6-trimethyl-	123-63-7	U182
Parathion	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester	56-38-2	P089
Pebulate	Carbamothioic acid, butylethyl-, S-propyl ester	1114-71-2	
Pentachlorobenzene	Benzene, pentachloro-	608-93-5	U183
Pentachlorodibenzo-p-dioxins			
Pentachlorodibenzofurans			
Pentachloroethane	Ethane, pentachloro-	76-01-7	U184
Pentachloronitrobenzene (PCNB)	Benzene, pentachloronitro-	82-68-8	U185
Pentachlorophenol	Phenol, pentachloro-	87-86-5	See F027
Phenacetin	Acetamide, N-(4-ethoxyphenyl)-	62-44-2	U187
Phenol	Same	108-95-2	U188
1,2-Phenylenediamine	1,2-Benzenediamine	95-54-5	
1,3-Phenylenediamine	1,3-Benzenediamine	108-45-2	
Phenylenediamine	Benzenediamine	25265-76-3	
Phenylmercury acetate	Mercury, (acetato-O)phenyl-	62-38-4	P092
Phenylthiourea	Thiourea, phenyl-	103-85-5	P093
Phosgene	Carbonic dichloride	75-44-5	P095
Phosphine	Same	7803-51-2	P096
Phorate	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester	298-02-2	P094
Phthalic acid esters, N.O.S. ¹			
Phthalic anhydride	1,3-Isobenzofurandione	85-44-9	U190
Physostigmine	Pyrrolo[2,3-b]indol-5-01, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-	57-47-6	P204
Physostigmine salicylate	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo [2,3-b]indol-5-yl methylcarbamate ester (1:1)	57-64-7	P188
2-Picoline	Pyridine, 2-methyl-	109-06-8	U191
Polychlorinated biphenyls, N.O.S. ¹			
Potassium cyanide	Potassium cyanide K(CN)	151-50-8	P098
Potassium dimethyldithiocarbamate	Carbamodithioic acid, dimethyl, potassium salt	128-03-0	
Potassium n-hydroxymethyl-n-methyl-dithiocarbamate	Carbamodithioic acid, (hydroxymethyl)methyl-, monopotassium salt	51026-28-9	
Potassium n-methyldithiocarbamate	Carbamodithioic acid, methyl-monopotassium salt	137-41-7	
Potassium pentachlorophenate	Pentachlorophenol, potassium salt	7778736	None
Potassium silver cyanide	Argentate(1-), bis(cyano-C)-, potassium	506-61-6	P099
Promecarb	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate	2631-37-0	P201
Pronamide	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-	23950-58-5	U192
1,3-Propane sultone	1,2-Oxathiolane, 2,2-dioxide	1120-71-4	U193
n-Propylamine	1-Propanamine	107-10-8	U194
Propargyl alcohol	2-Propyn-1-ol	107-19-7	P102
Propham	Carbamic acid, phenyl-, 1-methylethyl ester	122-42-9	U373
Propoxur	Phenol, 2-(1-methylethoxy)-, methylcarbamate	114-26-1	U411
Propylene dichloride	Propane, 1,2-dichloro-	78-87-5	U083
1,2-Propylenimine	Aziridine, 2-methyl-	75-55-8	P067
Propylthiouracil	4(1H)-Pyrimidinone, 2,3-dihydro-6-propyl-2-thioxo-	51-52-5	
Prosulfocarb	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester	52888-80-9	U387
Pyridine	Same	110-86-1	U196

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Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
Reserpine	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-smethyl ester, (3beta,16beta,17alpha,18beta,20alpha)-	50-55-5	U200
Resorcinol	1,3-Benzenediol	108-46-3	U201
Safrole	1,3-Benzodioxole, 5-(2-propenyl)-	94-59-7	U203
Selenium	Same	7782-49-2	
Selenium compounds, N.O.S. ¹			
Selenium dioxide	Selenious acid	7783-00-8	U204
Selenium sulfide	Selenium sulfide SeS ₂	7488-56-4	U205
Selenium, tetrakis(dimethyl-dithiocarbamate)	Carbamodithioic acid, dimethyl-, tetraanhydrosulfide with ortho-thioselenious acid	144-34-3	
Selenourea	Same	630-10-4	P103
Silver	Same	7440-22-4	
Silver compounds, N.O.S. ¹			
Silver cyanide	Silver cyanide Ag(CN)	506-64-9	P104
Silvex (2,4,5-TP)	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-	93-72-1	See F027
Sodium cyanide	Sodium cyanide Na(CN)	143-33-9	P106
Sodium dibutylthiocarbamate	Carbamodithioic acid, dibutyl, sodium salt	136-30-1	
Sodium diethylthiocarbamate	Carbamodithioic acid, diethyl-, sodium salt	148-18-5	
Sodium dimethylthiocarbamate	Carbamodithioic acid, dimethyl-, sodium salt	128-04-1	
Sodium pentachlorophenate	Pentachlorophenol, sodium salt	131522	None
Streptozotocin	D-Glucose, 2-deoxy-2-[[[(methylnitrosoamino)carbonyl]amino]-	18883-66-4	U206
Strychnine	Strychnidin-10-one	57-24-9	P108
Strychnine salts			P108
Sulfallate	Carbamodithioic acid, diethyl-, 2-chloro-2-propenyl ester	95-06-7	
TCDD	Dibenzo[b,e][1,4]dioxin, 2,3,7,8-tetrachloro-	1746-01-6	
Tetrabutylthiuram disulfide	Thioperoxydicarbonic diamide, tetrabutyl	1634-02-2	
1,2,4,5-Tetrachlorobenzene	Benzene, 1,2,4,5-tetrachloro-	95-94-3	U207
Tetrachlorodibenzo-p-dioxins			
Tetrachlorodibenzofurans			
Tetrachloroethane, N.O.S. ¹	Ethane, tetrachloro-, N.O.S.	25322-20-7	
1,1,1,2-Tetrachloroethane	Ethane, 1,1,1,2-tetrachloro-	630-20-6	U208
1,1,2,2-Tetrachloroethane	Ethane, 1,1,2,2-tetrachloro-	79-34-5	U209
Tetrachloroethylene	Ethene, tetrachloro-	127-18-4	U210
2,3,4,6-Tetrachlorophenol	Phenol, 2,3,4,6-tetrachloro-	58-90-2	See F027
2,3,4,6-tetrachlorophenol, potassium salt	same	53535276	None
2,3,4,6-tetrachlorophenol, sodium salt	same	25567559	None
Tetraethyldithiopyrophosphate	Thiodiphosphoric acid, tetraethyl ester	3689-24-5	P109
Tetraethyl lead	Plumbane, tetraethyl-	78-00-2	P110
Tetraethyl pyrophosphate	Diphosphoric acid, tetraethyl ester	107-49-3	P111
Tetramethylthiuram monosulfide	Bis(dimethylthiocarbamoyl) sulfide	97-74-5	
Tetranitromethane	Methane, tetranitro-	509-14-8	P112
Thallium	Same	7440-28-0	
Thallium compounds, N.O.S. ¹			
Thallic oxide	Thallium oxide Tl ₂ O ₃	1314-32-5	P113
Thallium(I) acetate	Acetic acid, thallium(1+) salt	563-68-8	U214
Thallium(I) carbonate	Carbonic acid, dithallium(1+) salt	6533-73-9	U215
Thallium(I) chloride	Thallium chloride TlCl	7791-12-0	U216
Thallium(I) nitrate	Nitric acid, thallium(1+) salt	10102-45-1	U217
Thallium selenite	Selenious acid, dithallium(1+) salt	12039-52-0	P114
Thallium(I) sulfate	Sulfuric acid, dithallium(1+) salt	7446-18-6	P115
Thioacetamide	Ethanethioamide	62-55-5	U218
Thiodicarb	Ethanimidithioic acid, N,N'-[thiobis [(methylimino) carbonyloxy]] bis-, dimethyl ester	59669-26-0	U410
Thiofanox	2-Butanone, 3,3-dimethyl-1-(methylthio)-, 0-[(methylamino)carbonyl] oxime	39196-18-4	P045

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Common name	Chemical abstracts name	Chemical abstracts No.	Hazardous waste No.
Thiomethanol	Methanethiol	74-93-1	U153
Thiophanate-methyl	Carbamic acid, [1,2-phenylenebis (iminocarbonothioyl)] bis-, dimethyl ester	23564-05-8	U409
Thiophenol	Benzenethiol	108-98-5	P014
Thiosemicarbazide	Hydrazinecarbothioamide	79-19-6	P116
Thiourea	Same	62-56-6	U219
Thiram	Thioperoxydicarbonic diamide [(H ₂ N)C(S)] ₂ S ₂ , tetramethyl-	137-26-8	U244
Tirpate	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino) carbonyl] oxime	26419-73-8	P185
Toluene	Benzene, methyl-	108-88-3	U220
Toluenediamine	Benzenediamine, ar-methyl-	25376-45-8	U221
Toluene-2,4-diamine	1,3-Benzenediamine, 4-methyl-	95-80-7	
Toluene-2,6-diamine	1,3-Benzenediamine, 2-methyl-	823-40-5	
Toluene-3,4-diamine	1,2-Benzenediamine, 4-methyl-	496-72-0	
Toluene diisocyanate	Benzene, 1,3-diisocyanatomethyl-	26471-62-5	U223
o-Toluidine	Benzenamine, 2-methyl-	95-53-4	U328
o-Toluidine hydrochloride	Benzenamine, 2-methyl-, hydrochloride	636-21-5	U222
p-Toluidine	Benzenamine, 4-methyl-	106-49-0	U353
Toxaphene	Same	8001-35-2	P123
Triallate	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl) ester	2303-17-5	U389
1,2,4-Trichlorobenzene	Benzene, 1,2,4-trichloro-	120-82-1	
1,1,2-Trichloroethane	Ethane, 1,1,2-trichloro-	79-00-5	U227
Trichloroethylene	Ethene, trichloro-	79-01-6	U228
Trichloromethanethiol	Methanethiol, trichloro-	75-70-7	P118
Trichloromonofluoromethane	Methane, trichlorofluoro-	75-69-4	U121
2,4,5-Trichlorophenol	Phenol, 2,4,5-trichloro-	95-95-4	See F027
2,4,6-Trichlorophenol	Phenol, 2,4,6-trichloro-	88-06-2	See F027
2,4,5-T	Acetic acid, (2,4,5-trichlorophenoxy)-	93-76-5	See F027
Trichloropropane, N.O.S. ¹		25735-29-9	
1,2,3-Trichloropropane	Propane, 1,2,3-trichloro-	96-18-4	
Triethylamine	Ethanamine, N,N-diethyl-	121-44-8	U404
O,O,O-Triethyl phosphorothioate	Phosphorothioic acid, O,O,O-triethyl ester	126-68-1	
1,3,5-Trinitrobenzene	Benzene, 1,3,5-trinitro-	99-35-4	U234
Tris(1-aziridinyl)phosphine sulfide	Aziridine, 1,1',1''-phosphinothioylidynetris-	52-24-4	
Tris(2,3-dibromopropyl) phosphate	1-Propanol, 2,3-dibromo-, phosphate (3:1)	126-72-7	U235
Trypan blue	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)]- bis[5-amino-4-hydroxy-, tetrasodium salt.	72-57-1	U236
Uracil mustard	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-	66-75-1	U237
Vanadium pentoxide	Vanadium oxide V ₂ O ₅	1314-62-1	P120
Vernolate	Carbamothioic acid, dipropyl-,S-propyl ester	1929-77-7	
Vinyl chloride	Ethene, chloro-	75-01-4	U043
Warfarin	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, when present at concentrations less than 0.3%	81-81-2	U248
Warfarin	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, when present at concentrations greater than 0.3%	81-81-2	P001
Warfarin salts, when present at concentrations less than 0.3%			U248
Warfarin salts, when present at concentrations greater than 0.3%			P001
Zinc cyanide	Zinc cyanide Zn(CN) ₂	557-21-1	P121
Zinc phosphide	Zinc phosphide Zn ₃ P ₂ , when present at concentrations greater than 10%	1314-84-7	P122
Zinc phosphide	Zinc phosphide Zn ₃ P ₂ , when present at concentrations of 10% or less	1314-84-7	U249
Ziram	Zinc, bis(dimethylcarbamodithioato-S,S')-, (T-4)-	137-30-4	P205

¹The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this appendix.

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Part 262—Standards applicable to generators of hazardous waste

Subpart A—General

- Sec. 262.10 Purpose, scope, and applicability.
 262.11 Hazardous waste determination.
 262.12 EPA identification numbers.

Subpart B—The Manifest

- 262.20 General requirements.
 262.21 Manifest tracking numbers, manifest printing, and obtaining manifests.
 262.22 Number of copies.
 262.23 Use of the manifest.
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Subpart C—Pre-Transport Requirements

- 262.30 Packaging.
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Subpart D—Recordkeeping and Reporting

- 262.40 Recordkeeping.
 262.41 Biennial report.
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 262.43 Additional reporting.
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Subpart E—Exports of Hazardous Waste

- 262.50 Applicability.
 262.51 Definitions.
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 262.53 Notification of intent to export.
 262.54 Special manifest requirements.
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Subpart F—Imports of Hazardous Waste

- 262.60 Imports of hazardous waste.

Subpart G—Farmers

- 262.70 Farmers.

Subpart H—Transfrontier Shipments of Hazardous Waste for Recovery within the OECD

- 262.80 Applicability.
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 262.84 Movement document.
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 262.88 Pre-approval for U.S. Recovery Facilities. [Reserved]
 262.89 OECD Waste Lists.

Subpart I—New York State Public Utilities

- 262.90 Project XL for Public Utilities in New York State.

Subpart J—University Laboratories XL Project—Laboratory Environmental Management Standard 262.100 To what organizations does this subpart apply?

- 262.101 What is in this subpart?
 262.102 What special definitions are included in this subpart?

- 262.103 What is the scope of the laboratory environmental management standard?
 262.104 What are the minimum performance criteria?
 262.105 What must be included in the laboratory environmental management plan?
 262.106 When must a hazardous waste determination be made?
 262.107 Under what circumstances will a university's participation in this environmental management standard pilot be terminated?
 262.108 When will this subpart expire?
 Appendix to Part 262—Uniform Hazardous Waste Manifest and Instructions (EPA Forms 8700–22 and 8700–22A and Their Instructions)

Part 263—Standards applicable to transporters of hazardous waste

Subpart A—General

- Sec. 263.10 Scope.
 263.11 EPA identification number.
 263.12 Transfer facility requirements.

Subpart B—Compliance With the Manifest System and Recordkeeping

- 263.20 The manifest system.
 263.21 Compliance with the manifest.
 263.22 Recordkeeping.

Subpart C—Hazardous Waste Discharges

- 263.30 Immediate action.
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Part 264—Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities

Subpart A—General

- 264.1 Purpose, scope and applicability.
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 264.3 Relationship to interim status standards.
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Subpart B—General Facility Standards

- 264.11 Identification number.
 264.12 Required notices.
 264.13 General waste analysis.
 264.14 Security.
 264.15 General inspection requirements.
 264.16 Personnel training.
 264.17 General requirements for ignitable, reactive, or incompatible wastes.
 264.18 Location standards.
 264.19 Construction quality assurance program.

Subpart C—Preparedness and Prevention

- 264.30 Applicability.
 264.31 Design and operation of facility.
 264.32 Required equipment.
 264.33 Testing and maintenance of equipment.
 264.34 Access to communications or alarm system.
 264.35 Required aisle space.
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- 264.51 Purpose and implementation of contingency plan.
- 264.52 Content of contingency plan.
- 264.53 Copies of contingency plan.
- 264.54 Amendment of contingency plan.
- 264.55 Emergency coordinator.
- 264.56 Emergency procedures.

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- 264.72 Manifest discrepancies.
- 264.73 Operating record.
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- 264.75 Biennial report.
- 264.76 Unmanifested waste report.
- 264.77 Additional reports.

Subpart F—Releases From Solid Waste Management Units

- 264.90 Applicability.
- 264.91 Required programs.
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- 264.93 Hazardous constituents.
- 264.94 Concentration limits.
- 264.95 Point of compliance.
- 264.96 Compliance period.
- 264.97 General ground-water monitoring requirements.
- 264.98 Detection monitoring program.
- 264.99 Compliance monitoring program.
- 264.100 Corrective action program.
- 264.101 Corrective action for solid waste management units.

Subpart G—Closure and Post-Closure

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- 264.112 Closure plan; amendment of plan.
- 264.113 Closure; time allowed for closure.
- 264.114 Disposal or decontamination of equipment, structures and soils.
- 264.115 Certification of closure.
- 264.116 Survey plat.
- 264.117 Post-closure care and use of property.
- 264.118 Post-closure plan; amendment of plan.
- 264.119 Post-closure notices.
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Subpart H—Financial Requirements

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- 264.143 Financial assurance for closure.
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- 264.145 Financial assurance for post-closure care.
- 264.146 Use of a mechanism for financial assurance of both closure and post-closure care.
- 264.147 Liability requirements.
- 264.148 Incapacity of owners or operators, guarantors, or financial institutions.
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- 264.151 Wording of the instruments.

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- 264.170 Applicability.
- 264.171 Condition of containers.
- 264.172 Compatibility of waste with containers.
- 264.173 Management of containers.
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- 264.175 Containment.
- 264.176 Special requirements for ignitable or reactive waste.
- 264.177 Special requirements for incompatible wastes.
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- 264.191 Assessment of existing tank system's integrity.
- 264.192 Design and installation of new tank systems or components.
- 264.193 Containment and detection of releases.
- 264.194 General operating requirements.
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- 264.196 Response to leaks or spills and disposition of leaking or unfit-for-use tank systems.
- 264.197 Closure and post-closure care.
- 264.198 Special requirements for ignitable or reactive wastes.
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265.440 Applicability.
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 265.443 Design and operating requirements.
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265.1050 Applicability.
 265.1051 Definitions.
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 265.1055 Standards: Sampling connection systems.
 265.1056 Standards: Open-ended valves or lines.
 265.1057 Standards: Valves in gas/vapor service or in light liquid service.
 265.1058 Standards: Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors.
 265.1059 Standards: Delay of repair.
 265.1060 Standards: Closed-vent systems and control devices.
 265.1061 Alternative standards for valves in gas/vapor service or in light liquid service: percentage of valves allowed to leak.
 265.1062 Alternative standards for valves in gas/vapor service or in light liquid service: skip period leak detection and repair.
 265.1063 Test methods and procedures.
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Subpart CC—Air Emission Standards for Tanks, Surface Impoundments, and Containers

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 265.1085 Standards: Tanks.
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265.1087 Standards: Containers.
 265.1088 Standards: Closed-vent systems and control devices.
 265.1089 Inspection and monitoring requirements.
 265.1090 Recordkeeping requirements.
 265.1091 [Reserved]

Subpart DD—Containment Buildings

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Subpart EE—Hazardous Waste Munitions and Explosives Storage

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 266.225 What wastes are eligible for the storage and treatment conditional exemption?
 266.230 What conditions must you meet for your LLMW to qualify for and maintain a storage and treatment exemption?

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266.235 What waste treatment does the storage and treatment conditional exemption allow?

Loss of Conditional Exemption

266.240 How could you lose the conditional exemption for your LLMW and what action must you take?
 266.245 If you lose the storage and treatment conditional exemption for your LLMW, can the exemption be reclaimed?

Recordkeeping

266.250 What records must you keep at your facility and for how long?

Reentry Into RCRA

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Storage Unit Closure

266.260 Do closure requirements apply to units that stored LLMW prior to the effective date of Subpart N?

Transportation and Disposal Conditional Exemption

266.305 What does the transportation and disposal conditional exemption do?

Eligibility

266.310 What wastes are eligible for the transportation and disposal conditional exemption?

Conditions

266.315 What are the conditions you must meet for your waste to qualify for and maintain the transportation and disposal conditional exemption?
 266.320 What treatment standards must your eligible waste meet?
 266.325 Are you subject to the manifest and transportation condition in §266.315(b)?
 266.330 When does the transportation and disposal exemption take effect?
 266.335 Where must your exempted waste be disposed of?
 266.340 What type of container must be used for disposal of exempted waste?

Notification

266.345 Whom must you notify?

Recordkeeping

266.350 What records must you keep at your facility and for how long?

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Loss of Transportation and Disposal Conditional Exemption

266.355 How could you lose the transportation and disposal conditional exemption for your waste and what actions must you take?

266.360 If you lose the transportation and disposal conditional exemption for a waste, can the exemption be reclaimed?

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266.401 Definitions.

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266.403 Procedures for adding persons as transporters to EPA's USFRS XL Project.

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266.406 Waste characterization.

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266.411 Releases of USFRS XL waste during transport.

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266.413 USFRS XL waste generator requirements to maintain alternate treatment or disposal capacity.

266.414 Termination of a USFRS XL waste approved customer's participation in the USFRS XL Project.

266.415 Termination of a USFRS XL waste generator's participation in the USFRS XL Project.

266.416 Termination of a USFRS XL waste approved transporter's participation in the USFRS XL Project.

266.417 Termination of a USFRS XL waste transporter's participation in the USFRS XL Project.

266.418 Termination of USFRS' participation in this XL Project.

266.419 USFRS recordkeeping and reporting requirements.

266.420 USFRS XL waste generator recordkeeping and reporting requirement.

266.421 USFRS XL waste transporter recordkeeping and reporting requirement.

266.422 Effective date and duration of the project.

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Appendix II to Part 266—Tier I Feed Rate Screening Limits for Total Chlorine

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Appendix V to Part 266—Risk Specific Doses (10–5)

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Appendix VIII to Part 266—Organic Compounds for Which Residues Must Be Analyzed

Appendix IX to Part 266—Methods Manual for Compliance With the BIF Regulations

Appendix X to Part 266 [Reserved]

Appendix XI to Part 266—Lead-Bearing Materials That May be Processed in Exempt Lead Smelters

Appendix XII to Part 266—Nickel or Chromium-Bearing Materials that may be Processed in Exempt Nickel-Chromium Recovery Furnaces

Appendix XIII to Part 266—Mercury Bearing Wastes That May Be Processed in Exempt Mercury Recovery Units

Subpart G—Spent lead-acid batteries being reclaimed

§266.80 Applicability and requirements.

(a) Are spent lead-acid batteries exempt from hazardous waste management requirements? If you generate, collect, transport, store, or regenerate lead-acid batteries for reclamation purposes, you may be exempt from certain hazardous waste management requirements. Use the following table to determine which requirements apply to you. Alternatively, you may choose to manage your spent lead-acid batteries under the “Universal Waste” rule in 40 CFR Part 273.

If your batteries ***	And if you ***	Then you ***	And you ***
(1) Will be reclaimed through regeneration (such as by electrolyte replacement).		are exempt from 40 CFR parts 262 (except for §262.11), 263, 264, 265, 266, 268, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR parts 261 and §262.11 of this chapter.
(2) Will be reclaimed other than through regeneration.	generate, collect, and/or transport these batteries.	are exempt from 40 CFR parts 262 (except for §262.11), 263, 264, 265, 266, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR parts 261 and §262.11, and applicable provisions under part 268.
(3) Will be reclaimed other than through regeneration.	store these batteries but you aren't the reclaimer.	are exempt from 40 CFR parts 262 (except for §262.11), 263, 264, 265, 266, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR parts 261, §262.11, and applicable provisions under part 268.
(4) Will be reclaimed other than through regeneration.	store these batteries before you reclaim them.	must comply with 40 CFR 266.80(b) and as appropriate other regulatory provisions described in 266.80(b).	are subject to 40 CFR parts 261, §262.11, and applicable provisions under part 268.
(5) Will be reclaimed other than through regeneration.	don't store these batteries before you reclaim them.	are exempt from 40 CFR parts 262 (except for §262.11), 263, 264, 265, 266, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	are subject to 40 CFR parts 261, §262.11, and applicable provisions under part 268.

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(6) Will be re-claimed through regeneration or any other means.	export these batteries for reclamation in a foreign country.	are exempt from 40 CFR parts 263, 264, 265, 266, 268, 270, 124 of this chapter, and the notification requirements at section 3010 of RCRA. You are also exempt from part 262, except for 262.11, and except for the applicable requirements in either: (1) 40 CFR part 262 subpart H; or (2) 262.53 "Notification of Intent to Export, 262.56(a)(1) through (4)(6) and (b) "Annual Reports," and 262.57 "Record-keeping".	are subject to 40 CFR part 261 and §262.11, and either must comply with 40 CFR part 262, subpart H (if shipping to one of the OECD countries specified in 40 CFR 262.58(a)(1)), or must: (a) Comply with the requirements applicable to a primary exporter in 40 CFR 262.53, 262.56(a)(1) through (4), (6), and (b) and 262.57; and (b) Export these batteries only upon consent of the receiving country and in conformance with the EPA Acknowledgement of Consent as defined in subpart E of part 262 of this chapter; and (c) Provide a copy of the EPA Acknowledgment of Consent for the shipment to the transporter transporting the shipment for export.	(7) Will be re-claimed through regeneration or any other means.	Transport these batteries in the U.S. to export them for reclamation in a foreign country.	are exempt from 40 CFR parts 263, 264, 265, 266, 268, 270,, 124 of this chapter, and the notification requirements at section 3010 of RCRA.	must comply with applicable requirements in 40 CFR part 262, subpart H (if shipping to one of the OECD countries specified in 40 CFR 262.58(a)(1)), or must comply with the following: (a) you may not accept a shipment if you know the shipment does not conform to the EPA Acknowledgment of Consent; (b) you must ensure that a copy of the EPA Acknowledgment of Consent accompanies the shipment; and (c) you must ensure that the shipment is delivered to the facility designated by the person initiating the shipment.

(b) If I store spent lead-acid batteries before I reclaim them but not through regeneration, which requirements apply? The requirements of paragraph (b) of this section apply to you if you store spent lead-acid batteries before you reclaim them, but you don't reclaim them through regeneration. The requirements are slightly different depending on your RCRA permit status.

(1) For Interim Status Facilities, you must comply with:

(i) Notification requirements under section 3010 of RCRA.

(ii) All applicable provisions in subpart A of part 265 of this chapter.

(iii) All applicable provisions in subpart B of part 265 of this chapter except §265.13 (waste analysis).

(iv) All applicable provisions in subparts C and D of part 265 of this chapter.

(v) All applicable provisions in subpart E of part 265 of this chapter except §265.71 and 265.72 (dealing with the use of the manifest and manifest discrepancies).

(vi) All applicable provisions in subparts F through L of part 265 of this chapter.

(vii) All applicable provisions in parts 270 and 124 of this chapter.

(b)(1)(viii) All applicable provisions in part 267 of this chapter.

(2) For Permitted Facilities.

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(i) Notification requirements under section 3010 of RCRA.

(ii) All applicable provisions in subpart A of part 264 of this chapter.

(iii) All applicable provisions in subpart B of part 264 of this chapter (but not §264.13 (waste analysis)).

(iv) All applicable provisions in subparts C and D of part 264 of this chapter.

(v) All applicable provisions in subpart E of part 264 of this chapter (but not §264.71 or §264.72 (dealing with the use of the manifest and manifest discrepancies)).

(vi) All applicable provisions in subparts F through L of part 264 of this chapter.

(vii) All applicable provisions in parts 270 and 124 of this chapter.

(b)(2)(viii) All applicable provisions in part 267 of this chapter.

Part 267—Standards for owners and operators of hazardous waste facilities operating under a standardized permit

Subpart A—General

267.1 What are the purpose, scope and applicability of this part?

267.2 What is the relationship to interim status standards?

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Subpart A—Definitions

§279.1 Definitions.

Terms that are defined in §§260.10, 261.1, and 280.12 of this chapter have the same meanings when used in this part.

Aboveground tank means a tank used to store or process used oil that is not an underground storage tank as defined in §280.12 of this chapter.

Container means any portable device in which a material is stored, transported, treated, disposed of, or otherwise handled.

Do-it-yourselfer used oil collection center means any site or facility that accepts/aggregates and stores used oil collected only from household do-it-yourselfers.

Existing tank means a tank that is used for the storage or processing of used oil and that is in operation, or for which installation has commenced on or prior to the effective date of the authorized used oil program for the State in which the tank is located. Installation will be considered to have commenced if the owner or operator has obtained all federal, state, and local approvals or permits necessary to begin installation of the tank and if either (1) A continuous on-site installation program has begun, or

(2) The owner or operator has entered into contractual obligations—which cannot be canceled or modified without substantial loss—for installation of the tank to be completed within a reasonable time.

Household “do-it-yourselfer” used oil means oil that is derived from households, such as used oil generated by individuals who generate used oil through the maintenance of their personal vehicles.

Household “do-it-yourselfer” used oil generator means an individual who generates household “do-it-yourselfer” used oil.

New tank means a tank that will be used to store or process used oil and for which installation has commenced after the effective date of the authorized used oil program for the State in which the tank is located.

Petroleum refining facility means an establishment primarily engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, and lubricants, through fractionation, straight distillation of crude oil, redistillation of unfinished petroleum derivatives, cracking or other processes (i.e., facilities classified as SIC 2911).

Processing means chemical or physical operations designed to produce from used oil, or to make used oil more amenable for production of, fuel oils, lubricants, or other used oil-derived product. Processing includes, but is not limited to: blending used oil with virgin petroleum

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products, blending used oils to meet the fuel specification, filtration, simple distillation, chemical or physical separation and re-refining.

Re-refining distillation bottoms means the heavy fraction produced by vacuum distillation of filtered and dehydrated used oil. The composition of still bottoms varies with column operation and feedstock.

Tank means any stationary device, designed to contain an accumulation of used oil which is constructed primarily of non-earthen materials, (e.g., wood, concrete, steel, plastic) which provides structural support.

Used oil means any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities.

Used oil aggregation point means any site or facility that accepts, aggregates, and/or stores used oil collected only from other used oil generation sites owned or operated by the owner or operator of the aggregation point, from which used oil is transported to the aggregation point in shipments of no more than 55 gallons. Used oil aggregation points may also accept used oil from household do-it-yourselfers.

Used oil burner means a facility where used oil not meeting the specification requirements in §279.11 is burned for energy recovery in devices identified in §279.61(a).

Used oil collection center means any site or facility that is registered/licensed/permitted/recognized by a state/county/municipal government to manage used oil and accepts/aggregates and stores used oil collected from used oil generators regulated under subpart C of this part who bring used oil to the collection center in shipments of no more than 55 gallons under the provisions of §279.24. Used oil collection centers may also accept used oil from household do-it-yourselfers.

Used oil fuel marketer means any person who conducts either of the following activities:

- (1) Directs a shipment of off-specification used oil from their facility to a used oil burner; or
- (2) First claims that used oil that is to be burned for energy recovery meets the used oil fuel specifications set forth in §279.11 of this part.

Used oil generator means any person, by site, whose act or process produces used oil or whose act first causes used oil to become subject to regulation.

Used oil processor/re-refiner means a facility that processes used oil.

Used oil transfer facility means any transportation related facility including loading docks, parking areas, storage areas and other areas where shipments of used oil are held for more than 24 hours and not longer than 35 days during the normal course of transportation or prior to an activity performed pursuant to §279.20(b)(2). Transfer facilities that store used oil for more than 35 days are subject to regulation under subpart F of this part.

Used oil transporter means any person who transports used oil, any person who collects used oil from more than one generator and transports the collected

oil, and owners and operators of used oil transfer facilities. Used oil transporters may consolidate or aggregate loads of used oil for purposes of transportation but, with the following exception, may not process used oil. Transporters may conduct incidental processing operations that occur in the normal course of used oil transportation (e.g., settling and water separation), but that are not designed to produce (or make more amenable for production of) used oil derived products or used oil fuel.

Subpart B—Applicability

§279.10 Applicability.

This section identifies those materials which are subject to regulation as used oil under this part. This section also identifies some materials that are not subject to regulation as used oil under this part, and indicates whether these materials may be subject to regulation as hazardous waste under parts 260 through 266, 268, 270, and 124 of this chapter.

(a) *Used oil*. EPA presumes that used oil is to be recycled unless a used oil handler disposes of used oil, or sends used oil for disposal. Except as provided in §279.11, the regulations of this part apply to used oil, and to materials identified in this section as being subject to regulation as used oil, whether or not the used oil or material exhibits any characteristics of hazardous waste identified in subpart C of part 261 of this chapter.

(b) *Mixtures of used oil and hazardous waste*—(1) *Listed hazardous waste*. (i) Mixtures of used oil and hazardous waste that is listed in subpart D of part 261 of this chapter are subject to regulation as hazardous waste under parts 260 through 266, 268, 270, and 124 of this chapter, rather than as used oil under this part.

(ii) *Rebuttable presumption for used oil*. Used oil containing more than 1,000 ppm total halogens is presumed to be a hazardous waste because it has been mixed with halogenated hazardous waste listed in subpart D of part 261 of this chapter. Persons may rebut this presumption by demonstrating that the used oil does not contain hazardous waste (for example, by showing that the used oil does not contain significant concentrations of halogenated hazardous constituents listed in appendix VIII of part 261 of this chapter).

(A) The rebuttable presumption does not apply to metalworking oils/fluids containing chlorinated paraffins, if they are processed, through a tolling arrangement as described in §279.24(c), to reclaim metalworking oils/fluids. The presumption does apply to metalworking oils/fluids if such oils/fluids are recycled in any other manner, or disposed.

(B) The rebuttable presumption does not apply to used oils contaminated with chlorofluorocarbons (CFCs) removed from refrigeration units where the CFCs are destined for reclamation. The rebuttable presumption does apply to used oils contaminated with CFCs that have been mixed with used oil from sources other than refrigeration units.

(2) *Characteristic hazardous waste*. Mixtures of used oil and hazardous waste that solely exhibit one or more of the hazardous waste characteristics identified in subpart C of part 261 of this chapter and mixtures of used

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oil and hazardous waste that is listed in subpart D solely because it exhibits one or more of the characteristics of hazardous waste identified in subpart C are subject to:

(i) Except as provided in paragraph (b)(2)(iii) of this section, regulation as hazardous waste under parts 260 through 266, 268, 270, and 124 of this chapter rather than as used oil under this part, if the resultant mixture exhibits any characteristics of hazardous waste identified in subpart C of part 261 of this chapter; or

(ii) Except as specified in §279.10(b)(2)(iii) regulation as used oil under this part, if the resultant mixture does not exhibit any characteristics of hazardous waste identified under subpart C of part 261 of this chapter.

(iii) Regulation as used oil under this part, if the mixture is of used oil and a waste which is hazardous solely because it exhibits the characteristic of ignitability (e.g., ignitable-only mineral spirits), provided that the resultant mixture does not exhibit the characteristic of ignitability under §261.21 of this chapter.

(3) *Conditionally exempt small quantity generator hazardous waste.* Mixtures of used oil and conditionally exempt small quantity generator hazardous waste regulated under §261.5 of this chapter are subject to regulation as used oil under this part.

(c) *Materials containing or otherwise contaminated with used oil.* (1) Except as provided in paragraph (c)(2) of this section, materials containing or otherwise contaminated with used oil from which the used oil has been properly drained or removed to the extent possible such that no visible signs of free-flowing oil remain in or on the material:

(i) Are not used oil and thus not subject to this part, and

(ii) If applicable are subject to the hazardous waste regulations of parts 124, 260 through 266, 268, and 270 of this chapter.

(2) Materials containing or otherwise contaminated with used oil that are burned for energy recovery are subject to regulation as used oil under this part.

(3) Used oil drained or removed from materials containing or otherwise contaminated with used oil is subject to regulation as used oil under this part.

(d) *Mixtures of used oil with products.* (1) Except as provided in paragraph (d)(2) of this section, mixtures of used oil and fuels or other fuel products are subject to regulation as used oil under this part.

(2) Mixtures of used oil and diesel fuel mixed on-site by the generator of the used oil for use in the generator's own vehicles are not subject to this part once the used oil and diesel fuel have been mixed. Prior to mixing, the used oil is subject to the requirements of subpart C of this part.

(e) *Materials derived from used oil.* (1) Materials that are reclaimed from used oil that are used beneficially and are not burned for energy recovery or used in a manner constituting disposal (e.g., re-refined lubricants) are:

(i) Not used oil and thus are not subject to this part, and

(ii) Not solid wastes and are thus not subject to the hazardous waste regulations of parts 260 through 266, 268, 270, and 124 of this chapter as provided in §261.3(c)(2)(i) of this chapter.

(2) Materials produced from used oil that are burned for energy recovery (e.g., used oil fuels) are subject to regulation as used oil under this part.

(3) Except as provided in paragraph (e)(4) of this section, materials derived from used oil that are disposed of or used in a manner constituting disposal are:

(i) Not used oil and thus are not subject to this Part, and

(ii) Are solid wastes and thus are subject to the hazardous waste regulations of parts 260 through 266, 268, 270, and 124 of this chapter if the materials are listed or identified as hazardous wastes.

(4) Used oil re-refining distillation bottoms that are used as feedstock to manufacture asphalt products are not subject to this part.

(f) *Wastewater.* Wastewater, the discharge of which is subject to regulation under either section 402 or section 307(b) of the Clean Water Act (including wastewaters at facilities which have eliminated the discharge of wastewater), contaminated with *de minimis* quantities of used oil are not subject to the requirements of this part. For purposes of this paragraph, "*de minimis*" quantities of used oils are defined as small spills, leaks, or drippings from pumps, machinery, pipes, and other similar equipment during normal operations or small amounts of oil lost to the wastewater treatment system during washing or draining operations. This exception will not apply if the used oil is discarded as a result of abnormal manufacturing operations resulting in substantial leaks, spills, or other releases, or to used oil recovered from wastewaters.

(g) *Used oil introduced into crude oil pipelines or a petroleum refining facility.* (1) Used oil mixed with crude oil or natural gas liquids (e.g., in a production separator or crude oil stock tank) for insertion into a crude oil pipeline is exempt from the requirements of this part. The used oil is subject to the requirements of this part prior to the mixing of used oil with crude oil or natural gas liquids.

(2) Mixtures of used oil and crude oil or natural gas liquids containing less than 1% used oil that are being stored or transported to a crude oil pipeline or petroleum refining facility for insertion into the refining process at a point prior to crude distillation or catalytic cracking are exempt from the requirements of this part.

(3) Used oil that is inserted into the petroleum refining facility process before crude distillation or catalytic cracking without prior mixing with crude oil is exempt from the requirements of this part provided that the used oil constitutes less than 1% of the crude oil feed to any petroleum refining facility process unit at any given time. Prior to insertion into the petroleum refining facility process, the used oil is subject to the requirements of this part.

(4) Except as provided in paragraph (g)(5) of this section, used oil that is introduced into a petroleum

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refining facility process after crude distillation or catalytic cracking is exempt from the requirements of this part only if the used oil meets the specification of §279.11. Prior to insertion into the petroleum refining facility process, the used oil is subject to the requirements of this part.

(5) Used oil that is incidentally captured by a hydrocarbon recovery system or wastewater treatment system as part of routine process operations at a petroleum refining facility and inserted into the petroleum refining facility process is exempt from the requirements of this part. This exemption does not extend to used oil which is intentionally introduced into a hydrocarbon recovery system (e.g., by pouring collected used oil into the waste water treatment system).

(6) Tank bottoms from stock tanks containing exempt mixtures of used oil and crude oil or natural gas liquids are exempt from the requirements of this part.

(h) *Used oil on vessels.* Used oil produced on vessels from normal shipboard operations is not subject to this part until it is transported ashore.

(i) *Used oil containing PCBs.* Used oil containing PCBs (as defined at 40 CFR 761.3) at any concentration less than 50 ppm is subject to the requirements of this Part unless, because of dilution, it is regulated under 40 CFR Part 761 as a used oil containing PCBs at 50 ppm or greater. PCB-containing used oil subject to the requirements of this Part may also be subject to the prohibitions and requirements found at 40 CFR Part 761, including §761.20(d) and (e). Used oil containing PCBs at concentrations of 50 ppm or greater is not subject to the requirements of this Part, but is subject to regulation under 40 CFR Part 761. No person may avoid these provisions by diluting used oil containing PCBs, unless otherwise specifically provided for in this Part or Part 761 of this chapter.

§279.11 Used oil specifications.

Used oil burned for energy recovery, and any fuel produced from used oil by processing, blending, or other treatment, is subject to regulation under this part unless it is shown not to exceed any of the allowable levels of the constituents and properties shown in Table 1. Once used oil that is to be burned for energy recovery has been shown not to exceed any allowable level and the person making that showing complies with §§279.72, 279.73, and 279.74(b), the used oil is no longer subject to this part.

TABLE 1— USED OIL NOT EXCEEDING ANY ALLOWABLE LEVEL SHOWN BELOW IS NOT SUBJECT TO THIS PART WHEN BURNED FOR ENERGY RECOVERY ¹

Constituent/property	Allowable level
Arsenic.....	5 ppm maximum.
Cadmium	2 ppm maximum.
Chromium.....	10 ppm maximum.
Lead	100 ppm maximum.
Flash point.....	100 °F minimum.
Total halogens	4,000 ppm maximum. ²

Note: Applicable standards for the burning of used oil containing PCBs are imposed by 40 CFR 761.20(e).

¹ The allowable levels do not apply to mixtures of used oil and hazardous waste that continue to be regulated as hazardous waste (see §279.10(b)).

Table 1— Used oil not exceeding any allowable level shown below is not subject to this part when burned for energy recovery ¹, Continued
² Used oil containing more than 1,000 ppm total halogens is presumed to be a hazardous waste under the rebuttable presumption provided under §279.10(b)(1). Such used oil is subject to subpart H of part 266 of this chapter rather than this part when burned for energy recovery unless the presumption of mixing can be successfully rebutted.

§279.12 Prohibitions.

(a) *Surface impoundment prohibition.* Used oil shall not be managed in surface impoundments or waste piles unless the units are subject to regulation under parts 264 or 265 of this chapter.

(b) *Use as a dust suppressant.* The use of used oil as a dust suppressant is prohibited, except when such activity takes place in one of the states listed in §279.82(c).

(c) *Burning in particular units.* Off-specification used oil fuel may be burned for energy recovery in only the following devices:

(1) Industrial furnaces identified in §260.10 of this chapter;

(2) Boilers, as defined in §260.10 of this chapter, that are identified as follows:

(i) Industrial boilers located on the site of a facility engaged in a manufacturing process where substances are transformed into new products, including the component parts of products, by mechanical or chemical processes;

(ii) Utility boilers used to produce electric power, steam, heated or cooled air, or other gases or fluids for sale; or

(iii) Used oil-fired space heaters provided that the burner meets the provisions of §279.23.

(3) Hazardous waste incinerators subject to regulation under subpart O of parts 264 or 265 of this chapter.

Subpart C—Standards for used oil generators

§279.20 Applicability.

(a) *General.* Except as provided in paragraphs (a)(1) through (a)(4) of this section, this subpart applies to all used oil generators. A used oil generator is any person, by site, whose act or process produces used oil or whose act first causes used oil to become subject to regulation.

(1) *Household “do-it-yourselfer” used oil generators.* Household “do-it-yourselfer” used oil generators are not subject to regulation under this part.

(2) *Vessels.* Vessels at sea or at port are not subject to this subpart. For purposes of this subpart, used oil produced on vessels from normal shipboard operations is considered to be generated at the time it is transported ashore. The owner or operator of the vessel and the person(s) removing or accepting used oil from the vessel are co-generators of the used oil and are both responsible for managing the waste in compliance with this subpart once the used oil is transported ashore. The co-generators may decide among them which party will fulfill the requirements of this subpart.

(3) *Diesel fuel.* Mixtures of used oil and diesel fuel mixed by the generator of the used oil for use in the

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generator's own vehicles are not subject to this part once the used oil and diesel fuel have been mixed. Prior to mixing, the used oil fuel is subject to the requirements of this subpart.

(4) *Farmers.* Farmers who generate an average of 25 gallons per month or less of used oil from vehicles or machinery used on the farm in a calendar year are not subject to the requirements of this part.

(b) *Other applicable provisions.* Used oil generators who conduct the following activities are subject to the requirements of other applicable provisions of this part as indicated in paragraphs (b)(1) through (5) of this section:

(1) Generators who transport used oil, except under the self-transport provisions of §279.24 (a) and (b), must also comply with subpart E of this part.

(2) (i) Except as provided in paragraph (b)(2)(ii) of this section, generators who process or re-refine used oil must also comply with subpart F of this part.

(ii) Generators who perform the following activities are not processors provided that the used oil is generated on-site and is not being sent off-site to a burner of on- or off-specification used oil fuel.

(A) Filtering, cleaning, or otherwise reconditioning used oil before returning it for reuse by the generator;

(B) Separating used oil from wastewater generated on-site to make the wastewater acceptable for discharge or reuse pursuant to section 402 or section 307(b) of the Clean Water Act or other applicable Federal or state regulations governing the management or discharge of wastewaters;

(C) Using oil mist collectors to remove small droplets of used oil from in-plant air to make plant air suitable for continued recirculation;

(D) Draining or otherwise removing used oil from materials containing or otherwise contaminated with used oil in order to remove excessive oil to the extent possible pursuant to §279.10(c); or

(E) Filtering, separating or otherwise reconditioning used oil before burning it in a space heater pursuant to §279.23.

(3) Generators who burn off-specification used oil for energy recovery, except under the on-site space heater provisions of §279.23, must also comply with subpart G of this part.

(4) Generators who direct shipments of off-specification used oil from their facility to a used oil burner or first claim that used oil that is to be burned for energy recovery meets the used oil fuel specifications set forth in §279.11 must also comply with subpart H of this part.

(5) Generators who dispose of used oil, including the use of used oil as a dust suppressant, must also comply with subpart I of this part.

§279.21 Hazardous waste mixing.

(a) Mixtures of used oil and hazardous waste must be managed in accordance with §279.10(b).

(b) The rebuttable presumption for used oil of §279.10(b)(1)(ii) applies to used oil managed by genera-

tors. Under the rebuttable presumption for used oil of §279.10(b)(1)(ii), used oil containing greater than 1,000 ppm total halogens is presumed to be a hazardous waste and thus must be managed as hazardous waste and not as used oil unless the presumption is rebutted. However, the rebuttable presumption does not apply to certain metalworking oils/fluids and certain used oils removed from refrigeration units.

§279.22 Used oil storage.

Used oil generators are subject to all applicable Spill Prevention, Control and Countermeasures (40 CFR part 112) in addition to the requirements of this Subpart. Used oil generators are also subject to the Underground Storage Tank (40 CFR part 280) standards for used oil stored in underground tanks whether or not the used oil exhibits any characteristics of hazardous waste, in addition to the requirements of this subpart.

(a) *Storage units.* Used oil generators shall not store used oil in units other than tanks, containers, or units subject to regulation under parts 264 or 265 of this chapter.

(b) *Condition of units.* Containers and aboveground tanks used to store used oil at generator facilities must be:

(1) In good condition (no severe rusting, apparent structural defects or deterioration); and

(2) Not leaking (no visible leaks).

(c) *Labels.* (1) Containers and aboveground tanks used to store used oil at generator facilities must be labeled or marked clearly with the words "Used Oil."

(2) Fill pipes used to transfer used oil into underground storage tanks at generator facilities must be labeled or marked clearly with the words "Used Oil."

(d) *Response to releases.* Upon detection of a release of used oil to the environment that is not subject to the requirements of part 280, subpart F of this chapter and which has occurred after the effective date of the recycled used oil management program in effect in the State in which the release is located, a generator must perform the following cleanup steps:

(1) Stop the release;

(2) Contain the released used oil;

(3) Clean up and manage properly the released used oil and other materials; and

(4) If necessary, repair or replace any leaking used oil storage containers or tanks prior to returning them to service.

§279.23 On-site burning in space heaters.

Generators may burn used oil in used oil-fired space heaters provided that:

(a) The heater burns only used oil that the owner or operator generates or used oil received from household do-it-yourself used oil generators;

(b) The heater is designed to have a maximum capacity of not more than 0.5 million Btu per hour; and

(c) The combustion gases from the heater are vented to the ambient air.

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§279.24 Off-site shipments.

Except as provided in paragraphs (a) through (c) of this section, generators must ensure that their used oil is transported only by transporters who have obtained EPA identification numbers.

(a) *Self-transportation of small amounts to approved collection centers.* Generators may transport, without an EPA identification number, used oil that is generated at the generator's site and used oil collected from household do-it-yourselfers to a used oil collection center provided that:

(1) The generator transports the used oil in a vehicle owned by the generator or owned by an employee of the generator;

(2) The generator transports no more than 55 gallons of used oil at any time; and

(3) The generator transports the used oil to a used oil collection center that is registered, licensed, permitted, or recognized by a state/county/municipal government to manage used oil.

(b) *Self-transportation of small amounts to aggregation points owned by the generator.* Generators may transport, without an EPA identification number, used oil that is generated at the generator's site to an aggregation point provided that:

(1) The generator transports the used oil in a vehicle owned by the generator or owned by an employee of the generator;

(2) The generator transports no more than 55 gallons of used oil at any time; and

(3) The generator transports the used oil to an aggregation point that is owned and/or operated by the same generator.

(c) *Tolling arrangements.* Used oil generators may arrange for used oil to be transported by a transporter without an EPA identification number if the used oil is reclaimed under a contractual agreement pursuant to which reclaimed oil is returned by the processor/re-refiner to the generator for use as a lubricant, cutting oil, or coolant. The contract (known as a "tolling arrangement") must indicate:

(1) The type of used oil and the frequency of shipments;

(2) That the vehicle used to transport the used oil to the processing/re-refining facility and to deliver recycled used oil back to the generator is owned and operated by the used oil processor/re-refiner; and

(3) That reclaimed oil will be returned to the generator.

Subpart D—Standards for used oil collection centers and aggregation points

§279.30 Do-it-yourselfer used oil collection centers.

(a) *Applicability.* This section applies to owners or operators of all do-it-yourselfer (DIY) used oil collection centers. A DIY used oil collection center is any site or

facility that accepts/aggregates and stores used oil collected only from household do-it-yourselfers.

(b) *DIY used oil collection center requirements.* Owners or operators of all DIY used oil collection centers must comply with the generator standards in subpart C of this part.

§279.31 Used oil collection centers.

(a) *Applicability.* This section applies to owners or operators of used oil collection centers. A used oil collection center is any site or facility that accepts/aggregates and stores used oil collected from used oil generators regulated under subpart C of this part who bring used oil to the collection center in shipments of no more than 55 gallons under the provisions of §279.24(a). Used oil collection centers may also accept used oil from household do-it-yourselfers.

(b) *Used oil collection center requirements.* Owners or operators of all used oil collection centers must:

(1) Comply with the generator standards in subpart C of this part; and

(2) Be registered/licensed/permitted/recognized by a state/county/municipal government to manage used oil.

§279.32 Used oil aggregation points owned by the generator.

(a) *Applicability.* This section applies to owners or operators of all used oil aggregation points. A used oil aggregation point is any site or facility that accepts, aggregates, and/or stores used oil collected only from other used oil generation sites owned or operated by the owner or operator of the aggregation point, from which used oil is transported to the aggregation point in shipments of no more than 55 gallons under the provisions of §279.24(b). Used oil aggregation points may also accept used oil from household do-it-yourselfers.

(b) *Used oil aggregation point requirements.* Owners or operators of all used oil aggregation points must comply with the generator standards in subpart C of this part.

Subpart E—Standards for used oil transporter and transfer facilities

§279.40 Applicability.

(a) *General.* Except as provided in paragraphs (a)(1) through (a)(4) of this section, this subpart applies to all used oil transporters. Used oil transporters are persons who transport used oil, persons who collect used oil from more than one generator and transport the collected oil, and owners and operators of used oil transfer facilities.

(1) This subpart does not apply to on-site transportation.

(2) This subpart does not apply to generators who transport shipments of used oil totalling 55 gallons or less from the generator to a used oil collection center as specified in §279.24(a).

(3) This subpart does not apply to generators who transport shipments of used oil totalling 55 gallons or less from the generator to a used oil aggregation point owned or operated by the same generator as specified in §279.24(b).

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(4) This subpart does not apply to transportation of used oil from household do-it-yourselfers to a regulated used oil generator, collection center, aggregation point, processor/re-refiner, or burner subject to the requirements of this part. Except as provided in paragraphs (a)(1) through (a)(3) of this section, this subpart does, however, apply to transportation of collected household do-it-yourselfer used oil from regulated used oil generators, collection centers, aggregation points, or other facilities where household do-it-yourselfer used oil is collected.

(b) *Imports and exports.* Transporters who import used oil from abroad or export used oil outside of the United States are subject to the requirements of this subpart from the time the used oil enters and until the time it exits the United States.

(c) *Trucks used to transport hazardous waste.* Unless trucks previously used to transport hazardous waste are emptied as described in §261.7 of this chapter prior to transporting used oil, the used oil is considered to have been mixed with the hazardous waste and must be managed as hazardous waste unless, under the provisions of §279.10(b), the hazardous waste/used oil mixture is determined not to be hazardous waste.

(d) *Other applicable provisions.* Used oil transporters who conduct the following activities are also subject to other applicable provisions of this part as indicated in paragraphs (d)(1) through (5) of this section:

(1) Transporters who generate used oil must also comply with subpart C of this part;

(2) Transporters who process or re-refine used oil, except as provided in §279.41, must also comply with subpart F of this part;

(3) Transporters who burn off-specification used oil for energy recovery must also comply with subpart G of this part;

(4) Transporters who direct shipments of off-specification used oil from their facility to a used oil burner or first claim that used oil that is to be burned for energy recovery meets the used oil fuel specifications set forth in §279.11 must also comply with subpart H of this part; and

(5) Transporters who dispose of used oil, including the use of used oil as a dust suppressant, must also comply with subpart I of this part.

§279.41 Restrictions on transporters who are not also processors or re-refiners.

(a) Used oil transporters may consolidate or aggregate loads of used oil for purposes of transportation. However, except as provided in paragraph (b) of this section, used oil transporters may not process used oil unless they also comply with the requirements for processors/re-refiners in subpart F of this part.

(b) Transporters may conduct incidental processing operations that occur in the normal course of used oil transportation (e.g., settling and water separation), but that are not designed to produce (or make more amenable for production of) used oil derived products unless they also comply with the processor/re-refiner requirements in subpart F of this part.

(c) Transporters of used oil that is removed from oil bearing electrical transformers and turbines and filtered by the transporter or at a transfer facility prior to being returned to its original use are not subject to the processor/re-refiner requirements in subpart F of this part.

§279.42 Notification.

(a) *Identification numbers.* Used oil transporters who have not previously complied with the notification requirements of RCRA section 3010 must comply with these requirements and obtain an EPA identification number.

(b) *Mechanics of notification.* A used oil transporter who has not received an EPA identification number may obtain one by notifying the Regional Administrator of their used oil activity by submitting either:

(1) A completed EPA Form 8700-12 (To obtain ordering information for EPA Form 8700-12 call RCRA/Superfund Hotline at 1-800-424-9346 or 703-920-9810); or

(2) A letter requesting an EPA identification number.

Call RCRA/Superfund Hotline to determine where to send a letter requesting an EPA identification number. The letter should include the following information:

(i) Transporter company name;

(ii) Owner of the transporter company;

(iii) Mailing address for the transporter;

(iv) Name and telephone number for the transporter point of contact;

(v) Type of transport activity (i.e., transport only, transport and transfer facility, transfer facility only);

(vi) Location of all transfer facilities at which used oil is stored;

(vii) Name and telephone number for a contact at each transfer facility.

§279.43 Used oil transportation.

(a) *Deliveries.* A used oil transporter must deliver all used oil received to:

(1) Another used oil transporter, provided that the transporter has obtained an EPA identification number;

(2) A used oil processing/re-refining facility who has obtained an EPA identification number;

(3) An off-specification used oil burner facility who has obtained an EPA identification number; or

(4) An on-specification used oil burner facility.

(b) *DOT Requirements.* Used oil transporters must comply with all applicable requirements under the U.S. Department of Transportation regulations in 49 CFR parts 171 through 180. Persons transporting used oil that meets the definition of a hazardous material in 49 CFR 171.8 must comply with all applicable regulations in 49 CFR parts 171 through 180.

(c) *Used oil discharges.* (1) In the event of a discharge of used oil during transportation, the transporter must take appropriate immediate action to protect human health and the environment (e.g., notify local authorities, dike the discharge area).

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(2) If a discharge of used oil occurs during transportation and an official (State or local government or a Federal Agency) acting within the scope of official responsibilities determines that immediate removal of the used oil is necessary to protect human health or the environment, that official may authorize the removal of the used oil by transporters who do not have EPA identification numbers.

(3) An air, rail, highway, or water transporter who has discharged used oil must:

(i) Give notice, if required by 49 CFR 171.15, to the National Response Center (800-424-8802 or 202-426-2675); and

(ii) Report in writing as required by 49 CFR 171.16 to the Director, Office of Hazardous Materials Regulations, Materials Transportation Bureau, Department of Transportation, Washington, DC 20590.

(4) A water transporter who has discharged used oil must give notice as required by 33 CFR 153.203.

(5) A transporter must clean up any used oil discharge that occurs during transportation or take such action as may be required or approved by federal, state, or local officials so that the used oil discharge no longer presents a hazard to human health or the environment.

§279.44 Rebuttable presumption for used oil.

(a) To ensure that used oil is not a hazardous waste under the rebuttable presumption of §279.10(b)(1)(ii), the used oil transporter must determine whether the total halogen content of used oil being transported or stored at a transfer facility is above or below 1,000 ppm.

(b) The transporter must make this determination by:

(1) Testing the used oil; or

(2) Applying knowledge of the halogen content of the used oil in light of the materials or processes used.

(c) If the used oil contains greater than or equal to 1,000 ppm total halogens, it is presumed to be a hazardous waste because it has been mixed with halogenated hazardous waste listed in subpart D of part 261 of this chapter. The owner or operator may rebut the presumption by demonstrating that the used oil does not contain hazardous waste (for example, by showing that the used oil does not contain significant concentrations of halogenated hazardous constituents listed in appendix VIII of part 261 of this chapter).

(1) The rebuttable presumption does not apply to metalworking oils/fluids containing chlorinated paraffins, if they are processed, through a tolling arrangement as described in §279.24(c), to reclaim metalworking oils/fluids. The presumption does apply to metalworking oils/fluids if such oils/fluids are recycled in any other manner, or disposed.

(2) The rebuttable presumption does not apply to used oils contaminated with chlorofluorocarbons (CFCs) removed from refrigeration units if the CFCs are destined for reclamation. The rebuttable presumption does apply to used oils contaminated with CFCs that have been mixed with used oil from sources other than refrigeration units.

(d) *Record retention.* Records of analyses conducted or information used to comply with paragraphs (a), (b), and

(c) of this section must be maintained by the transporter for at least 3 years.

§279.45 Used oil storage at transfer facilities.

Used oil transporters are subject to all applicable Spill Prevention, Control and Countermeasures (40 CFR part 112) in addition to the requirements of this subpart. Used oil transporters are also subject to the Underground Storage Tank (40 CFR part 280) standards for used oil stored in underground tanks whether or not the used oil exhibits any characteristics of hazardous waste, in addition to the requirements of this subpart.

(a) *Applicability.* This section applies to used oil transfer facilities. Used oil transfer facilities are transportation related facilities including loading docks, parking areas, storage areas, and other areas where shipments of used oil are held for more than 24 hours during the normal course of transportation and not longer than 35 days. Transfer facilities that store used oil for more than 35 days are subject to regulation under subpart F of this part.

(b) *Storage units.* Owners or operators of used oil transfer facilities may not store used oil in units other than tanks, containers, or units subject to regulation under parts 264 or 265 of this chapter.

(c) *Condition of units.* Containers and aboveground tanks used to store used oil at transfer facilities must be:

(1) In good condition (no severe rusting, apparent structural defects or deterioration); and

(2) Not leaking (no visible leaks).

(d) *Secondary containment for containers.* Containers used to store used oil at transfer facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

(i) Dikes, berms or retaining walls; and

(ii) A floor. The floor must cover the entire area within the dikes, berms, or retaining walls; or

(iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floors, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(e) *Secondary containment for existing aboveground tanks.* Existing aboveground tanks used to store used oil at transfer facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

(i) Dikes, berms or retaining walls; and

(ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall except areas where existing portions of the tank meet the ground; or

(iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floors, must be sufficiently impervious to used oil to

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prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(f) *Secondary containment for new aboveground tanks.* New aboveground tanks used to store used oil at transfer facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

- (i) Dikes, berms or retaining walls; and
- (ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall; or
- (iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floors, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(g) *Labels.* (1) Containers and aboveground tanks used to store used oil at transfer facilities must be labeled or marked clearly with the words “Used Oil.”

(2) Fill pipes used to transfer used oil into underground storage tanks at transfer facilities must be labeled or marked clearly with the words “Used Oil.”

(h) *Response to releases.* Upon detection of a release of used oil to the environment that is not subject to the requirements of part 280, subpart F of this chapter and which has occurred after the effective date of the recycled used oil management program in effect in the State in which the release is located, the owner/operator of a transfer facility must perform the following cleanup steps:

- (1) Stop the release;
- (2) Contain the released used oil;
- (3) Clean up and manage properly the released used oil and other materials; and
- (4) If necessary, repair or replace any leaking used oil storage containers or tanks prior to returning them to service.

§279.46 Tracking.

(a) *Acceptance.* Used oil transporters must keep a record of each used oil shipment accepted for transport. Records for each shipment must include:

- (1) The name and address of the generator, transporter, or processor/re-refiner who provided the used oil for transport;
- (2) The EPA identification number (if applicable) of the generator, transporter, or processor/re-refiner who provided the used oil for transport;
- (3) The quantity of used oil accepted;
- (4) The date of acceptance; and
- (5)(i) Except as provided in paragraph (a)(5)(ii) of this section, the signature, dated upon receipt of the used oil, of a representative of the generator, transporter, or processor/re-refiner who provided the used oil for transport.

(ii) Intermediate rail transporters are not required to sign the record of acceptance.

(b) *Deliveries.* Used oil transporters must keep a record of each shipment of used oil that is delivered to another used oil transporter, or to a used oil burner, processor/re-refiner, or disposal facility. Records of each delivery must include:

- (1) The name and address of the receiving facility or transporter;
- (2) The EPA identification number of the receiving facility or transporter;
- (3) The quantity of used oil delivered;
- (4) The date of delivery;
- (5)(i) Except as provided in paragraph (b)(5)(ii) of this section, the signature, dated upon receipt of the used oil, of a representative of the receiving facility or transporter.
- (ii) Intermediate rail transporters are not required to sign the record of delivery.

(c) *Exports of used oil.* Used oil transporters must maintain the records described in paragraphs (b)(1) through (b)(4) of this section for each shipment of used oil exported to any foreign country.

(d) *Record retention.* The records described in paragraphs (a), (b), and (c) of this section must be maintained for at least three years.

§279.47 Management of residues.

Transporters who generate residues from the storage or transport of used oil must manage the residues as specified in §279.10(e).

Subpart F—Standards for used oil processors and re-refiners

§279.50 Applicability.

(a) The requirements of this subpart apply to owners and operators of facilities that process used oil. Processing means chemical or physical operations designed to produce from used oil, or to make used oil more amenable for production of, fuel oils, lubricants, or other used oil-derived products. Processing includes, but is not limited to: blending used oil with virgin petroleum products, blending used oils to meet the fuel specification, filtration, simple distillation, chemical or physical separation and re-refining. The requirements of this subpart do not apply to:

(1) Transporters that conduct incidental processing operations that occur during the normal course of transportation as provided in §279.41; or

(2) Burners that conduct incidental processing operations that occur during the normal course of used oil management prior to burning as provided in §279.61(b).

(b) *Other applicable provisions.* Used oil processors/re-refiners who conduct the following activities are also subject to the requirements of other applicable provisions of this part as indicated in paragraphs (b)(1) through (b)(5) of this section.

(1) Processors/re-refiners who generate used oil must also comply with subpart C of this part;

(2) Processors/re-refiners who transport used oil must also comply with subpart E of this part;

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(3) Except as provided in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, processors/re-refiners who burn off-specification used oil for energy recovery must also comply with subpart G of this part. Processor/re-refiners burning used oil for energy recovery under the following conditions are not subject to subpart G of this part:

(i) The used oil is burned in an on-site space heater that meets the requirements of §279.23; or

(ii) The used oil is burned for purposes of processing used oil, which is considered burning incidentally to used oil processing;

(4) Processors/re-refiners who direct shipments of off-specification used oil from their facility to a used oil burner or first claim that used oil that is to be burned for energy recovery meets the used oil fuel specifications set forth in §279.11 must also comply with subpart H of this part; and

(5) Processors/re-refiners who dispose of used oil, including the use of used oil as a dust suppressant, also must comply with subpart I of this part.

§279.51 Notification.

(a) *Identification numbers.* Used oil processors and re-refiners who have not previously complied with the notification requirements of RCRA section 3010 must comply with these requirements and obtain an EPA identification number.

(b) *Mechanics of notification.* A used oil processor or re-refiner who has not received an EPA identification number may obtain one by notifying the Regional Administrator of their used oil activity by submitting either:

(1) A completed EPA Form 8700–12 (To obtain EPA Form 8700–12 call RCRA/Superfund Hotline at 1–800–424–9346 or 703–920–9810); or

(2) A letter requesting an EPA identification number.

Call RCRA/Superfund Hotline to determine where to send a letter requesting an EPA identification number. The letter should include the following information:

- (i) Processor or re-refiner company name;
- (ii) Owner of the processor or re-refiner company;
- (iii) Mailing address for the processor or re-refiner;
- (iv) Name and telephone number for the processor or re-refiner point of contact;
- (v) Type of used oil activity (i.e., process only, process and re-refine);
- (vi) Location of the processor or re-refiner facility.

§279.52 General facility standards.

(a) *Preparedness and prevention.* Owners and operators of used oil processing and re-refining facilities must comply with the following requirements:

(1) *Maintenance and operation of facility.* Facilities must be maintained and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of used oil to air, soil, or surface water which could threaten human health or the environment.

(2) *Required equipment.* All facilities must be equipped with the following, unless none of the hazards

posed by used oil handled at the facility could require a particular kind of equipment specified in paragraphs (a)(2)(i) through (iv) of this section:

(i) An internal communications or alarm system capable of providing immediate emergency instruction (voice or signal) to facility personnel;

(ii) A device, such as a telephone (immediately available at the scene of operations) or a hand-held two-way radio, capable of summoning emergency assistance from local police departments, fire departments, or State or local emergency response teams;

(iii) Portable fire extinguishers, fire control equipment (including special extinguishing equipment, such as that using foam, inert gas, or dry chemicals), spill control equipment and decontamination equipment; and

(iv) Water at adequate volume and pressure to supply water hose streams, or foam producing equipment, or automatic sprinklers, or water spray systems.

(3) *Testing and maintenance of equipment.* All facility communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, must be tested and maintained as necessary to assure its proper operation in time of emergency.

(4) *Access to communications or alarm system.* (i) Whenever used oil is being poured, mixed, spread, or otherwise handled, all personnel involved in the operation must have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee, unless such a device is not required in paragraph (a)(2) of this section.

(ii) If there is ever just one employee on the premises while the facility is operating, the employee must have immediate access to a device, such as a telephone (immediately available at the scene of operation) or a hand-held two-way radio, capable of summoning external emergency assistance, unless such a device is not required in paragraph (a)(2) of this section.

(5) *Required aisle space.* The owner or operator must maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency, unless aisle space is not needed for any of these purposes.

(6) *Arrangements with local authorities.* (i) The owner or operator must attempt to make the following arrangements, as appropriate for the type of used oil handled at the facility and the potential need for the services of these organizations:

(A) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of used oil handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to roads inside the facility, and possible evacuation routes;

(B) Where more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any

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others to provide support to the primary emergency authority;

(C) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers; and

(D) Arrangements to familiarize local hospitals with the properties of used oil handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility.

(ii) Where State or local authorities decline to enter into such arrangements, the owner or operator must document the refusal in the operating record.

(b) *Contingency plan and emergency procedures.* Owners and operators of used oil processing and re-refining facilities must comply with the following requirements:

(1) *Purpose and implementation of contingency plan.*

(i) Each owner or operator must have a contingency plan for the facility. The contingency plan must be designed to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of used oil to air, soil, or surface water.

(ii) The provisions of the plan must be carried out immediately whenever there is a fire, explosion, or release of used oil which could threaten human health or the environment.

(2) *Content of contingency plan.* (i) The contingency plan must describe the actions facility personnel must take to comply with paragraphs (b) (1) and (6) of this section in response to fires, explosions, or any unplanned sudden or non-sudden release of used oil to air, soil, or surface water at the facility.

(ii) If the owner or operator has already prepared a Spill Prevention, Control, and Countermeasures (SPCC) Plan in accordance with part 112 of this chapter, or part 1510 of chapter V of this title, or some other emergency or contingency plan, the owner or operator need only amend that plan to incorporate used oil management provisions that are sufficient to comply with the requirements of this part.

(iii) The plan must describe arrangements agreed to by local police departments, fire departments, hospitals, contractors, and State and local emergency response teams to coordinate emergency services, pursuant to paragraph (a)(6) of this section.

(iv) The plan must list names, addresses, and phone numbers (office and home) of all persons qualified to act as emergency coordinator (see paragraph (b)(5) of this section), and this list must be kept up to date. Where more than one person is listed, one must be named as primary emergency coordinator and others must be listed in the order in which they will assume responsibility as alternates.

(v) The plan must include a list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems (internal and external), and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of

each item on the list, and a brief outline of its capabilities.

(vi) The plan must include an evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of used oil or fires).

(3) *Copies of contingency plan.* A copy of the contingency plan and all revisions to the plan must be:

(i) Maintained at the facility; and

(ii) Submitted to all local police departments, fire departments, hospitals, and State and local emergency response teams that may be called upon to provide emergency services.

(4) *Amendment of contingency plan.* The contingency plan must be reviewed, and immediately amended, if necessary, whenever:

(i) Applicable regulations are revised;

(ii) The plan fails in an emergency;

(iii) The facility changes—in its design, construction, operation, maintenance, or other circumstances—in a way that materially increases the potential for fires, explosions, or releases of used oil, or changes the response necessary in an emergency;

(iv) The list of emergency coordinators changes; or

(v) The list of emergency equipment changes.

(5) *Emergency coordinator.* At all times, there must be at least one employee either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures. This emergency coordinator must be thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the location and characteristic of used oil handled, the location of all records within the facility, and facility layout. In addition, this person must have the authority to commit the resources needed to carry out the contingency plan.

Guidance: The emergency coordinator's responsibilities are more fully spelled out in paragraph (b)(6) of this section. Applicable responsibilities for the emergency coordinator vary, depending on factors such as type and variety of used oil handled by the facility, and type and complexity of the facility.

(6) *Emergency procedures.* (i) Whenever there is an imminent or actual emergency situation, the emergency coordinator (or the designee when the emergency coordinator is on call) must immediately:

(A) Activate internal facility alarms or communication systems, where applicable, to notify all facility personnel; and

(B) Notify appropriate State or local agencies with designated response roles if their help is needed.

(ii) Whenever there is a release, fire, or explosion, the emergency coordinator must immediately identify the character, exact source, amount, and areal extent of any released materials. He may do this by observation or

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review of facility records or manifests and, if necessary, by chemical analyses.

(iii) Concurrently, the emergency coordinator must assess possible hazards to human health or the environment that may result from the release, fire, or explosion. This assessment must consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-offs from water or chemical agents used to control fire and heat-induced explosions).

(iv) If the emergency coordinator determines that the facility has had a release, fire, or explosion which could threaten human health, or the environment, outside the facility, he must report his findings as follows:

(A) If his assessment indicated that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to help appropriate officials decide whether local areas should be evacuated; and

(B) He must immediately notify either the government official designated as the on-scene coordinator for the geographical area (in the applicable regional contingency plan under part 1510 of this title), or the National Response Center (using their 24-hour toll free number 800/424-8802). The report must include:

- (1) Name and telephone number of reporter;
- (2) Name and address of facility;
- (3) Time and type of incident (e.g., release, fire);
- (4) Name and quantity of material(s) involved, to the extent known;
- (5) The extent of injuries, if any; and
- (6) The possible hazards to human health, or the environment, outside the facility.

(v) During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other used oil or hazardous waste at the facility. These measures must include, where applicable, stopping processes and operation, collecting and containing released used oil, and removing or isolating containers.

(vi) If the facility stops operation in response to a fire, explosion, or release, the emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.

(vii) Immediately after an emergency, the emergency coordinator must provide for recycling, storing, or disposing of recovered used oil, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility.

(viii) The emergency coordinator must ensure that, in the affected area(s) of the facility:

(A) No waste or used oil that may be incompatible with the released material is recycled, treated, stored, or disposed of until cleanup procedures are completed; and

(B) All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.

(C) The owner or operator must notify the Regional Administrator, and appropriate State and local authorities that the facility is in compliance with paragraphs (b)(6)(viii)(A) and (B) of this section before operations are resumed in the affected area(s) of the facility.

(ix) The owner or operator must note in the operating record the time, date and details of any incident that requires implementing the contingency plan. Within 15 days after the incident, he must submit a written report on the incident to the Regional Administrator. The report must include:

(A) Name, address, and telephone number of the owner or operator;

(B) Name, address, and telephone number of the facility;

(C) Date, time, and type of incident (e.g., fire, explosion);

(D) Name and quantity of material(s) involved;

(E) The extent of injuries, if any;

(F) An assessment of actual or potential hazards to human health or the environment, where this is applicable;

(G) Estimated quantity and disposition of recovered material that resulted from the incident.

§279.53 Rebuttable presumption for used oil.

(a) To ensure that used oil managed at a processing/re-refining facility is not hazardous waste under the rebuttable presumption of §279.10(b)(1)(ii), the owner or operator of a used oil processing/re-refining facility must determine whether the total halogen content of used oil managed at the facility is above or below 1,000 ppm.

(b) The owner or operator must make this determination by:

- (1) Testing the used oil; or
- (2) Applying knowledge of the halogen content of the used oil in light of the materials or processes used.

(c) If the used oil contains greater than or equal to 1,000 ppm total halogens, it is presumed to be a hazardous waste because it has been mixed with halogenated hazardous waste listed in subpart D of part 261 of this chapter. The owner or operator may rebut the presumption by demonstrating that the used oil does not contain hazardous waste (for example, by showing that the used oil does not contain significant concentrations of halogenated hazardous constituents listed in appendix VIII of part 261 of this chapter).

(1) The rebuttable presumption does not apply to metalworking oils/fluids containing chlorinated paraffins, if they are processed, through a tolling agreement, to reclaim metalworking oils/fluids. The presumption does apply to metalworking oils/fluids if such oils/fluids are recycled in any other manner, or disposed.

(2) The rebuttable presumption does not apply to used oils contaminated with chlorofluorocarbons (CFCs) removed from refrigeration units where the CFCs are

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destined for reclamation. The rebuttable presumption does apply to used oils contaminated with CFCs that have been mixed with used oil from sources other than refrigeration units.

§279.54 Used oil management.

Used oil processor/re-refiners are subject to all applicable Spill Prevention, Control and Countermeasures (40 CFR part 112) in addition to the requirements of this subpart. Used oil processors/re-refiners are also subject to the Underground Storage Tank (40 CFR part 280) standards for used oil stored in underground tanks whether or not the used oil exhibits any characteristics of hazardous waste, in addition to the requirements of this subpart.

(a) *Management units.* Used oil processors/re-refiners may not store used oil in units other than tanks, containers, or units subject to regulation under part 264 or 265 of this chapter.

(b) *Condition of units.* Containers and aboveground tanks used to store or process used oil at processing and re-refining facilities must be:

- (1) In good condition (no severe rusting, apparent structural defects or deterioration); and
- (2) Not leaking (no visible leaks).

(c) *Secondary containment for containers.* Containers used to store or process used oil at processing and re-refining facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

- (i) Dikes, berms or retaining walls; and
- (ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall; or
- (iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floor, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(d) *Secondary containment for existing aboveground tanks.* Existing aboveground tanks used to store or process used oil at processing and re-refining facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

- (i) Dikes, berms or retaining walls; and
- (ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall except areas where existing portions of the tank meet the ground; or
- (iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floor, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(e) *Secondary containment for new aboveground tanks.* New aboveground tanks used to store or process used oil at processing and re-refining facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

- (i) Dikes, berms or retaining walls; and
- (ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall; or
- (iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floor, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(f) *Labels.* (1) Containers and aboveground tanks used to store or process used oil at processing and re-refining facilities must be labeled or marked clearly with the words "Used Oil."

(2) Fill pipes used to transfer used oil into underground storage tanks at processing and re-refining facilities must be labeled or marked clearly with the words "Used Oil."

(g) *Response to releases.* Upon detection of a release of used oil to the environment that is not subject to the requirements of part 280, subpart F of this chapter and which has occurred after the effective date of the recycled used oil management program in effect in the State in which the release is located, an owner/operator must perform the following cleanup steps:

- (1) Stop the release;
- (2) Contain the released used oil;
- (3) Clean up and manage properly the released used oil and other materials; and
- (4) If necessary, repair or replace any leaking used oil storage containers or tanks prior to returning them to service.

(h) *Closure*—(1) *Aboveground tanks.* Owners and operators who store or process used oil in aboveground tanks must comply with the following requirements:

(i) At closure of a tank system, the owner or operator must remove or decontaminate used oil residues in tanks, contaminated containment system components, contaminated soils, and structures and equipment contaminated with used oil, and manage them as hazardous waste, unless the materials are not hazardous waste under this chapter.

(ii) If the owner or operator demonstrates that not all contaminated soils can be practicably removed or decontaminated as required in paragraph (h)(1)(i) of this section, then the owner or operator must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to hazardous waste landfills (§265.310 of this chapter).

(2) *Containers.* Owners and operators who store used oil in containers must comply with the following requirements:

(i) At closure, containers holding used oils or residues of used oil must be removed from the site;

(ii) The owner or operator must remove or decontaminate used oil residues, contaminated containment system components, contaminated soils, and structures and equipment contaminated with used oil, and manage

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them as hazardous waste, unless the materials are not hazardous waste under part 261 of this chapter.

§279.55 Analysis plan.

Owners or operators of used oil processing and re-refining facilities must develop and follow a written analysis plan describing the procedures that will be used to comply with the analysis requirements of §279.53 and, if applicable, §279.72. The owner or operator must keep the plan at the facility.

(a) *Rebuttable presumption for used oil in §279.53.* At a minimum, the plan must specify the following:

(1) Whether sample analyses or knowledge of the halogen content of the used oil will be used to make this determination.

(2) If sample analyses are used to make this determination:

(i) The sampling method used to obtain representative samples to be analyzed. A representative sample may be obtained using either:

(A) One of the sampling methods in appendix I of part 261 of this chapter; or

(B) A method shown to be equivalent under §§260.20 and 260.21 of this chapter;

(ii) The frequency of sampling to be performed, and whether the analysis will be performed on-site or off-site; and

(iii) The methods used to analyze used oil for the parameters specified in §279.53; and

(3) The type of information that will be used to determine the halogen content of the used oil.

(b) *On-specification used oil fuel in §279.72.* At a minimum, the plan must specify the following if §279.72 is applicable:

(1) Whether sample analyses or other information will be used to make this determination;

(2) If sample analyses are used to make this determination:

(i) The sampling method used to obtain representative samples to be analyzed. A representative sample may be obtained using either:

(A) One of the sampling methods in appendix I of part 261 of this chapter; or

(B) A method shown to be equivalent under §§260.20 and 260.21 of this chapter;

(ii) Whether used oil will be sampled and analyzed prior to or after any processing/re-refining;

(iii) The frequency of sampling to be performed, and whether the analysis will be performed on-site or off-site; and

(iv) The methods used to analyze used oil for the parameters specified in §279.72; and

(3) The type of information that will be used to make the on-specification used oil fuel determination.

§279.56 Tracking.

(a) *Acceptance.* Used oil processors/re-refiners must keep a record of each used oil shipment accepted for processing/re-refining. These records may take the form of a log, invoice, manifest, bill of lading or other ship-

ping documents. Records for each shipment must include the following information:

(1) The name and address of the transporter who delivered the used oil to the processor/re-refiner;

(2) The name and address of the generator or processor/re-refiner from whom the used oil was sent for processing/re-refining;

(3) The EPA identification number of the transporter who delivered the used oil to the processor/re-refiner;

(4) The EPA identification number (if applicable) of the generator or processor/re-refiner from whom the used oil was sent for processing/re-refining;

(5) The quantity of used oil accepted; and

(6) The date of acceptance.

(b) *Delivery.* Used oil processor/re-refiners must keep a record of each shipment of used oil that is shipped to a used oil burner, processor/re-refiner, or disposal facility. These records may take the form of a log, invoice, manifest, bill of lading or other shipping documents. Records for each shipment must include the following information:

(1) The name and address of the transporter who delivers the used oil to the burner, processor/re-refiner or disposal facility;

(2) The name and address of the burner, processor/re-refiner or disposal facility who will receive the used oil;

(3) The EPA identification number of the transporter who delivers the used oil to the burner, processor/re-refiner or disposal facility;

(4) The EPA identification number of the burner, processor/re-refiner, or disposal facility who will receive the used oil;

(5) The quantity of used oil shipped; and

(6) The date of shipment.

(c) *Record retention.* The records described in paragraphs (a) and (b) of this section must be maintained for at least three years.

§279.57 Operating record and reporting.

(a) *Operating record.* (1) The owner or operator must keep a written operating record at the facility.

(2) The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility;

(i) Records and results of used oil analyses performed as described in the analysis plan required under §279.55; and

(ii) Summary reports and details of all incidents that require implementation of the contingency plan as specified in §279.52(b).

(b) *Reporting.* A used oil processor/re-refiner must report to the Regional Administrator, in the form of a letter, on a biennial basis (by March 1 of each even numbered year), the following information concerning used oil activities during the previous calendar year;

(1) The EPA identification number, name, and address of the processor/re-refiner;

(2) The calendar year covered by the report; and

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(3) The quantities of used oil accepted for processing/re-refining and the manner in which the used oil is processed/re-refined, including the specific processes employed.

§279.58 Off-site shipments of used oil.

Used oil processors/re-refiners who initiate shipments of used oil off-site must ship the used oil using a used oil transporter who has obtained an EPA identification number.

§279.59 Management of residues.

Owners and operators who generate residues from the storage, processing, or re-refining of used oil must manage the residues as specified in §279.10(e).

Subpart G—Standards for used oil burners who burn off-specification used oil for energy recovery

§279.60 Applicability.

(a) *General.* The requirements of this subpart apply to used oil burners except as specified in paragraphs (a)(1) and (a)(2) of this section. A used oil burner is a facility where used oil not meeting the specification requirements in §279.11 is burned for energy recovery in devices identified in §279.61(a). Facilities burning used oil for energy recovery under the following conditions are not subject to this Subpart:

- (1) The used oil is burned by the generator in an on-site space heater under the provisions of §279.23; or
- (2) The used oil is burned by a processor/re-refiner for purposes of processing used oil, which is considered burning incidentally to used oil processing.

(b) *Other applicable provisions.* Used oil burners who conduct the following activities are also subject to the requirements of other applicable provisions of this part as indicated below.

- (1) Burners who generate used oil must also comply with subpart C of this part;
- (2) Burners who transport used oil must also comply with subpart E of this part;
- (3) Except as provided in §279.61(b), burners who process or re-refine used oil must also comply with subpart F of this part;
- (4) Burners who direct shipments of off-specification used oil from their facility to a used oil burner or first claim that used oil that is to be burned for energy recovery meets the used oil fuel specifications set forth in §279.11 must also comply with subpart H of this part; and
- (5) Burners who dispose of used oil, including the use of used oil as a dust suppressant, must comply with subpart I of this part.

(c) *Specification fuel.* This subpart does not apply to persons burning used oil that meets the used oil fuel specification of §279.11, provided that the burner complies with the requirements of subpart H of this part.

§279.61 Restrictions on burning.

(a) Off-specification used oil fuel may be burned for energy recovery in only the following devices:

- (1) Industrial furnaces identified in §260.10 of this chapter;
- (2) Boilers, as defined in §260.10 of this chapter, that are identified as follows:
 - (i) Industrial boilers located on the site of a facility engaged in a manufacturing process where substances are transformed into new products, including the component parts of products, by mechanical or chemical processes;
 - (ii) Utility boilers used to produce electric power, steam, heated or cooled air, or other gases or fluids for sale; or
 - (iii) Used oil-fired space heaters provided that the burner meets the provisions of §279.23; or
- (3) Hazardous waste incinerators subject to regulation under subpart O of parts 264 or 265 of this chapter.

(b)(1) With the following exception, used oil burners may not process used oil unless they also comply with the requirements of subpart F of this part.

(2) Used oil burners may aggregate off-specification used oil with virgin oil or on-specification used oil for purposes of burning, but may not aggregate for purposes of producing on-specification used oil.

§279.62 Notification

(a) *Identification numbers.* Used oil burners which have not previously complied with the notification requirements of RCRA section 3010 must comply with these requirements and obtain an EPA identification number.

(b) *Mechanics of notification.* A used oil burner who has not received an EPA identification number may obtain one by notifying the Regional Administrator of their used oil activity by submitting either:

- (1) A completed EPA Form 8700-12 (To obtain EPA Form 8700-12 call RCRA/Superfund Hotline at 1-800-424-9346 or 703-920-9810); or
- (2) A letter requesting an EPA identification number. Call the RCRA/Superfund Hotline to determine where to send a letter requesting an EPA identification number. The letter should include the following information:
 - (i) Burner company name;
 - (ii) Owner of the burner company;
 - (iii) Mailing address for the burner;
 - (iv) Name and telephone number for the burner point of contact;
 - (v) Type of used oil activity; and
 - (vi) Location of the burner facility.

§279.63 Rebuttable presumption for used oil.

(a) To ensure that used oil managed at a used oil burner facility is not hazardous waste under the rebuttable presumption of §279.10(b)(1)(ii), a used oil burner must determine whether the total halogen content of used oil managed at the facility is above or below 1,000 ppm.

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(b) The used oil burner must determine if the used oil contains above or below 1,000 ppm total halogens by:

- (1) Testing the used oil;
- (2) Applying knowledge of the halogen content of the used oil in light of the materials or processes used; or
- (3) If the used oil has been received from a processor/re-refiner subject to regulation under subpart F of this part, using information provided by the processor/re-refiner.

(c) If the used oil contains greater than or equal to 1,000 ppm total halogens, it is presumed to be a hazardous waste because it has been mixed with halogenated hazardous waste listed in subpart D of part 261 of this chapter. The owner or operator may rebut the presumption by demonstrating that the used oil does not contain hazardous waste (for example, by showing that the used oil does not contain significant concentrations of halogenated hazardous constituents listed in appendix VIII of part 261 of this chapter).

(1) The rebuttable presumption does not apply to metalworking oils/fluids containing chlorinated paraffins, if they are processed, through a tolling arrangement as described in §279.24(c), to reclaim metalworking oils/fluids. The presumption does apply to metalworking oils/fluids if such oils/fluids are recycled in any other manner, or disposed.

(2) The rebuttable presumption does not apply to used oils contaminated with chlorofluorocarbons (CFCs) removed from refrigeration units where the CFCs are destined for reclamation. The rebuttable presumption does apply to used oils contaminated with CFCs that have been mixed with used oil from sources other than refrigeration units.

(d) Record retention. Records of analyses conducted or information used to comply with paragraphs (a), (b), and (c) of this section must be maintained by the burner for at least 3 years.

§279.64 Used oil storage.

Used oil burners are subject to all applicable Spill Prevention, Control and Countermeasures (40 CFR part 112) in addition to the requirements of this subpart. Used oil burners are also subject to the Underground Storage Tank (40 CFR part 280) standards for used oil stored in underground tanks whether or not the used oil exhibits any characteristics of hazardous waste, in addition to the requirements of this subpart.

(a) *Storage units.* Used oil burners may not store used oil in units other than tanks, containers, or units subject to regulation under parts 264 or 265 of this chapter.

(b) *Condition of units.* Containers and aboveground tanks used to store oil at burner facilities must be:

- (1) In good condition (no severe rusting, apparent structural defects or deterioration); and
- (2) Not leaking (no visible leaks).

(c) *Secondary containment for containers.* Containers used to store used oil at burner facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

- (i) Dikes, berms or retaining walls; and
- (ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall.

(2) The entire containment system, including walls and floor, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(d) *Secondary containment for existing aboveground tanks.* Existing aboveground tanks used to store used oil at burner facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

- (i) Dikes, berms or retaining walls; and
- (ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall except areas where existing portions of the tank meet the ground; or
- (iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floor, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(e) *Secondary containment for new aboveground tanks.* New aboveground tanks used to store used oil at burner facilities must be equipped with a secondary containment system.

(1) The secondary containment system must consist of, at a minimum:

- (i) Dikes, berms or retaining walls; and
- (ii) A floor. The floor must cover the entire area within the dike, berm, or retaining wall; or
- (iii) An equivalent secondary containment system.

(2) The entire containment system, including walls and floor, must be sufficiently impervious to used oil to prevent any used oil released into the containment system from migrating out of the system to the soil, groundwater, or surface water.

(f) *Labels.* (1) Containers and aboveground tanks used to store used oil at burner facilities must be labeled or marked clearly with the words "Used Oil."

(2) Fill pipes used to transfer used oil into underground storage tanks at burner facilities must be labeled or marked clearly with the words "Used Oil."

(g) *Response to releases.* Upon the detection of a release of used oil to the environment that is not subject to the requirements of part 280, subpart F of this chapter and which has occurred after the effective date of the recycled used oil management program in effect in the State in which the release is located, a burner must perform the following cleanup steps:

- (1) Stop the release;
- (2) Contain the released used oil;
- (3) Clean up and manage properly the released used oil and other materials; and
- (4) If necessary, repair or replace any leaking used oil storage containers or tanks prior to returning them to service.

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§279.65 Tracking.

(a) *Acceptance.* Used oil burners must keep a record of each used oil shipment accepted for burning. These records may take the form of a log, invoice, manifest, bill of lading, or other shipping documents. Records for each shipment must include the following information:

- (1) The name and address of the transporter who delivered the used oil to the burner;
- (2) The name and address of the generator or processor/re-refiner from whom the used oil was sent to the burner;
- (3) The EPA identification number of the transporter who delivered the used oil to the burner;
- (4) The EPA identification number (if applicable) of the generator or processor/re-refiner from whom the used oil was sent to the burner;
- (5) The quantity of used oil accepted; and
- (6) The date of acceptance.

(b) *Record retention.* The records described in paragraph (a) of this section must be maintained for at least three years.

§279.66 Notices.

(a) *Certification.* Before a burner accepts the first shipment of off-specification used oil fuel from a generator, transporter, or processor/re-refiner, the burner must provide to the generator, transporter, or processor/re-refiner a one-time written and signed notice certifying that:

- (1) The burner has notified EPA stating the location and general description of his used oil management activities; and
- (2) The burner will burn the used oil only in an industrial furnace or boiler identified in §279.61(a).

(b) *Certification retention.* The certification described in paragraph (a) of this section must be maintained for three years from the date the burner last receives shipment of off-specification used oil from that generator, transporter, or processor/re-refiner.

§279.67 Management of residues.

Burners who generate residues from the storage or burning of used oil must manage the residues as specified in §279.10(e).

Subpart H—Standards for used oil fuel marketers

§279.70 Applicability.

(a) Any person who conducts either of the following activities is subject to the requirements of this subpart:

- (1) Directs a shipment of off-specification used oil from their facility to a used oil burner; or
- (2) First claims that used oil that is to be burned for energy recovery meets the used oil fuel specifications set forth in §279.11.

(b) The following persons are not marketers subject to this subpart:

- (1) Used oil generators, and transporters who transport used oil received only from generators, unless the

generator or transporter directs a shipment of off-specification used oil from their facility to a used oil burner. However, processors/re-refiners who burn some used oil fuel for purposes of processing are considered to be burning incidentally to processing. Thus, generators and transporters who direct shipments of off-specification used oil to processor/re-refiners who incidentally burn used oil are not marketers subject to this Subpart;

(2) Persons who direct shipments of on-specification used oil and who are not the first person to claim the oil meets the used oil fuel specifications of §279.11.

(c) Any person subject to the requirements of this Subpart must also comply with one of the following:

- (1) Subpart C of this part—Standards for Used Oil Generators;
- (2) Subpart E of this part—Standards for Used Oil Transporters and Transfer Facilities;
- (3) Subpart F of this part—Standards for Used Oil Processors and Re-refiners; or
- (4) Subpart G of this part—Standards for Used Oil Burners who Burn Off-Specification Used Oil for Energy Recovery.

§279.71 Prohibitions.

A used oil fuel marketer may initiate a shipment of off-specification used oil only to a used oil burner who:

- (a) Has an EPA identification number; and
- (b) Burns the used oil in an industrial furnace or boiler identified in §279.61(a).

§279.72 On-specification used oil fuel.

(a) *Analysis of used oil fuel.* A generator, transporter, processor/re-refiner, or burner may determine that used oil that is to be burned for energy recovery meets the fuel specifications of §279.11 by performing analyses or obtaining copies of analyses or other information documenting that the used oil fuel meets the specifications.

(b) *Record retention.* A generator, transporter, processor/re-refiner, or burner who first claims that used oil that is to be burned for energy recovery meets the specifications for used oil fuel under §279.11, must keep copies of analyses of the used oil (or other information used to make the determination) for three years.

§279.73 Notification.

(a) *Identification numbers.* A used oil fuel marketer subject to the requirements of this subpart who has not previously complied with the notification requirements of RCRA section 3010 must comply with these requirements and obtain an EPA identification number.

(b) A marketer who has not received an EPA identification number may obtain one by notifying the Regional Administrator of their used oil activity by submitting either:

- (1) A completed EPA Form 8700-12; or
- (2) A letter requesting an EPA identification number. The letter should include the following information:
 - (i) Marketer company name;
 - (ii) Owner of the marketer;
 - (iii) Mailing address for the marketer;

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(iv) Name and telephone number for the marketer point of contact; and

(v) Type of used oil activity (i.e., generator directing shipments of off-specification used oil to a burner).

§279.74 Tracking.

(a) *Off-specification used oil delivery.* Any used oil marketer who directs a shipment of off-specification used oil to a burner must keep a record of each shipment of used oil to a used oil burner. These records may take the form of a log, invoice, manifest, bill of lading or other shipping documents. Records for each shipment must include the following information:

(1) The name and address of the transporter who delivers the used oil to the burner;

(2) The name and address of the burner who will receive the used oil;

(3) The EPA identification number of the transporter who delivers the used oil to the burner;

(4) The EPA identification number of the burner;

(5) The quantity of used oil shipped; and

(6) The date of shipment.

(b) *On-specification used oil delivery.* A generator, transporter, processor/re-refiner, or burner who first claims that used oil that is to be burned for energy recovery meets the fuel specifications under §279.11 must keep a record of each shipment of used oil to the facility to which it delivers the used oil. Records for each shipment must include the following information:

(1) The name and address of the facility receiving the shipment;

(2) The quantity of used oil fuel delivered;

(3) The date of shipment or delivery; and

(4) A cross-reference to the record of used oil analysis or other information used to make the determination that the oil meets the specification as required under §279.72(a).

(c) *Record retention.* The records described in paragraphs (a) and (b) of this section must be maintained for at least three years.

§279.75 Notices.

(a) *Certification.* Before a used oil generator, transporter, or processor/re-refiner directs the first shipment of off-specification used oil fuel to a burner, he must obtain a one-time written and signed notice from the burner certifying that:

(1) The burner has notified EPA stating the location and general description of used oil management activities; and

(2) The burner will burn the off-specification used oil only in an industrial furnace or boiler identified in §279.61(a).

(b) *Certification retention.* The certification described in paragraph (a) of this section must be maintained for three years from the date the last shipment of off-specification used oil is shipped to the burner.

Subpart I—Standards for use as a dust suppressant and disposal of used oil

§279.80 Applicability.

The requirements of this subpart apply to all used oils that cannot be recycled and are therefore being disposed.

§279.81 Disposal.

(a) *Disposal of hazardous used oils.* Used oils that are identified as a hazardous waste and cannot be recycled in accordance with this part must be managed in accordance with the hazardous waste management requirements of parts 260 through 266, 268, 270 and 124 of this chapter.

(b) *Disposal of nonhazardous used oils.* Used oils that are not hazardous wastes and cannot be recycled under this part must be disposed in accordance with the requirements of parts 257 and 258 of this chapter.

§279.82 Use as a dust suppressant.

(a) The use of used oil as a dust suppressant is prohibited, except when such activity takes place in one of the states listed in paragraph (c) of this section.

(b) A State may petition (e.g., as part of its authorization petition submitted to EPA under §271.5 of this chapter or by a separate submission) EPA to allow the use of used oil (that is not mixed with hazardous waste and does not exhibit a characteristic other than ignitability) as a dust suppressant. The State must show that it has a program in place to prevent the use of used oil/hazardous waste mixtures or used oil exhibiting a characteristic other than ignitability as a dust suppressant. In addition, such programs must minimize the impacts of use as a dust suppressant on the environment.

(c) List of States. [Reserved]

Part 1065—Engine-testing procedures

§1065.703 Distillate diesel fuel.

(a) Distillate diesel fuels for testing must be clean and bright, with pour and cloud points adequate for proper engine operation.

(b) There are three grades of #2 diesel fuel specified for use as a test fuel. See the standard-setting part to determine which grade to use. If the standard-setting part does not specify which grade to use, use good engineering judgment to select the grade that represents the fuel on which the engines will operate in use. The three grades are specified in Table 1 of this section.

(c) You may use the following nonmetallic additives with distillate diesel fuels:

(1) Cetane improver.

(2) Metal deactivator.

(3) Antioxidant, dehazer.

(4) Rust inhibitor.

(5) Pour depressant.

(6) Dye.

Regulations

(7) Dispersant.

(8) Biocide.

TABLE 1 OF §1065.703-TEST FUEL SPECIFICATIONS FOR
DISTILLATE DIESEL FUEL

Item	Units	Ultra low sulfur	Low sulfur	High sulfur	Reference procedure ¹
Cetane Number		40-50	40-50	40-50	ASTM D 613-03b
Distillation range:					
Initial boiling point	°C	171- 204	171- 204	171- 204	ASTM D 86-04b
10 pct. point	°C	204- 238	204- 238	204- 238	
50 pct. point	°C	243- 282	243- 282	243- 282	
90 pct. point	°C	293- 332	293- 332	293- 332	
Endpoint	°C	321- 366	321- 366	321- 366	
Gravity	°API	32-37	32-37	32-37	ASTM D 287-92
Total sulfur	mg/kg	7-15	300- 500	2000- 4000	ASTM D 2622-03
Aromatics, minimum. (Remainder shall be par- affins, naphthalenes, and olefins)	g/kg	100	100	100	ASTM D 5186-03
Flashpoint, min	°C	54	54	54	ASTM D 93-02a
Viscosity	cSt	2.0- 3.2	2.0- 3.2	2.0- 3.2	ASTM D 445-04

¹All ASTM procedures are incorporated by reference in §1065.1010.
See §1065.701(d) for other allowed procedures.

Vehicle Maintenance Pro

Reserved

Reference

FMCSA Service Centers

The Federal Motor Carrier Safety Administration (FMCSA) maintains Service Centers, to which official correspondence may be directed, and Field Offices, where the safety investigators for each state are located. The field offices are also referred to as “divisions.” Each state has one Field Office, which is where the Division Administrator for that Field Office is located. The staffs at these offices are ready and willing to answer questions and help anyone who is interested in improving commercial vehicle safety.

Eastern Service Center

802 Cromwell Park Dr.

Ste. N

Glen Burnie, MD 21061

(443) 703-2240

Fax: (443) 703-2253

Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Puerto Rico, Rhode Island, Vermont, Virginia, Virgin Islands, West Virginia

Southern Service Center

1800 Century Blvd., Ste. 1700

Atlanta, GA 30345

(404) 327-7400

Fax: (404) 327-7349

Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee

Midwestern Service Center

4749 Lincoln Mall Dr., Ste. 300A

Matteson, IL 60443

(708) 283-3577

Fax: (708) 283-3579

Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, Wisconsin

Western Service Center

Golden Hills Office Centre

12600 W. Colfax Ave., Ste. B-300

Lakewood, CO 80215

(303) 407-2350

Fax: (303) 407-2339

Alaska, American Samoa, Arizona, California, Colorado, Guam, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Northern Mariana Islands, Oregon, South Dakota, Texas, Utah, Washington, Wyoming

Note for Canadian and Mexican Carriers:

Canadian carriers should contact an FMCSA division (state) office in AK, ME, MI, MT, NY, ND, VT, or WA.

Mexican carriers should contact an FMCSA division (state) office in AZ, CA, NM, or TX.

Vehicle Maintenance Pro

FMCSA field offices

Alabama

Federal Motor Carrier Safety
Administration
520 Cotton Gin Rd.
Montgomery, AL 36117-2018
(334) 290-4954
Fax: (334) 290-4944

Alaska

Federal Motor Carrier Safety
Administration
Frontier Bldg., Ste. 260
3601 "C" St.
Anchorage, AK 99503
(907) 271-4068
Fax: (907) 271-4069

Arizona

Federal Motor Carrier Safety
Administration
400 E. Van Buren St., Ste. 401
Phoenix, AZ 85004
(602) 379-6851
Fax: (602) 379-3627

Arkansas

Federal Motor Carrier Safety
Administration
2527 Federal Bldg.
700 W. Capitol Ave.
Little Rock, AR 72201
(501) 324-5050
Fax: (501) 324-6562

California

Federal Motor Carrier Safety
Administration
1325 J St., Ste. 1540
Sacramento, CA 95814-2941
(916) 930-2760
Fax: (916) 930-2778

Colorado

Federal Motor Carrier Safety
Administration
12300 W. Dakota Ave., Ste. 130
Lakewood, CO 80228
(720) 963-3130
Fax: (720) 963-3131

Connecticut

Federal Motor Carrier Safety
Administration
Glastonbury Corporate Center
628-2 Hebron Ave., Ste. 302
Glastonbury, CT 06033-5007
(860) 659-6700
Fax: (860) 659-6725

Delaware

Federal Motor Carrier Safety
Administration
College Business Park
1203 College Park Dr., Ste. 102
Dover, DE 19904-8703
(302) 734-8173
Fax: (302) 346-5101

District of Columbia

Federal Motor Carrier Safety
Administration
1990 K St., NW, Ste. 510
Washington, DC 20006
(202) 219-3576
Fax: (202) 219-3546

Florida

Federal Motor Carrier Safety
Administration
545 John Knox Rd., Rm. 102
Tallahassee, FL 32303
(850) 942-9338
Fax: (850) 942-9680

Georgia

Federal Motor Carrier Safety
Administration
Two Crown Center
1745 Phoenix Blvd., Ste. 380
Atlanta, GA 30349
(678) 284-5130
Fax: (678) 284-5146

Hawaii

Federal Motor Carrier Safety
Administration
Prince Jonah Kuhio Kalaniana'ole Bldg.
300 Ala Moana Blvd., Rm. 3-239
P.O. Box 50226
Honolulu, HI 96850
(808) 541-2790
Fax: (808) 541-2702

Reference

Idaho

Federal Motor Carrier Safety
Administration
3200 N. Lakeharbor Ln., Ste. 161
Boise, ID 83703
(208) 334-1842
Fax: (208) 334-1046

Illinois

Federal Motor Carrier Safety
Administration
3250 Executive Park Dr.
Springfield, IL 62703-4514
(217) 492-4608
Fax: (217) 492-4986

Indiana

Federal Motor Carrier Safety
Administration
Minton-Capehart Federal Bldg.
575 N. Pennsylvania St., Rm. 261
Indianapolis, IN 46204-1520
(317) 226-7474
Fax: (317) 226-5657

Iowa

Federal Motor Carrier Safety
Administration
105 6th St.
Ames, IA 50010-6337
(515) 233-7400
Fax: (515) 233-7494

Kansas

Federal Motor Carrier Safety
Administration
1303 SW First American Pl., Ste. 200
Topeka, KS 66604-4040
(785) 271-1260
Fax: (877) 547-0378

Kentucky

Federal Motor Carrier Safety
Administration
Federal Building and U.S. Courthouse
330 W. Broadway, Rm. 124
Frankfort, KY 40601
(502) 223-6779
Fax: (502) 223-6767

Louisiana

Federal Motor Carrier Safety
Administration
5304 Flanders Dr., Ste. A
Baton Rouge, LA 70808
(225) 757-7640
Fax: (225) 757-7636

Maine

Federal Motor Carrier Safety
Administration
Edmund S. Muskie Federal Bldg.
40 Western Ave., Rm. 411
Augusta, ME 04330
(207) 622-8358
Fax: (207) 622-8477

Maryland

Federal Motor Carrier Safety
Administration
City Crescent Bldg.
10 S. Howard St., Ste. 2710
Baltimore, MD 21201
(410) 962-2889
Fax: (410) 962-3916

Massachusetts

Federal Motor Carrier Safety
Administration
50 Mall Rd., Ste. 212
Burlington, MA 01803
(781) 425-3210
Fax: (781) 425-3225

Michigan

Federal Motor Carrier Safety
Administration
Federal Bldg.
315 W. Allegan St., Rm. 219
Lansing, MI 48933-1514
(517) 853-5990
Fax: (517) 377-1868

Minnesota

Federal Motor Carrier Safety
Administration
380 Jackson St.
Galtier Plaza, Ste. 500
St. Paul, MN 55101
(651) 291-6150
Fax: (651) 291-6001

Vehicle Maintenance Pro

Mississippi

Federal Motor Carrier Safety
Administration
100 West Capitol St., Ste. 1049
Jackson, MS 39269
(601) 965-4219
Fax: (601) 965-4674

Missouri

Federal Motor Carrier Safety
Administration
3219 Emerald Ln., Ste. 500
Jefferson City, MO 65109
(573) 636-3246
Fax: (573) 636-8901

Montana

Federal Motor Carrier Safety
Administration
2880 Skyway Dr.
Helena, MT 59602
(406) 449-5304
Fax: (406) 449-5318

Nebraska

Federal Motor Carrier Safety
Administration
100 Centennial Mall North, Rm. 406
Lincoln, NE 68508-5146
(402) 437-5986
Fax: (402) 437-5837

Nevada

Federal Motor Carrier Safety
Administration
705 N. Plaza St., Ste. 204
Carson City, NV 89701
(775) 687-5335
Fax: (775) 687-8353

New Hampshire

Federal Motor Carrier Safety
Administration
70 Commercial St., Ste. 102
Concord, NH 03301
(603) 228-3112
Fax: (603) 223-0390

New Jersey

Federal Motor Carrier Safety
Administration
One Independence Way, Ste. 120
Princeton, NJ 08540
(609) 275-2604
Fax: (609) 275-5108

New Mexico

Federal Motor Carrier Safety
Administration
2440 Louisiana Blvd., NE
Ste. 520
Albuquerque, NM 87110
(505) 346-7858
Fax: (505) 346-7859

New York

Federal Motor Carrier Safety
Administration
Leo W. O'Brien Federal Bldg., Rm. 815
Clinton Ave. and N. Pearl St.
Albany, NY 12207
(518) 431-4145
Fax: (518) 431-4140

North Carolina

Federal Motor Carrier Safety
Administration
310 New Bern Ave., Ste. 468
Raleigh, NC 27601
(919) 856-4378
Fax: (919) 856-4369

North Dakota

Federal Motor Carrier Safety
Administration
1471 Interstate Loop
Bismarck, ND 58503
(701) 250-4346
Fax: (701) 250-4389

Ohio

Federal Motor Carrier Safety
Administration
200 N. High St., Rm. 609
Columbus, OH 43215-2482
(614) 280-5657
Fax: (614) 280-6875

Oklahoma

Federal Motor Carrier Safety
Administration
300 N. Meridian, Ste. 106 North
Oklahoma City, OK 73107-6560
(405) 605-6047
Fax: (405) 605-6176

Reference

Oregon

Federal Motor Carrier Safety
Administration
The Equitable Center
530 Center St., NE, Ste. 440
Salem, OR 97301-3740
(503) 399-5775
Fax: (503) 316-2580

Pennsylvania

Federal Motor Carrier Safety
Administration
215 Limekiln Rd., Ste. 200
New Cumberland, PA 17070
(717) 614-4060
Fax: (717) 614-4066

Puerto Rico

Federal Motor Carrier Safety
Administration
Torre Chardón Ste. 207
350 Chardón St.
Hato Rey, PR 00918
(787) 766-5985
Fax: (787) 766-5015

Rhode Island

Federal Motor Carrier Safety
Administration
20 Risho Ave., Ste. E
East Providence, RI 02914
(401) 431-6010
Fax: (401) 431-6019

South Carolina

Federal Motor Carrier Safety
Administration
1835 Assembly St., Ste. 1253
Columbia, SC 29201-2430
(803) 765-5414
Fax: (803) 765-5413

South Dakota

Federal Motor Carrier Safety
Administration
1410 E. Highway 14, Ste. B
Pierre, SD 57501
(605) 224-8202
Fax: (605) 224-1766

Tennessee

Federal Motor Carrier Safety
Administration
640 Grassmere Park, Ste. 111
Nashville, TN 37211
(615) 781-5781
Fax: (615) 781-5780

Texas

Federal Motor Carrier Safety
Administration
903 San Jacinto Blvd., Ste. 101
Austin, TX 78701
(512) 916-5440
Fax: (512) 916-5482

Utah

Federal Motor Carrier Safety
Administration
310 E. 4500 S., Ste. 102
Salt Lake City, UT 84107-3993
(801) 288-0360
Fax: (801) 288-8867

Vermont

Federal Motor Carrier Safety
Administration
Federal Bldg.
87 State St., Rm. 305
P.O. Box 338
Montpelier, VT 05601
(802) 828-4480
Fax: (802) 828-4581

Virginia

Federal Motor Carrier Safety
Administration
400 N. 8th St., Ste. 780
Richmond, VA 23219-4827
(804) 771-8585
Fax: (804) 771-8670

Washington

Federal Motor Carrier Safety
Administration
2424 Heritage Ct., SW, Suite 302
Olympia, WA 98502-6031
(360) 753-9875
Fax: (360) 753-9024

Vehicle Maintenance Pro

West Virginia

Federal Motor Carrier Safety
Administration
700 Washington St. East
Geary Plaza, Ste. 205
Charleston, WV 25301
(304) 347-5935
Fax: (304) 347-5617

Wisconsin

Federal Motor Carrier Safety
Administration
One Point Pl., Ste. 101
Madison, WI 53719-2809
(608) 662-2010
Fax: (608) 829-7540

Wyoming

Federal Motor Carrier Safety
Administration
2617 East Lincolnway, Ste. F
Cheyenne, WY 82001
(307) 772-2305
Fax: (307) 772-2905

Note for Canadian and Mexican Carriers: Canadian carriers should contact an FMCSA Field Office in AK, ME, MI, MT, NY, ND, VT, or WA. Mexican carriers should contact an FMCSA Field Office in AZ, CA, NM, or TX.

OSHA regional offices

If you are unable to contact your local OSHA Area Office, you may contact the appropriate OSHA Regional Office for information and/or assistance. These addresses are current as of **August 7, 2014**.

Region I

(CT* MA, ME, NH, RI, VT*)
JFK Federal Building, Room E340
Boston, MA 02203
(617) 565-9860
Fax: (617) 565-9827

Region II

(NJ, NY, Puerto Rico, Virgin Islands)*
201 Varick Street, Room 670
New York, NY 10014
(212) 337-2378
Fax: (212) 337-2371

Region III

(DC, DE, MD,* PA, VA,* WV)
U.S. Department of Labor/OSHA
The Curtis Center—Suite 740 West
170 S. Independence Mall West
Philadelphia, PA 19106-3309
(215) 861-4900
Fax: (215) 861-4904

Region IV

(AL, FL, GA, KY,* MS, NC,* SC,* TN*)
61 Forsyth Street SW
Room 6T50
Atlanta, GA 30303
(678) 237-0400
Fax: (678) 237-0447

Region V

(IL,* IN,* MI,* MN,* OH, WI)
230 South Dearborn Street, Room 3244
Chicago, IL 60604
(312) 353-2220
Fax: (312) 353-7774

Region VI

(AR, LA, NM,* OK, TX)
525 Griffin Street, Suite 602
Dallas, TX 75202
(972) 850-4145
Fax: (972) 850-4149

Region VII

(IA,* KS, MO, NE)
Two Pershing Square Building
2300 Main Street, Suite 1010
Kansas City, MO 64108-2416
(816) 283-8745
Fax: (816) 283-0547

Reference

Region VIII

(CO, MT, ND, SD, UT,* WY*)

Cesar Chavez Memorial Building

1244 Speer Blvd., Suite 551

Denver, CO 80204

(720) 264-6550

Fax: (720) 264-6585

Region IX

(American Samoa, AZ,* CA,* Guam, HI,*

NV,* Trust Territories of the Pacific)

90 7th Street, Suite 18100

San Francisco, CA 94103

(415) 625-2547 (Main Public — 8:00 AM -

4:30 PM Pacific)

Fax: (415) 625-2534

Region X

(AK,* ID, OR,* WA*)

300 Fifth Avenue, Suite 1280

Seattle, WA 98104-2397

(206) 757-6700

Fax: (206) 757-6705

*These states and territories operate their own OSHA-approved job safety and health programs (Connecticut, Illinois, New Jersey, New York, and Virgin Islands plans cover public employees only). States with approved programs must have a standard that is identical to, or at least as effective as, the federal standard.

EPA REGIONAL OFFICES

EPA Phone Numbers

Environmental Protection Agency

401 M Street, S.W.

Washington, D.C. 20460

202/260-2090

Air and Radiation Programs.....	202/260-7400
Asbestos Action Program.....	202/260-7849
Medical Waste Task Force.....	202/260-8551
Pesticides and Toxic Substances.....	202/260-3810
Research and Development.....	202/260-7676
Solid Waste and Emergency Response	202/260-4627
Stormwater	703/821-4823
Underground Storage Tanks.....	703/308-8850
Waste Characterization Branch, MD OS331...	703/308-8402
Office of Water	202/260-5700

Hotlines Available

Sara Title III, Community Right-to-Know (EPCRA)	800-535-0202
RCRA/Superfund Hotline	800-424-9346
(under which falls the Medical Waste Tracking Act)	
Safe Drinking Water	800-426-4791
National Pesticide Telecommunications Network.....	800-858-7378
Stormwater	703/821-4823

Vehicle Maintenance Pro

National Response Center..... 800-424-8802
(for hazardous substance releases and oil
spills)
Underground Storage Tanks..... 800-424-9346

EPA Regional Offices

Region I

(Connecticut, Maine, Massachusetts, New
Hampshire, Rhode Island, Vermont)
John F. Kennedy Federal Building
One Congress Street, Rm 2203
Boston, MA 02203
617/565-3420

Region II

(New Jersey, New York, Puerto Rico, Virgin
Islands)
Jacob K. Javits Federal Building
26 Federal Plaza, Rm 900
New York, NY 10278
212/264-2657

Region III

(Delaware, District of Columbia, Maryland,
Pennsylvania, Virginia, West Virginia)
841 Chestnut St.
Philadelphia, PA 19107
215/597-9800

Region IV

(Alabama, Florida, Georgia, Kentucky,
Mississippi, North Carolina, South Carolina,
Tennessee)
345 Courtland Street, N.E.
Atlanta, GA 30365
404/347-4727

Region V

(Illinois, Indiana, Michigan, Minnesota,
Ohio, Wisconsin)
77 West Jackson Boulevard
Chicago, IL 60604-3507
312/353-2000

Region VI

(Arkansas, Louisiana, New Mexico,
Oklahoma, Texas)
First Interstate Bank Tower at Fountain
Place
1445 Ross Avenue, 12th Floor, Suite 1200
Dallas, TX 75202-2733
214/655-6444

Region VII

(Iowa, Kansas, Missouri, Nebraska)
726 Minnesota Avenue
Kansas City, KS 66101
913/551-7000

Region VIII

(Colorado, Montana, North Dakota, South
Dakota, Utah, Wyoming)
999 18th Street, Suite 500
Denver, CO 80202-2405
303/293-1603

Region IX

(American Samoa, Arizona, California,
Guam, Hawaii, Nevada)
75 Hawthorne Street
San Francisco, CA 94105
415/744-1305

Region X

(Alaska, Idaho, Oregon, Washington)
1200 Sixth Avenue
Seattle, WA 98101
206/553-4973

Vehicle Maintenance Pro

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Operational analysis	Operational planning-2
Operational objectives	Operational planning-3

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Operational plan	Operational planning-1
OSHA	OSHA compliance-1
OSHA 2203	OSHA compliance-4A
OSHA 3165	OSHA compliance-4A
OSHA Form 300	OSHA compliance-4A
OSHA Form 300A Summary	OSHA compliance-4A
OSHA inspection	OSHA compliance-46
OSHA training	OSHA compliance-57
Parking lamps	DOT compliance-8A
Part 382	DOT compliance-38
Part 383	DOT compliance-44
Part 391	DOT compliance-31
Part 393	DOT compliance-1
Part 395	DOT compliance-35
Part 396	DOT compliance-17
Part 40	DOT compliance-38
Parts	Parts management-1
Parts stocking	Parts management-9
Parts tracking	Parts management-5
Parts warranty	Parts management-7
Performance evaluation	Performance evaluation-1
Periodic inspection	DOT compliance-24W
Personal protective equipment	OSHA compliance-55
PM	Determining maintenance schedules-2
PM A	Determining maintenance schedules-8
PM B	Determining maintenance schedules-9
PM C	Determining maintenance schedules-9
PM checklists	Determining maintenance schedules-5
PM D	Determining maintenance schedules-9
PM intervals	Determining maintenance schedules-4
Policy on the misuse of alcohol and use of controlled substances	DOT compliance-43
Post-accident testing	DOT compliance-40
Pre-employment testing	DOT compliance-40
Pre-service inspection	Determining maintenance schedules-10A
Pretreatment program	EPA compliance-39
Preventive maintenance	Determining maintenance schedules-2
Programmed inspections	OSHA compliance-49
Progressive shifting	Improving fuel efficiency-1
Protection against shifting and falling cargo	DOT compliance-16
Protection for using rights	OSHA compliance-10
Qualification of drivers	DOT compliance-31
Qualifications of brake inspectors	DOT compliance-25

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Quality circles	Recruiting, training, and retaining technicians-12
Quality control	Performance evaluation-7
Radial	Tire management-4
Random testing	DOT compliance-41
Reasonable suspicion testing	DOT compliance-42
Rebuilt parts	Parts management-2
Record of duty status	DOT compliance-38
Records review	OSHA compliance-49
Refrigerants	EPA compliance-22
Refrigerants, other	EPA compliance-26
Release detection	EPA compliance-34
Remanufactured parts	Parts management-3
Removal from safety-sensitive function	DOT compliance-43
Repair order	Recordkeeping-1
Retread record	Tire management-29
Retreading	Tire management-23
Retroreflective sheeting	DOT compliance-8B
Return on investment	Requirements and accessories-2
Rework tracking	Performance evaluation-7
Right to know reporting	EPA compliance-52
Safe Drinking Water Act (SDWA)	EPA compliance-43
Safety fitness procedures	DOT compliance-44B
Safety rating	DOT compliance-50
Scheduled repair	Performance evaluation-6
Septic systems	EPA compliance-43
Shop meetings	Recruiting, training, and retaining technicians-11
Shop productivity	Recordkeeping-18
Side marker lamps	DOT compliance-7
Significant industrial users	EPA compliance-42
Small Quantity Generators (SQG)	EPA compliance-8
Specialized work areas	OSHA compliance-21
Spill Prevention, Control and Countermeasure (SPCC)	EPA compliance-38
Stormwater	EPA compliance-45
Stormwater NPDES permit	EPA compliance-45
Subpart B — Single license requirement	DOT compliance-44A
Subpart C — Notification requirements and employer responsibilities	DOT compliance-44A
Subpart D — Driver disqualifications and penalties	DOT compliance-44A
Super-single	Tire management-6
T1	Determining maintenance schedules-9
T2	Determining maintenance schedules-9
T3	Determining maintenance schedules-9
Tail lamps	DOT compliance-6

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Task recording	Recordkeeping-5
Time control	Performance evaluation-7
Tire air pressure checks	Tire management-11
Tire balancing	Tire management-22
Tire branding	Tire management-29
Tire control	Tire management-29
Tire identification	Tire management-28
Tire inventory record	Tire management-29
Tire maintenance	Tire management-10
Tire mounting/dismounting record	Tire management-29
Toxic chemical release reporting	EPA compliance-53
Training for supervisors	DOT compliance-43
Transmission	Requirements and accessories-10
Tread design	Tire management-7
TSD permitting	EPA compliance-12
Turn signal lamps	DOT compliance-3
Underground injection control	EPA compliance-43
Underground Storage Tank Compliance Act	EPA compliance-32
Underground storage tanks	EPA compliance-30
Uniform Hazardous Waste Manifest (UHWM)	EPA compliance-14
Unscheduled repair	Performance evaluation-6
Used batteries	EPA compliance-28
Used parts	Parts management-2
UST audit checklist	Self audits-12
UST release detection	EPA compliance-34
Violation of out-of-service orders	DOT compliance-33
VMRS ROs	Recordkeeping-7
Waste oil	EPA compliance-19
Waste tires	EPA compliance-17
Wastes with specific characteristic	EPA compliance-6
Wastewater	EPA compliance-39
Water separators	Requirements and accessories-15
Wear pattern analysis	Tire management-35
Wide-base singles	Tire management-6
Will-fit parts	Parts management-4
Workplace chemical audit checklist	Self audits-7