

3B Scientific

3Bscientific.com

...going one step further

Student Experiments
3B NETlog™
Mechanics
Waves
Energy and Environment
Thermodynamics
Optics
Electricity and Magnetism
Atomic and Nuclear Physics
Laboratory Equipment

www.EngineeringBooksPDF.com



Dr. Johannes Recht
Head of Physics

Dear Customers,

Your custom has elevated us to becoming one of the world's leading manufacturers of physics teaching resources in the short space of just ten years. Now we are continuing to work hard on improving even more, with your help and for your benefit. That is why you will find **many new innovations** and further developments of existing products alongside the familiar items on these pages.

It is worth casting an eye over the **space-saving table-top experiments** on mechanical oscillations (page 73) and the equipment for demonstrating wave properties using ultra-sound (page 105). We have worked closely with experienced teachers, and some particularly convenient and illustrative experiments have come into being as a result.

Due to popular demand from our customers, we will as of now be able to offer the tried and trusted **NEVA optics system** with modern optical lamps (page 140). This change was one that many of you had requested, as was the expansion of our student experiment range to include new equipment sets for **electrostatics** (page 18) and **radioactivity** (page 25).

Building circuits, whether simple or complex, will now be quicker and easier to understand. New products for this can be found on pages 184 and 185 as well as pages 190 to 192. Other brand new items include the **inexpensive** millisecond counter for our free-fall experiment (page 63), a durable fine beam electron tube complete with control unit (page 227), a dosimeter for detecting radioactivity which has been proven in everyday use (page 244), a high-quality scanning tunnelling microscope (page 229) and various models for demonstrating the structure of matter on atomic and sub-atomic scales (pages 230 – 232).

The use of **ultra-sound in medicine** can now be explained using the new apparatus on pages 102/104 and some possibilities for experimenting on the **Hall effect** in semiconductors can be found on page 242.

You can see that "… ***going one step further***" really is our motto, because we are always taking that extra step to give you better quality, variety and value for money. So come and join because with your help, we can only keep on getting better.

Yours sincerely,

Dr. Johannes Recht
Head of Physics

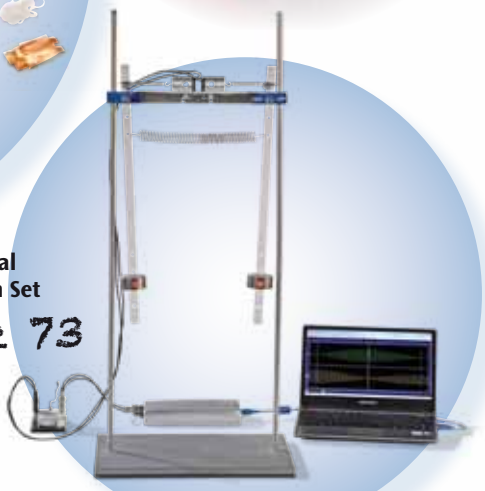


STUDENT *Kit* – Electrostatics
Page 18





SW Ultrasonics Set
Page 105

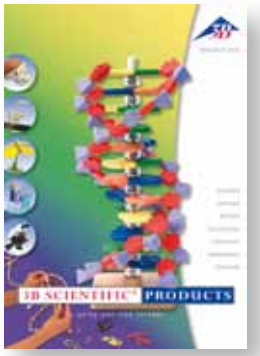


SW Physical Pendulum Set
Page 73

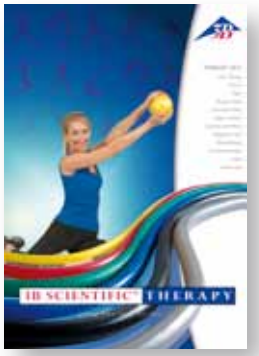
Further 3B Scientific® Catalogues



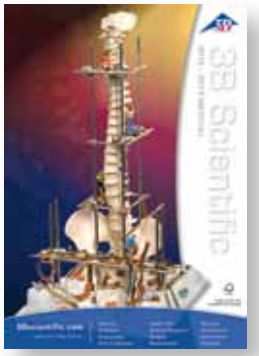
Physics Experiments



Biology



Physiotherapy



Medical

Copyright © 2011, 3B Scientific GmbH, Hamburg. Unauthorized reproduction and publication of this material is strictly forbidden.

www.EngineeringBooksPDF.com



Contents

6 New Products

14 Student Experiments
14 Student kits
19 Acoustics kit
20 Student Experiment Kits (SEK)
26 Kröncke optical system for student exercises and practical courses
28 Basic student experiments
31 "Renewable Energy" kit

34 Computer Aided Experimentation
34 3B NET*lab*™
35 3B NET*log*™
36 Sensors
43 Fourier analysis

44 Mechanics
44 Mechanics on a whiteboard
45 Measurement of time
46 Measurement of length
47 Volume measurement
48 Dynamometers
49 Helical springs
50 Balance weights
52 Gravitation/Astronomy
53 Statics
54 Friction
55 Simple machines
57 Linear motion
60 Motion in a plane
63 Free fall / Uniform acceleration
64 Vertical and horizontal trajectories
66 Rotational motion
68 Gyroscope
69 Oscillations
75 Buoyancy
76 Density and volume
78 Pressure
81 Surface tension / Viscosity
82 Vacuum
84 Vacuum pumps with hose connections
85 Vacuum pumps with flange connections
86 Aerodynamics
87 Laminar flow

88 Waves and Sound
88 Wave optics
89 Water waves
90 Mechanical waves
93 Sound
97 Ultrasound

106 Energy and the Environment
106 Solar energy
107 Greenhouse effect
108 Fuel cells
110 Weather
111 Noise

112 Heat and Thermodynamics
112 Thermometer
116 Equivalent of heat
117 Calorimeters
118 Thermal expansion
121 Heat conduction / Heat flow
122 Radiation of heat
123 Gas laws
127 Cyclic processes
133 Heat sources

134 Light and Optics
134 Optics on a whiteboard
137 Geometric optics
138 Kröncke optics
140 NEVA Optical system
141 Optics using an optical bench U
142 Optics using an optical bench D
143 Optical lamps on stem
145 Optical components on stem
149 Apertures, diffraction elements, filters
152 Diffraction elements
153 Prisms / Optical crystals
155 Wave optics using a laser
157 Colour
158 CCD camera
160 Polarisation
162 Spectrum tubes and spectrum lamps
164 Spectrometers
167 Interferometers
168 Solid-state laser physics
172 Equipment sets
174 Speed of light
175 Eye and vision

176 Electricity and Magnetism
176 Electrostatics
182 Electrical circuits
190 3B Plug-In component system
193 Electro-chemistry
196 Magnetism
198 Magnetic fields
204 Conductors in magnetic fields
206 Induction
210 Demountable transformer
213 Tesla coil transformer
214 Free electrons in gases and in vacuum

228 Atomic and Nuclear Physics
228 Periodic table of the elements
229 Scanning tunneling microscope
230 Model crystals
231 Molecule building sets
232 Atomic orbitals
233 Millikan's experiment
234 Fundamentals of atomic physics
236 Franck-Hertz-experiment
239 Waves and particles
240 ESR / NMR
242 Hall-effect
243 Radioactivity

246 Instrumentation
246 Power supplies
252 Function generators
254 Oscilloscopes
257 Power and energy meter
258 Hand-held analogue measuring instruments
260 Hand-held digital measuring instruments
264 Digital counters
266 Rotational motion
267 Microvoltmeter / Amplifier
268 Laboratory scales
270 Overhead projector
271 Microscopes
272 Video cameras
274 Magnetic stirrers
275 Whiteboards

276 Lab Material
276 Stand equipment
278 Tubing
279 Experiment leads and cables
281 Glassware

283 Historical Experiments

284 Index

298 New Products

303 More Product Ranges

Committed to quality

3B Scientific provides you with good quality at fair prices. Our sophisticated quality management complies with the ISO 9001:2008 standards and the Worlddidac Quality Charter and is regularly approved by independent experts.

That's something you can rely on.

www.EngineeringBooksPDF.com

9 Reasons to Buy 3B Scientific Products

1 3-year quality guarantee

If, in spite of proper handling, you should discover any material or manufacturing defect within three years of the date of purchase, we will replace the product or correct the defect.

2 Low-price guarantee

With your purchase you obtain the highest quality at the lowest prices. If you can purchase a qualitatively comparable product at a lower price anywhere in the world within 14 days of purchase, you may return the product and we will refund the full purchase price.

3 14-day right of return

If, for any reason, you should not be fully satisfied with a 3B Scientific® product, simply return it in the original packaging and a copy of the invoice within 14 days. You will receive a complete refund.

4 Rapid delivery

We have an extensive range of products on site in our warehouse and can deliver most of the equipment within just a few days.

5 Special discounts

When orders entail larger volumes you can benefit from extra savings. Please ask our sales team about special volume discounts.

6 Continuous improvements

In order to be able to offer you the best possible quality, we continue to develop new products and innovate our product processes. For that reason it might be the case that actual products appear slightly different from the ones illustrated here.

7 Expanding the product spectrum

We are constantly expanding our product range and for that reason look forward to your ideas and comments to help inspire new developments.

8 Operational world-wide

In general, our products can be put into operation anywhere. Please pay close attention to your local mains voltage, i.e. 230 or 115 volts, when connecting up equipment with a mains power supply.

9 Quality management

As of June 2000 we have obtained a quality approval certification for service, products and organisational processes according to DIN EN ISO 9001:2008. This recognised Quality Management System has since lent us official support for our strategic commitment to innovation, product improvement and customer orientation. In addition to this we also continue to fulfil all of the quality standards associated with the introduction of the Worlddidac Quality Charter initiated in September 2004.

The 3B Scientific…

Group started in 2000 with the preparations for introducing an extensive range of Physics apparatus. It was to encompass equipment suitable for early Secondary School studies ranging up to University level. By the following year, the range was already in place for its launch and in the winter of 2001/2002 the first 3B Scientific® Physics Catalogue appeared. Even then it covered 144 pages.

From day one the company has been marketing products of its own manufacture, but the physics section took a major step forward in 2004 with the takeover of ELWE Didactic and another in 2005 with the purchase of TELTRON. Both Brands were already well-established with good reputations in the Educational Equipment market across the globe as outstanding product ranges, backed by decades of experience.

ELWE Didactic had its roots in a company called ELWE Lehrsysteme, which had already extended its commercial foothold in the pure sciences by taking over Kröncke in 1987, as well NEVA and Simeto in 1992. In 1995 ELWE Lehrgerätebau Klingenthal (formerly Simeto), which is now known as ELWE Didactic, took over the development, manufacturing and sales of teaching equipment for physics.

TELTRON was founded in 1963 and rapidly gained a worldwide name for its development of highly evacuated cathode ray tubes and a wide range of teaching equipment for the areas of atomic and nuclear physics.

Timeline

1958	Establishment of ELWE Lehrsysteme (Cremlingen, Germany)
1963	Establishment of TELTRON (London, England)
1987	Acquisition of Kröncke (Hanover, Germany) by ELWE Lehrsysteme
1992	Acquisition of Neva (Geißlingen an der Steige, Germany) and Simeto (Klingenthal, Germany) by ELWE Lehrsysteme
1995	Simeto renamed ELWE Lehrgerätebau Klingenthal, later to become ELWE Didactic
2000	Establishment of 3B Physics Department
2002	Introduction of Physics range to the global market with the 3B Physics catalogue, available in six languages.
2004	Integration of Elwe Didactic into 3B Scientific group
2005	Purchase of the TELTRON® brand and establishment of new factory in London, England
2007	First edition of 3B Physics Experiments catalogue in six languages

www.EngineeringBooksPDF.com

3B Scientific Physics Manufacturing...

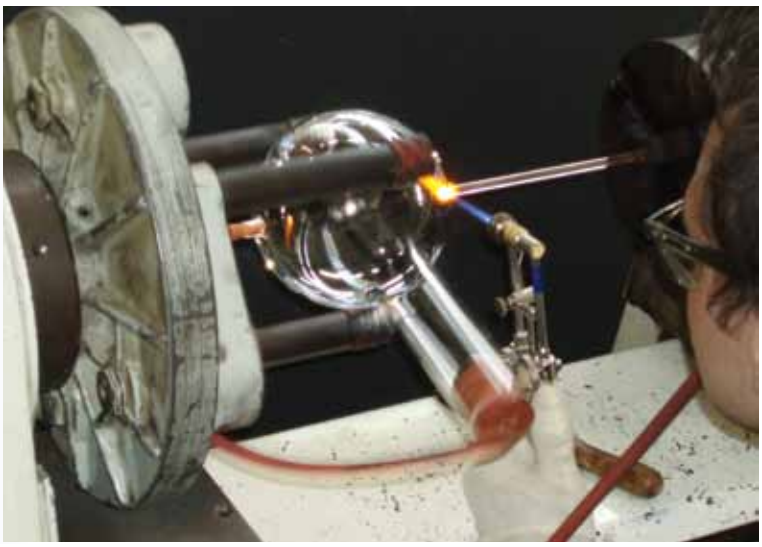
The physics business unit has seen highly positive developments at its various manufacturing sites in recent years.

In particular, the physics production facilities at ELWE and TELTRON have been modernised, reorganised and certified in accordance with ISO 9001:2008 so that we can fulfil your needs better and more quickly.

One thing is certain: for you we will always be pleased to go one step further.

Manufacturing a TELTRON® Electron Tube at UK 3B Scientific in London

Electron tubes are produced at only a very small number of places in the world. Only specially trained technicians with many years of experience have the skills that are needed for this technologically advanced manufacturing process, which ensures that every TELTRON® electron tube that you receive from us will have the same consistently high quality.



Assembly Production at the CNC Processing Centre of ELWE in Klingenthal

The universally recognised high quality of the teaching equipment produced under the ELWE® brand name is achieved through a combination of modern process technology with the best traditional craftsmanship. The skills and facilities of the CNC Processing Centre in Klingenthal guarantee not only the mechanical precision that is essential for high-quality physical instruments, but also cost-effective series production with consistently high quality.



A CAD/CAM Workstation at ELWE in Klingenthal

A direct extension from the principles of CAD (Computer Aided Design) is CAM (Computer Aided Manufacturing), here shown being applied to controlling a flat-bed milling machine. This manufacturing technology makes it possible to fulfil special project requirements with speed and with the usual high precision.



www.EngineeringBooksPDF.com

NEW

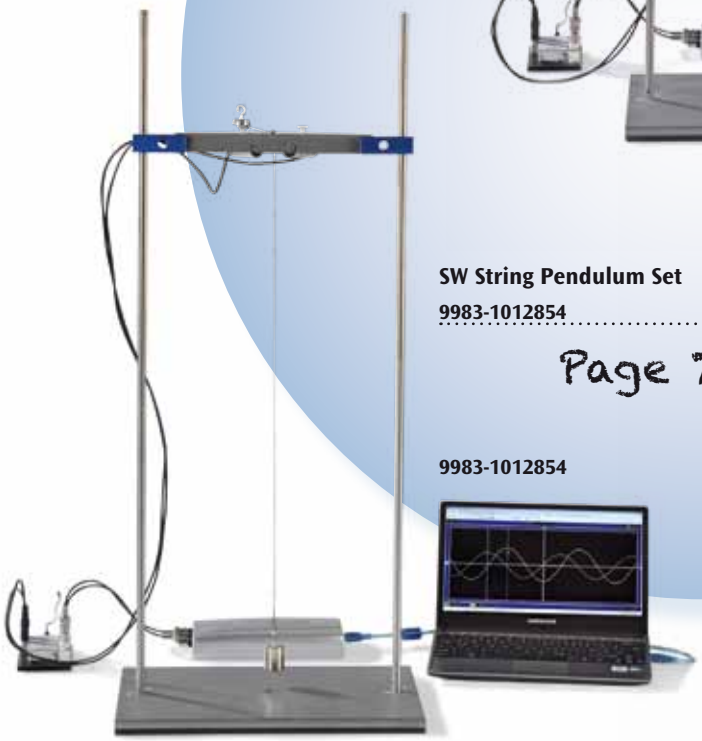
Mechanical Oscillations in a Space Saving Table Top Experiment



SW Physical Pendulum Set
9983-1012853

Page 73

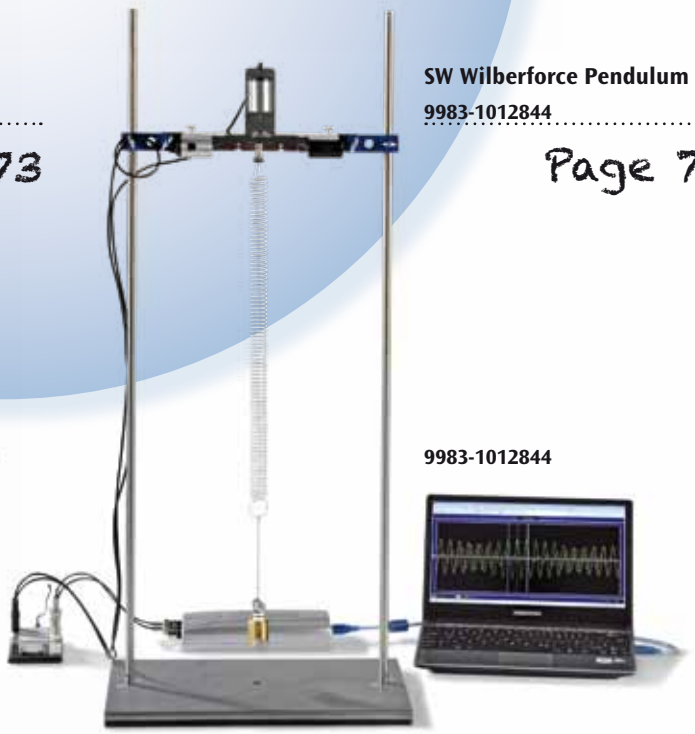
9983-1012853



SW String Pendulum Set
9983-1012854

Page 73

9983-1012854



SW Wilberforce Pendulum Set
9983-1012844

Page 73

9983-1012844



SW Sensors Set (230 V, 50/60 Hz)
9983-1012850

SW Sensors Set (115 V, 50/60 Hz)
9983-1012851

Page 43

9983-1012850

www.EngineeringBooksPDF.com

NEW

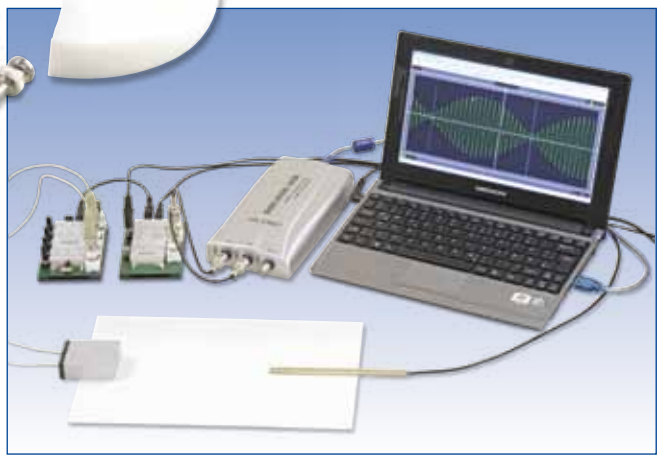
SW Ultrasonics Set (230 V, 50/60 Hz)
9983-1012845

SW Ultrasonics Set (115 V, 50/60 Hz)
9983-1012846

Page 105



9983-1012845
9983-1012846



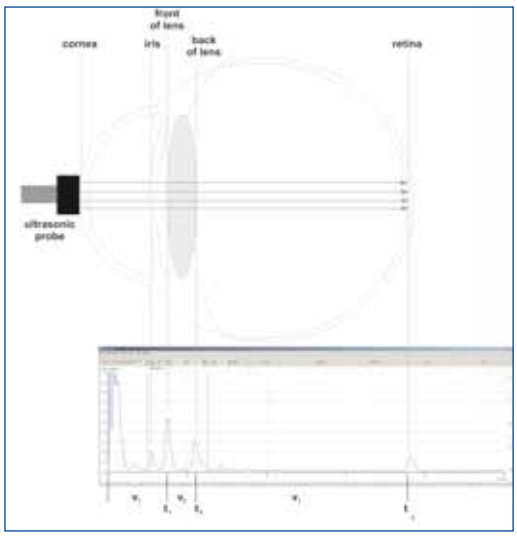
Millisecond Counter (230 V, 50/60 Hz)
9983-1012832

Millisecond Counter (115 V, 50/60 Hz)
9983-1012833

Page 265



9983-1012832
9983-1012833





9983-1012869

Model Eye for Ultrasonic Biometry
9983-1012869

Page 102

www.EngineeringBooksPDF.com

NEW



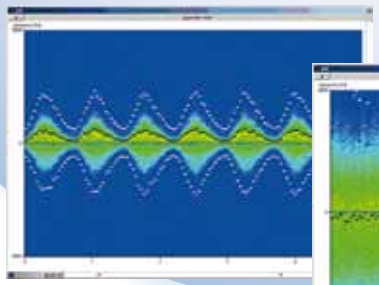
9983-1012880

Experiment Topics:

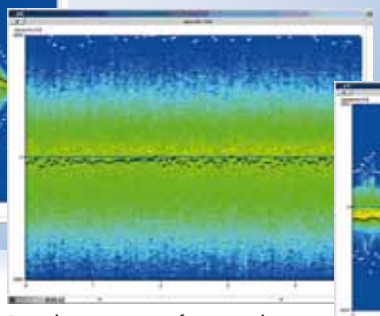
- Doppler sonographic examinations of the human arm.
- Measurement of the flow velocity of blood
- Recording of Doppler spectra and pulse curves
- Diagnosis of stenosis (vascular stricture) in an arm

Arm Phantom Set
9983-1012880

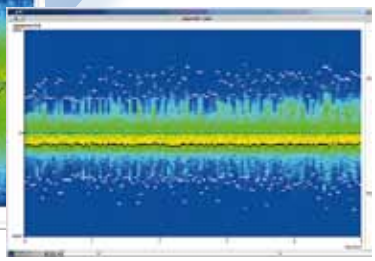
Page 104



Doppler spectrum at arterial flow



Doppler spectrum of a stenosis



Doppler spectrum at venous flow

Charge Indicator
9983-1009962

Page 177



9983-1009962



9983-1008505

9983-1009948

Complete Fine Beam Tube System
The complete fine-beam tube system consists of the following parts:

Fine Beam Tube T
9983-1008505

Operating Unit for Fine-Beam Tube
9983-1009948

Page 227

www.EngineeringBooksPDF.com

NEW



9983-1009883

STUDENT *Kit* – Electrostatics

9983-1009883

Page 18



9983-1009883

Charge Storage Device with Piezo Charger

9983-1009963

Page 177



9983-1009963



Hall Effect Experiment

Page 242

...going one step further

www.EngineeringBooksPDF.com

NEW



SEK Radioactivity

9983-1006804

Page 25

9983-1006804



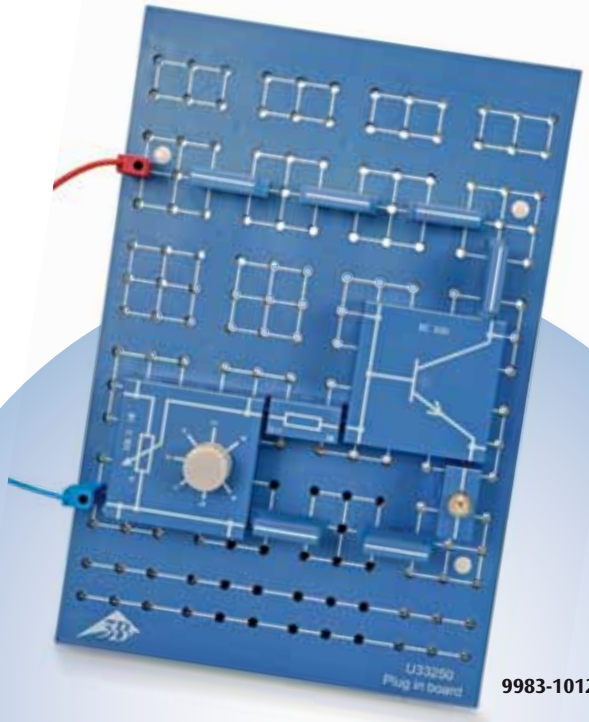


9983-1012827

Falling Sphere Viscometer

9983-1012827

Page 81



9983-1012902

Plug-in Board for Components

9983-1012902

Page 190

New Products

www.EngineeringBooksPDF.com

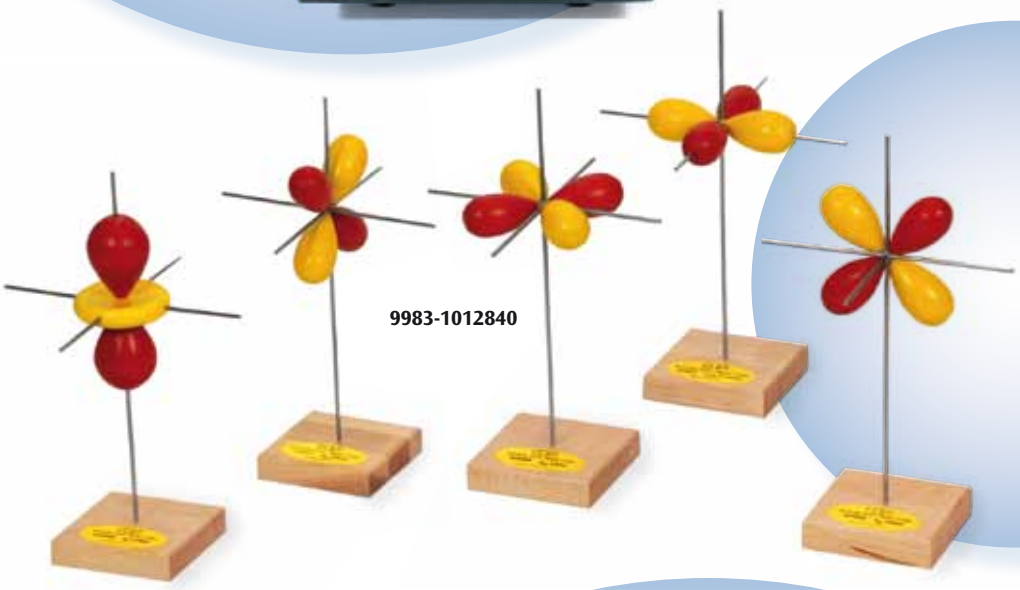
NEW



9983-1012782

Scanning Tunnelling Microscope
9983-1012782

Page 229



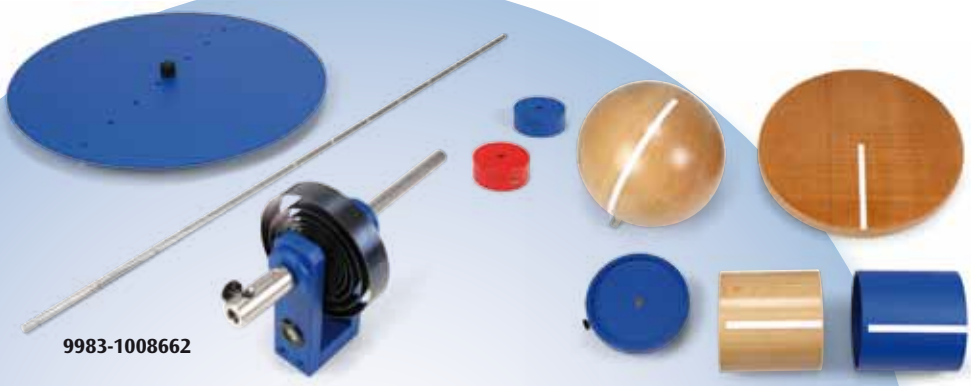
9983-1012840

Set of 5 d-Orbitals
9983-1012840

Page 232

Experiment Topics:

- Rotary oscillations
- Determination of moments of inertia using the oscillation method
- Moments of inertia of various geometric bodies
- Steiner's theorem



9983-1008662

9983-1008663

Torsion Axle
9983-1008662

Set of Test Bodies for Torsion Axle
9983-1008663

Page 74



9983-1012827

www.EngineeringBooksPDF.com

NEW



9983-1000845



9983-1009946

The NEVA optics system offers inexpensive reliability and ease of use for setting up basic experiments in ray optics.

All the optical components are set in a slide with a magnetic base and can easily be aligned on an optical base and moved into a beam of light.



Optical Lamp N (115 V, 50/60 Hz)
9983-1009945

Optical Lamp N (230 V, 50/60 Hz)
9983-1009946

Object Holder N
9983-1000845

Page 140

Optical Bench N
9983-4003987



9983-4003987



9983-1012862

Gauge with Adapter
9983-1012862

Page 119

9983-1012894



Dosimeter Radex RD 1706
9983-1012894

Page 244



9983-1012696



9983-1010158



9983-1012698



9983-1010156

LED Graetz Bridge in 3B Box
9983-1012696

ELV Motor on 3B Box
9983-1010158

Ohm's Law Apparatus in 3B Box
9983-1012698

Universal Holder on 3B Box
9983-1010156

Page 184/185

www.EngineeringBooksPDF.com

NEW

9983-1012881



ABS Analytical Scales (230 V. 50/60 Hz)

9983-1012881

Page 270

9983-1012816

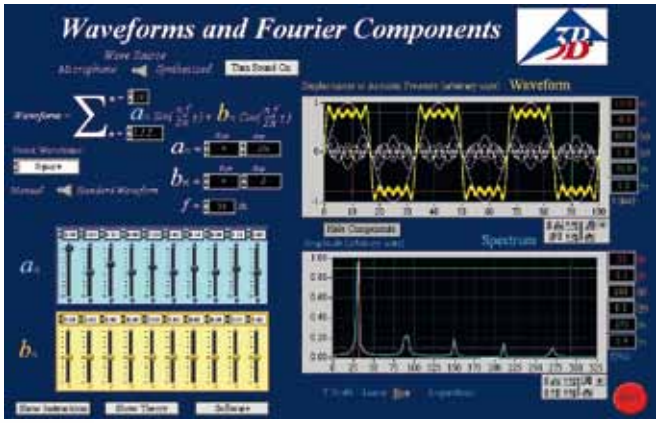


TRMS

DMM60 Digital Multimeter

9983-1012816

Page 262

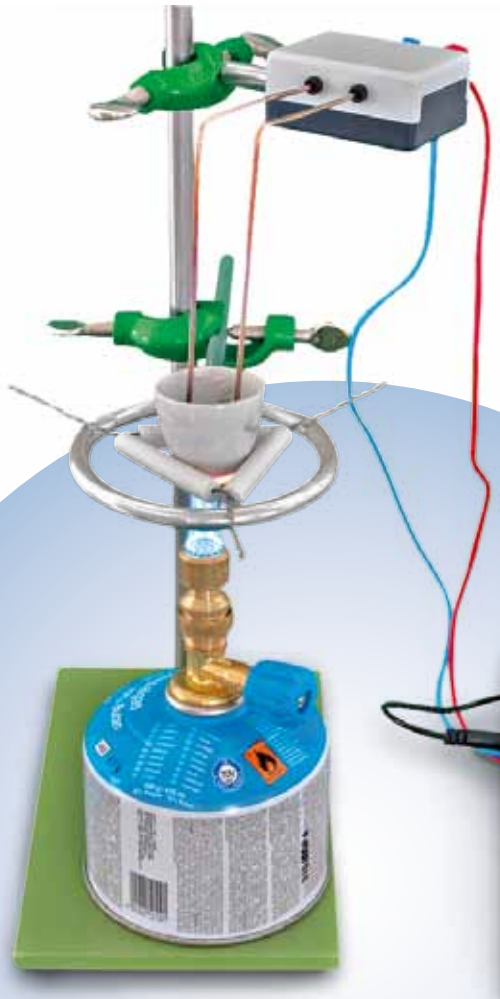


9983-1012587

Software for Fourier Analysis

9983-1012587

Page 43



9983-1012890

Conductivity Tester

9983-1012890

Page 195

More new products on page 298

www.EngineeringBooksPDF.com

3B STUDENT *Kit*
Student Experiments for Lower Secondary

The versatile 3B STUDENT *Kits* allow students in lower secondary level to work independently in setting up and carrying out a comprehensive range of basic experiments on the topics of mechanics, heat and optics. Detailed instructions for the experiments, divided into pages for students and pages for teachers, help the students to perform the experiments and enable the teachers to make the necessary preparations.

Each equipment set-up enables students to work in pairs and requires a bench area of only 400 mm x 250 mm, which is sufficient to ensure a clear and stable set-up. The robust components are made of anodised aluminium, plastic or glass.

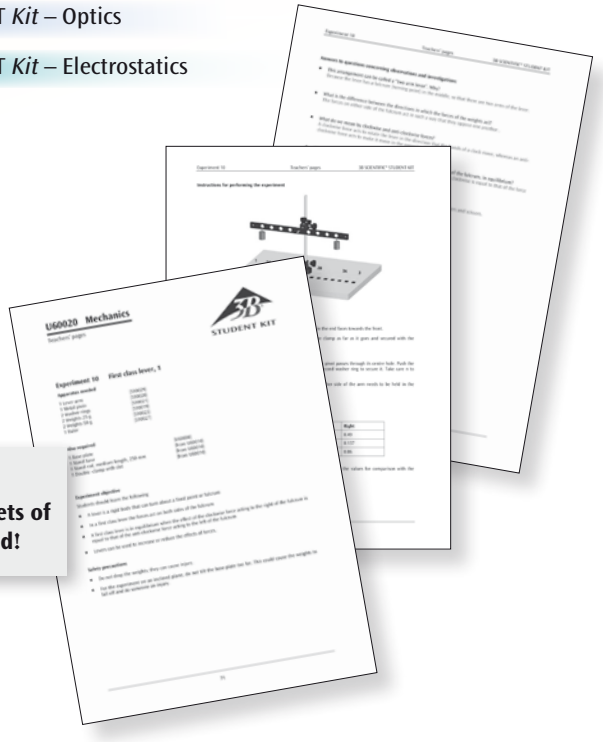
3B STUDENT *Kit* – Basic Set

3B STUDENT *Kit* – Mechanics

3B STUDENT *Kit* – Heat

3B STUDENT *Kit* – Optics

3B STUDENT *Kit* – Electrostatics



CD-ROM containing more than 70 different sets of instructions is included!

Please ask for quantity discounts on class sets of 8 pieces or more.

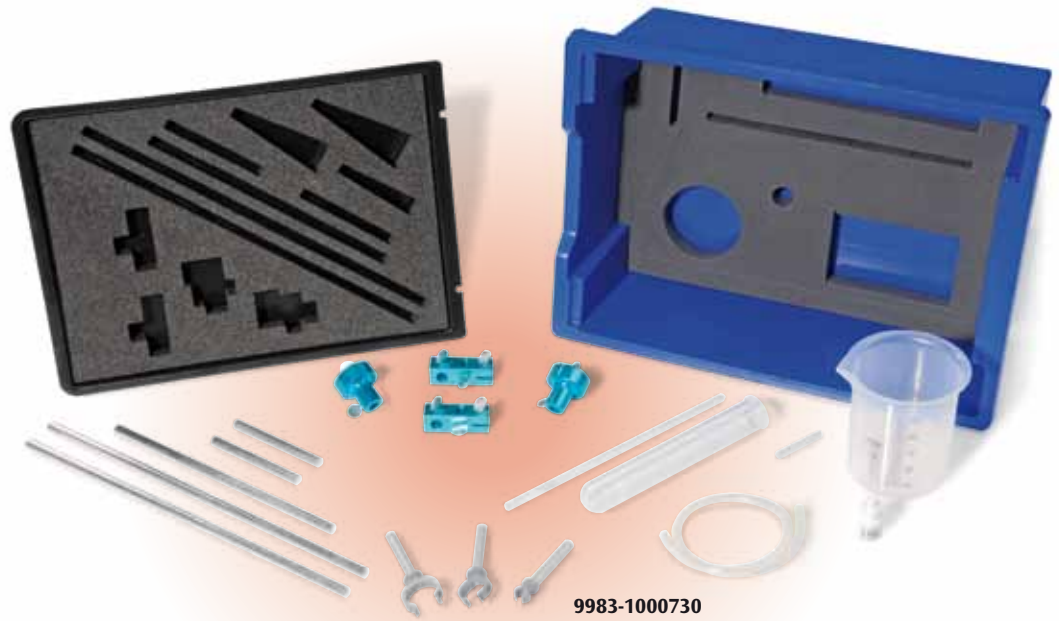
STUDENT *Kit* – Basic Set

Basic set of apparatus for use with STUDENT *Kits* for mechanics (9983-1000731) and heat (9983-1000732). Consisting of a robust base-plate made of plastic, stands and clamps made of anodised aluminium and other components that are used in both mechanics and heat experiments. In a robust plastic box with foam inserts moulded to the shapes of the items plus a transparent lid. Includes a CD with instructions for the experiments.

Contents:
1 Base-plate
2 Stand bases
2 Stand rods, 360 mm
1 Stand rod, 250 mm
2 Stand rods, 100 mm
2 Double clamps with slot
1 Clip, 8 mm diam.
1 Clip 22 mm diam.
1 Clip 27 mm diam.
1 Beaker, 500 ml
1 Test tube
1 Glass tube, 50 mm
1 Glass tube, 250 mm
1 Silicone tube, 500 mm x 6 mm diam.
4 g Glycerine
1 CD with sets of instructions for experiments

9983-1000730

3B STUDENT *Kit* – Basic Set



9983-1000730

www.EngineeringBooksPDF.com

STUDENT *Kit* – Mechanics

Set of apparatus for carrying out 25 basic student experiments on the mechanics of solids, liquids, and gases. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. The experiments are designed to occupy as little space as possible on the base-plate of the STUDENT *Kit* basic set (9983-1000730), while remaining clear and easy to perform.

Contents:

1 Steel leaf spring
1 Lever arm
1 Ruler
1 Pulley
1 Pulley with hook
1 Weight, 100 g
3 Weights, 50 g
2 Weights, 25 g
1 Dynamometer, 2 N
1 Metal pivot
4 Washer rings to fit metal pivot
1 Pulley with cord
1 Trolley
1 Friction pad
1 Coil spring
1 Iron block
1 Aluminium block
1 Wooden block
1 Silicone tube, 500 mm x 3 mm diam.
1 Tubing connector
1 Clip, 8 mm diam.
1 Clip, 14 mm diam.
1 Syringe, 60 ml
1 Syringe, 30 ml
1 Plastic sphere
1 Rubber stopper (30 mm x 31/25 mm diam.)
1 Funnel, 40 mm diam.
1 U-tube manometer
1 Measuring cylinder
100 g Modelling clay

9983-1000731



9983-1000731

Additionally required:
9983-1000730 STUDENT *Kit* – Basic Set

Includes 25 Experiments on the Subject of Mechanics:

- Effects of forces
- Action and reaction
- Deformation by forces (2 experiments)
- Masses and densities of bodies
- Friction
- Second class lever
- First class lever (2 experiments)
- Fixed pulley
- Moving pulleys
- Combinations of fixed and moving pulleys (block and tackle)
- Inclined plane (2 experiments)
- Connected vessels
- Pressure in liquids
- Principle of the U-tube manometer
- Pressure due to weight of fluids
- Buoyancy in liquids
- Floating and sinking
- Air as a body
- Pressure and volume
- Temperature and volume
- Effects of atmospheric pressure

Equipment mechanics:
9983-1000731 STUDENT *Kit* – Mechanics
9983-1000730 STUDENT *Kit* – Basic Set



First class lever

www.EngineeringBooksPDF.com

STUDENT *Kit* – Heat

Set of apparatus for carrying out 10 basic student experiments on heat. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. The experiments are designed to occupy as little space as possible on the base-plate of the STUDENT *Kit* basic set (9983-1000730), while remaining clear and easy to perform.

Contents:

1 Conical flask, 100 ml
1 Bimetallic strip
1 Concave mirror mounted on stem
1 Aluminium rod 200 mm
1 Thermometer, –10°C – +100°C
1 Glass tube with 90° bend
1 Rubber stopper, 25 mm x 24/19 mm diam.
1 Spirit burner
1 Ceramic mat

9983-1000732

Additionally required:
9983-1000730 STUDENT *Kit* – Basic Set

3B STUDENT *Kit* – Heat



9983-1000732

Please ask for quantity discounts on class sets of 8 pieces or more.

Includes 10 Experiments on the Subject of Heat:

- Principle of a thermometer
- Heating of solid bodies
- Heating of liquid bodies
- Heating of gases
- Behaviour of bimetallic objects
- Conduction of heat
- Radiation of heat
- Condensation
- Distillation
- Temperature of mixtures

Equipment heat:
9983-1000732 STUDENT *Kit* – Heat
9983-1000730 STUDENT *Kit* – Basic Set



Principle of a thermometer

www.EngineeringBooksPDF.com

STUDENT *Kit* – Optics

Set of apparatus for carrying out 23 basic student experiments in optics. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. Includes a CD with instructions for the experiments. The experiments are designed to occupy as little space as possible on the included optical bench, while remaining clear and easy to perform.

Contents:

2 lenses, f = +100 mm
1 lens, f = +50 mm
1 lens, f = -100 mm
1 lens, f = +300 mm
1 diaphragm holder
1 plug-in power supply unit for optical lights
1 optical light
1 overlay mask protractor
1 projection screen/experiment table
1 optic bench
2 tea lights
1 opaque body
1 single aperture slot
1 triple aperture slot
1 colour slide M-Y-C
1 F diaphragm
1 flexible mirror
1 coplanar board
1 semicircular body
1 converging lens
1 diverging lens
1 right-angled prism
2 sheets of graph paper, transparent DIN A5
1 scale



9983-1000734

STUDENT *Kit* Optics (230 V, 50/60 Hz)

9983-1000734 .....

STUDENT *Kit* Optics (115 V, 50/60 Hz)

9983-1000733 .....

Includes 23 Experiments on the Subject of Optics:

- Propagation of light
- Light and shadows
- Reflection at a plane mirror
- Concave and convex mirrors
- Refraction of light (2 experiments)
- Refractive index
- Optical lenses (paths of rays)
- Focal point of convergent lenses
- Focal length of convergent lenses
- Formation of images with converging lenses
- Laws of images
- Magnifying glasses
- Function of the eye
- Function of spectacles (2 experiments)
- Principle of a camera
- Principle of a slide projector
- Principle of a Galilean telescope
- Principle of an astronomical telescope
- Principle of a microscope
- Breaking down light into its components
- Mixing of colours



Principle of a slide projector

Equipment optics:
9983-1000734 STUDENT *Kit* – Optics (230 V, 50/60 Hz)
or
9983-1000733 STUDENT *Kit* – Optics (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

STUDENT *Kit* – Electrostatics

Set of apparatus for carrying out 15 basic student experiments on electrostatics. Including electroscope, charge indicator, charge storage unit and Piezo charger. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. Includes a CD with instructions for the experiments. The experiments are designed to occupy as little space as possible in the apparatus frame, while remaining clear and easy to perform.

NEW

Contents:

1 Stand base
1 Apparatus frame
2 Aluminium rods
1 Aluminium rod with magnet
1 Electroscope
1 Plastic plate, angled
1 Plastic rod
1 Glass rod
1 Conductor body
1 Set of needles
1 Spinner
1 Pendulum bob (polystyrene)
1 Screw-on needle
1 Set of plasticine
2 Experiment leads
1 Set of balloons
1 Set of papers with 1 plastic cloth
1 Set of metal strips
1 Piezo charger
1 Faraday cage
1 Faraday cup
1 Charge indicator
1 Charge storage unit
2 Capacitor plates
1 Dielectric

9983-1009883



9983-1009883

Please ask for quantity discounts on class sets of 8 pieces or more.

Includes 15 Experiments on the Subject of Electrostatics:

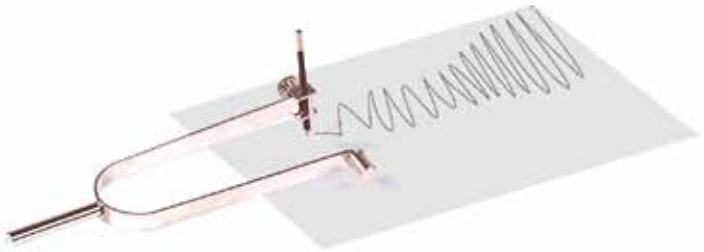
- Electrostatic charging of hair
- Forces on uncharged particles
- Charge indicator
- Forces between charged bodies
- Build your own electroscope
- Electroscope
- "Shock of hair"
- Demonstrating charge on a capacitor
- "Charge pendulum"
- "Spinner"
- Charging due to induction
- Transfer of charge using a "charge spoon"
- Faraday's cup
- Faraday's cage
- Plate capacitor



"Shock of hair"

www.EngineeringBooksPDF.com

The acoustics kit allows students to carry out numerous experiments on acoustics independently. A wide variety of sound sources are studied to begin with and the concepts of noise, bangs and tones as well as pitch and loudness are investigated. Waves along a rope are used to illustrate harmonic vibrations and overtones. There is also some extensive study of various different musical instruments. Different high-pitched tones are generated by means of a monochord and the ensuing intervals are calculated experimentally. These studies are expanded to other instruments and can easily lead over to a study of musical notes.



BEST SELLER

Acoustics Kit
Complete set of equipment for carrying out more than 30 student experiments on acoustics. In plastic tray with foam inlay. Includes CD with experiment instruction.
Dimensions: 530x375x155 mm³ approx.
Weight: 4.5 kg approx.

Contents:
1 Monochord, with ruler and musical scale
1 Steel string
1 Perlon string
1 Spring balance on support
1 Reed pipe with 8 valves
1 Tuning fork with plotter pen, 21 Hz
1 Tuning fork, 440 Hz
1 Light-metal tuning fork, 1700 Hz
1 Pipe
1 Variable-length closed air column
1 Tuned open air column
1 Chladni disc with rod
1 Bell dome
1 Galton whistle
1 Kundt pipe with retaining clip
5 g Lycopodium powder in sprinkling cellar
1 Metallophone with beater
1 Rope for demonstrating waves
1 Helmholtz resonator, 70 mm diam.
1 Helmholtz resonator, 52 mm diam.
1 Helmholtz resonator, 40 mm diam.
1 Helmholtz resonator, 32 mm diam.
1 Screw clamp
1 Plastic block
1 Plunger

9983-1000816

Experiment Topics:

- Noise, bangs, pure tones
- Vibrating air columns
- Whistles and pipes
- Vibrating bars, plates and bells
- Infra-sound
- Ultra-sound
- Tuning fork with plotter pen
- Travelling waves along a rope
- Velocity of propagation of sound
- Moving sources of sound (Doppler effect)
- Plate vibrations (Chladni figures)
- Vibrations of a bell
- Standing waves on a rope, overtones
- Sounds of musical instruments
- Representation of oscillations with a tuning fork with plotter pen
- Timbre of the human voice
- Measurement of wavelength (Kundt figures)
- Resonance
- Helmholtz ball resonators
- Sound analysis
- Loudness
- Pitch of string instruments
- Pitch of wind instruments
- Reed pipe
- C-major scale and its intervals
- Triads, harmonies
- Semitones, major and minor



9983-1000816

www.EngineeringBooksPDF.com

Student Experiment Kits (SEK)

SEK Mechanics

Set of equipment for carrying out 23 student experiments on the mechanics of solids. In a tough plastic box containing a foam insert with cut-outs for the equipment and featuring a transparent lid. Includes CD with experiment instructions. Experiments are set up and performed on the SEK base plate (9983-1000789) so that they are compact but still clear in their layout and objectives.



9983-1008527

SEK Mechanics

Contents:

2 Stand rods with external and internal thread, 400 mm
1 Stand rod with external thread, 400 mm
2 Stand rods, 110 mm
2 Double clamps
1 Beam balance
2 Weighing pans with holders
1 Scale for balance
1 Axle rod for pulleys
1 Rolling pin with add-on weights
1 Block and tackle with two pulleys and two hooks
1 Block and tackle with two pulleys and one hook
1 Multiple pulley
1 Plastic pulley, 40 mm
4 Weights, 25 g
1 Weight, 50 g
1 Weight, 100 g
1 Magnetic base
1 Adjustable bracket
2 S-shaped hooks, 1 g
2 S-shaped hooks, 2 g
2 S-shaped hooks, 5 g
4 O-rings
1 Body for friction and inertia experiments
1 Set of plastic strips for friction experiment
1 Dynamometer 1 N
1 Dynamometer 2 N
1 Leaf spring, 330 mm
1 Coil spring with 2 eyelets, approx. 5.25 N/m
100 m of twine
2 Pointers
1 Measuring cylinder
1 Stand base for measuring cylinder
3 Strips of velour paper
1 Set square
1 Ruler

9983-1008527

Includes 23 Experiments on the Subject of Mechanics:

- Hooke's law
- Calibrating a dynamometer
- Deformation of a leaf spring
- Addition of forces acting along the same line
- Resolution of a force into two components
- Investigation of inertia
- Types of friction
- Laws of static and kinetic friction
- Equilibrium conditions for a first-class lever
- Equilibrium conditions for second and third-class levers
- Forces, paths and work with fixed pulleys
- Forces, paths and work with non-fixed pulleys
- Forces, paths and work with block and tackle
- Forces, paths and work with multiple pulleys
- Forces on an inclined plane
- Determining the volume of solid bodies
- Determining the mass of solid bodies (beam balance)
- Determination of density
- Determining the nature of a material by measuring density
- Specific weight and buoyancy
- Period of a string pendulum
- Determining gravitational acceleration with the aid of a string pendulum
- Period of a spring oscillator

Equipment mechanics:
9983-1008527 SEK Mechanics
9983-1000789 SEK Base Plate



Forces on an inclined plane

www.EngineeringBooksPDF.com

SEK Heat

Set of equipment for carrying out 23 basic student experiments on heat. In a tough plastic box containing a foam insert with cut-outs for the equipment and featuring a transparent lid. Includes CD with experiment instructions. Experiments are set up and performed on the SEK base plate (9983-1000789) so that they are compact but still clear in their layout and objectives.

Contents:

1 Stand rod with internal and external threads, 400 mm
4 Wooden rods
1 Metal tube, short
1 Pointer/hook
1 Stirrer
1 Steel tube
1 Brass tube
1 Aluminium tube
1 Thermometer without scale, red liquid
2 Thermometers, -10 – 110°C, 1 K, red liquid
1 Capillary tube
1 Bimetal strip with 10-mm stub
10 Round filters
10 Sheets of thermal paper
1 Steel body
1 Lead body
1 Spirit burner
1 Beaker, 100 ml
1 Conical flask, 100 ml
1 Test tube holder with rod attachment
1 Test tube
1 Measuring cylinder, 50 ml
1 Calorimeter with heating filament, 200 ml
1 Rubber stopper with two holes
2 Rubber stoppers with one hole
1 10 g weight with hook
2 Double clamp
5 ml of food colouring
10 g of table salt

SEK Heat

1 Holder for metal beaker
1 Metal beaker, black
1 Metal beaker, aluminium
4 g of glycerine
3 Flow spirals
1 Hose
2 Round gaskets
1 Angle scale
10 Sheets of paper
5 Sheets of aluminium foil

9983-1008528

SEK Mechanics
SEK Heat
SEK Optics
SEK Electricity and Magnetism
SEK Radioactivity

CD-ROM containing more than 100 different sets of instructions is included!



9983-1008528

Includes 23 Experiments on the Subject of Heat

- Change in the volume of liquids due to heating
- Calibration of a thermometer
- Change in the volume of air due to changes in temperature
- Changes in state of an enclosed volume of air
- Changes in the length of solid bodies when heated
- Linear expansion coefficient
- Investigations using bimetal strips
- Transfer of heat in solid bodies
- Transfer of heat in liquids
- Transfer of heat in gases
- Radiation of heat
- Slowing down the transport of heat
- Temperature changes when liquids are heated
- Fundamental equation of thermodynamics
- Mixing water of differing temperatures, temperature of mixture
- Specific heat capacity of a calorimeter
- Specific heat capacity of metals
- Initial temperature of a metal body heated in a flame
- Conversion of electrical energy into heat
- Temperature changes when ice melts
- Specific latent heat of melting ice
- Boiling and condensation of water
- Distillation
- Evaporation of liquids (what it depends on and heat loss due to evaporation)

Equipment heat:
9983-1008528 SEK Heat
9983-1000789 SEK Base Plate



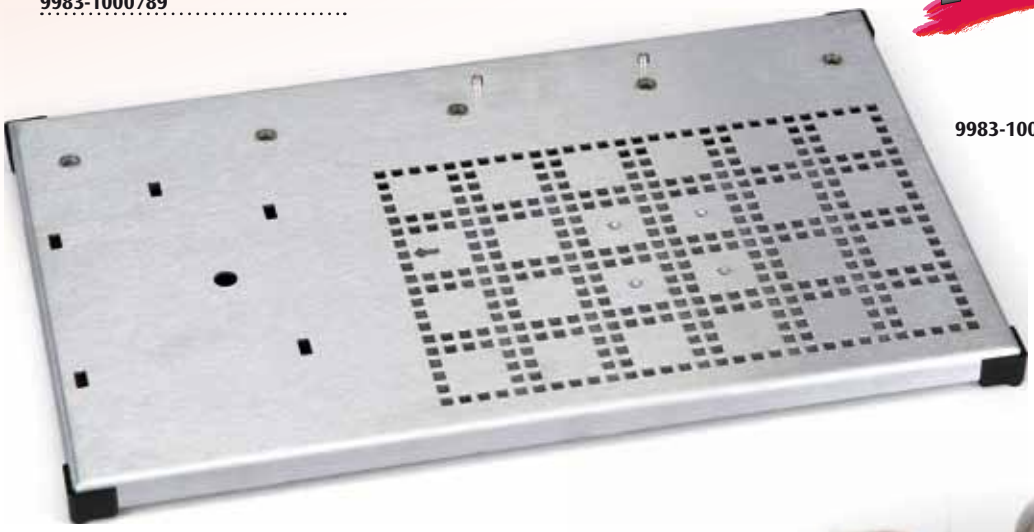
Changes in the length of solid bodies when heated

www.EngineeringBooksPDF.com

SEK Base Plate
Tilt-resistant stainless-steel base with five special threads for the tilt-free insertion of stand rods, threads for mounting a dismantling transformer and numerous expansion slots for the insertion of electrical components. With stable and nonslip rubber feet.
Dimensions: 400x245x15 mm approx.

9983-1000789

NEW



9983-1000789





SEK Power Supply
AC/DC power supply for SEK electricity and magnetism kit (9983-1008532). Housing with attachment hooks for clamping into the SEK base plate (9983-1000789).
Voltages: 1.5/ 3.0/ 4.5/ 6.0 V AC/DC

SEK Power Supply (230 V, 50/60 Hz)

9983-1000998

SEK Power Supply (115 V, 50/60 Hz)

9983-1000997



9983-1000998
9983-1000997

www.EngineeringBooksPDF.com

SEK Electricity and Magnetism

Set of equipment for carrying out 41 student experiments on electricity and magnetism. In a tough plastic box containing a foam insert with cut-outs for the equipment and featuring a transparent lid. Includes CD with experiment instructions. The experiments are set up and performed in a space saving fashion but are still clearly laid out on the SEK base plate (9983-1000789).

9983-1008532



9983-1008532

SEK Electricity and Magnetism

Contents:

1 Set of experiment leads
1 Bar magnet, 65x16 x 5 mm approx.
1 Horseshoe magnet, ALNICO, flat
1 Resistor board
1 Transformer core, 20 x 20 mm
1 Tightening screw
1 Coil, 200/400/600 windings
1 Coil, 400/400/800 windings
2 Current branches (plug-in components)
1 Potentiometer, 100 Ω (plug-in component)
1 Switch (plug-in component)
1 Capacitor, 4700 µF (plug-in component)
1 Capacitor, 10 µF (plug-in component)
1 Resistor, 33 Ω (plug-in component)
1 Resistor, 47 Ω (plug-in component)
1 Resistor, 1 kΩ (plug-in component)
1 NTC-resistor, 100 Ω (plug-in component)
2 Lamp sockets, E10 (plug-in components)
2 Light bulbs, E10, 7 V
1 Storage box with 1 set of threads with washer, 2 threaded bushes, 2 threaded pins, 2 Paper clips, 2 aluminium electrodes, constant wire
50 g of iron filings
50 m of chrome/nickel wire, 0.2 mm
50 m of iron wire, 0.2 mm
1 Tea candle

Please ask for quantity discounts on class sets of 8 pieces or more.

Includes 41 Experiments on the Subject of Electricity and Magnetism:

- Closed circuits
- Conductors and insulators
- Circuits with no branches
- Circuits with branches
- Current in a circuit with no branches
- Current in a circuit with branches
- Initial voltage and terminal voltages
- Voltage in a circuit with no branches
- Voltage in a circuit with branches
- Voltage dividers
- Ohm's law
- Temperature dependence of a resistor (iron wire)
- Current-voltage diagram for a light bulb
- Current-voltage diagram for a thermistor
- Law of resistance
- Resistance in a circuit with no branches
- Resistance in a circuit with branches
- Resistance and voltage in a circuit with no branches
- Resistance and current in a circuit with branches
- Voltage dividers with and without a load
- Voltage-time diagram for charging and discharging of a capacitor
- Current-time diagram for charging and discharging of a capacitor
- Relationship between charge and voltage
- Capacitor in the DC and AC circuit (response)
- Test bodies in a magnetic field
- Magnetic poles
- Magnetic field of a horseshoe magnet and a bar magnet
- Magnetic dipoles
- A coil used as a magnet
- Forces in the magnetic field of a coil
- Induction due to relative motion
- Induction due to changes in magnetic field
- Induction law
- Ohmic resistance in AC and DC circuits



Transformer under load

- Capacitors in AC and DC circuits (resistance)
- Coils in AC and DC circuits
- How a transformer works
- Voltage and number of windings for a transformer with no load
- Transformer under load
- Transformer under heavy load
- Thermoelectricity

Equipment electricity:

9983-1008532 SEK Electricity and Magnetism
9983-1000789 SEK Base Plate
9983-1006811 ESCOLA2 Multimeter
9983-1000998 SEK Power Supply (230 V, 50/60 Hz)
or
9983-1000997 SEK Power Supply (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

SEK Optics

Set of equipment for carrying out 38 student experiments on ray optics. In a tough plastic box containing a foam insert with cut-outs for the equipment and featuring a transparent lid. Includes CD with experiment instructions. The experiments are designed to be compact but still easy to see when set up and carried out on the supplied optical bench or the SEK base plate (9983-1000789). In both cases, the optical components are attached in non-slip fashion by magnets. Supplied overlays designate where the components are to be placed.

SEK Optics (230 V, 50/60 Hz)

9983-1008531

SEK Optics (115 V, 50/60 Hz)

9983-1008530

9983-1008531/
9983-1008530



NEW

SEK Optics

Contents:

1 Optical bench
1 Optical lamp, 5 V, 2 W
1 Plug-in power supply, 100 – 240 V, 50/60 Hz
4 Tea candles
1 Plastic container
1 Slide holder, magnetic
1 F-shaped slide
1 Slide with triple and quintuple slits
1 Slide with single slit
1 Object for use as an image
1 Colour filter, red
1 Colour filter, blue
1 Acrylic block with holder
1 Semi-circular body
1 Diverging lens, flat model
1 Converging lens, flat model
1 Right-angled prism
1 Rectangular block
1 Objects for casting shadows
1 Flexible mirror, magnetic
1 Projection screen/Experiment table
2 Lenses, f = +50 mm
1 Lens, f = +100 mm
1 Lens, f = +300 mm
1 Lens, f = -100 mm
1 Set of overlays

Includes 38 Experiments on the Subject of Optics:

- Propagation of light, light beams and rays
- Transparency
- Light and shadow
- Umbra and penumbra
- Reflection from a plane mirror
- Concentration of light by a concave mirror
- Reflection and path of light for a concave mirror
- Reflection and path of light for a convex mirror
- Characteristics of the image from a plane mirror
- When light passes from air into glass / Determination of refractive index
- When light passes from glass into air / Determination of refractive index
- Determination of critical angle for total internal reflection (glass to air)
- Ray diagrams for a rectangular glass block, laws
- Ray diagrams for a glass prism
- Total internal reflection inside a prism
- Path of light through a converging lens
- Determination of focal length for a converging lens
- Ray diagrams with parallel ray and ray through centre of lens (converging lens)
- Path of light through a diverging lens
- Determination of focal length for a diverging lens
- Ray diagrams with parallel ray and ray through centre of lens (converging lens)
- Path of light through a system of lenses
- Image properties (converging lens)
- Image magnification and the lens equation
- Image aberrations with converging lenses
- Formation of images in the eye
- Short-sightedness
- Long-sightedness

CD-ROM containing all different sets of instructions is included!



Reflection and path of light for aconvex mirror

- Astigmatism
- Cameras
- Slide projectors
- Microscopes
- Galileo telescope
- Kepler's telescope
- Terrestrial telescope
- Separation of light into a spectrum
- Recomposition of spectral colours
- Additive mixing of colours, complementary colours

Equipment optics:
9983-1008531 SEK Optics (230 V, 50/60 Hz)
or
9983-1008530 SEK Optics (115 V, 50/60 Hz)

The optics experiments can be set up on the optical bench included in the SEK optics set (9983-1008531/9983-1008530) or on the SEK base plate (9983-1000789).

www.EngineeringBooksPDF.com

SEK Radioactivity

Set of apparatus for carrying out 10 basic student experiments on radioactivity. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. Includes a CD with instructions for the experiments. The experiments are designed to occupy as little space as possible on the supplied base plate, while remaining clear and easy to perform. To determine the count rates, it is recommended that a GAMMA-SCOUT Geiger counter (9983-1002722) be used (not included).

9983-1006804

SEK Radioactivity

Contents:

1 Base plate 340x250 mm
3 Work templates
1 Holder for sources and deflecting magnet
1 Deflecting magnet
1 Thorium irradiation module I (weld filler wire)
1 Uranium glass cube
2 Aluminium plates, 0.5 mm
1 Aluminium plate, 1 mm
1 Lead plate, 2 mm, in plastic cover



Includes 10 Experiments on the Subject of Radioactivity:

- Determining background radiation
- Determining pulse rates for various radioactive preparations
- Statistical distribution of counter pulses
- Determination of equivalent dose for various radioactive preparations
- Penetrative capacity and range of radiation
- Deflection of alpha and beta radiation by a magnetic field*
- Absorption of alpha rays*
- Absorption of beta rays*
- Absorption of gamma rays*
- Inverse square law

Equipment radioactivity:
9983-1006804 SEK Radioactivity
9983-1002722 Geiger Counter GAMMASCOUT

*additionally required:
9983-1006797 Radiation Cartiridge ^{226}Ra 4 kBq



Deflection of alpha and beta radiation by a magnetic field

www.EngineeringBooksPDF.com

Kröncke Optical System for Student Exercises

The Kröncke optical system provides robust reliability that has been tried and tested for decades and offers all the precision needed for student exercises and practical courses in numerous experiments on ray and wave optics. The experiments are carried out in traditional fashion using the white light of an incandescent lamp, the filament of which can be projected through an adjustable slit to observe interference in particular.

All optical components are mounted in diaphragms with no stems and can easily be adjusted vertically and with precision into the optical light path when mounted on optical riders. Optical riders can freely move on the U-profile rail of an optical bench and can be attached with a minimum of force.

CD-ROM containing all different sets of instructions is included!

Please ask for quantity discounts on class sets of 8 pieces or more.

Basic Set for Kröncke Optical System

Contents:
1 Optical lamp
1 Transformer 12 V, 25 VA
1 Optical bench, 1000 mm
6 Optical slides
2 Clamps
2 Converging lenses, f = 50 mm
2 Converging lenses, f = 100 mm
2 Converging lenses, f = 150 mm
1 Converging lens, f = 300 mm
1 Converging lens, f = 500 mm
1 Diverging lens, f=-100 mm
1 Diverging lens, f=-500 mm
1 Diaphragm with 1 slit
1 Diaphragm with 3 slits
1 Photograph in slide frame
1 Transparent screen
1 White screen
1 Set of 4 colour filters
1 Ruler, 15 mm
1 Set of holes arranged to form the number “1”
1 Pinhole aperture, d = 1 mm
1 Pinhole aperture, d = 6 mm

9983-1009932
9983-1009931



Basic Set for Kröncke Optical System (230 V, 50/60 Hz)
9983-1009932

Basic Set for Kröncke Optical System (115 V, 50/60 Hz)
9983-1009931

Ray Optics:

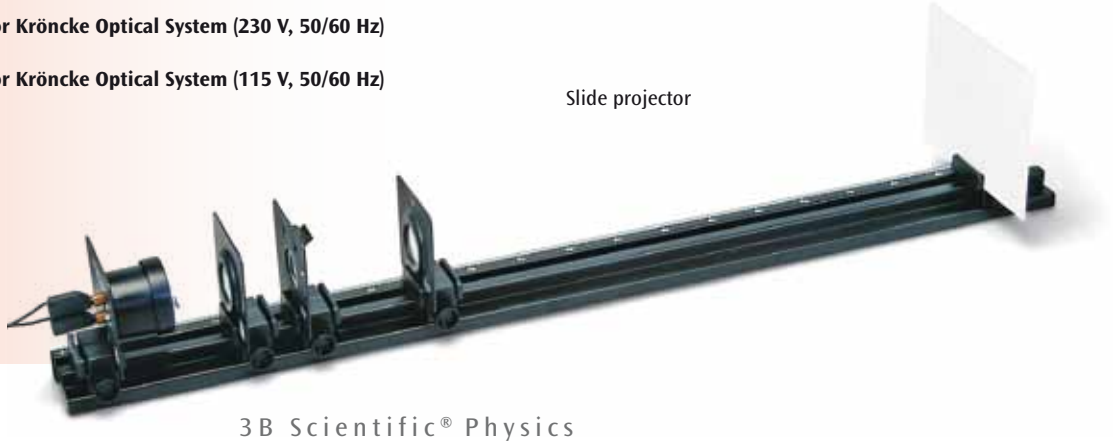
- Pinhole camera
- Imaging with converging lenses
- Image aberrations
- Images in the eye (eye model)
- Correction of vision
- Magnifying glasses
- Microscopes
- Astronomical telescopes
- Terrestrial telescopes
- Slide projectors



Diffraction by a multiple slit

Equipment ray optics:
9983-1009932 Basic Set for Kröncke Optical System (230 V, 50/60 Hz)
or
9983-1009931 Basic Set for Kröncke Optical System (115 V, 50/60 Hz)

Slide projector



www.EngineeringBooksPDF.com



Visibility of polarised light in turbid water

Polarisation:

- Polarisation of transverse waves
- Polariser and analyser
- Visibility of polarised light in turbid water
- Double refraction
- Rotation of planes of polarisation by a sugar solution

Equipment polarisation:

9983-1009932 Basic Set for Kröncke Optical System (230 V, 50/60 Hz)

or

9983-1009931 Basic Set for Kröncke Optical System (115 V, 50/60 Hz)

9983-1009701 Supplementary Set for Polarisation



9983-1009701

Supplementary Set for Polarisation

Supplementary set to the Kröncke optics basic set (9983-1009932 resp. 9983-1009931) for carrying out student experiments on the polarisation of light waves.

Contents:

1 Pair of polarising filters
1 Pinhole aperture, 10 mm
1 Rectangular cuvette

9983-1009701



9983-1009700

Supplementary Set for Interference

Supplementary set to the Kröncke optics basic set (9983-1009932 resp. 9983-1009931) for carrying out student experiments on the interference of light waves.

Contents:

1 Optical bench, 500 mm
1 Adjustable slit
1 Diaphragm with 9 circular discs
1 Diaphragm with 9 circular holes
1 Diaphragm with 3 individual slits and 1 double slit
1 Diaphragm with 4 multiple slits and grating
1 Diaphragm with 3 ruled gratings
1 Micrometer screw
1 Fresnel mirror

9983-1009700

Interferences:

- Fresnel mirror
- Diffraction by small openings and plates
- Diffraction by an air gap
- Diffraction by the wire
- Diffraction by multiple slits
- Diffraction by the grating
- Optical resolution
- Determining the wavelength of light

Equipment interference:

9983-1009932 Basic Set for Kröncke Optical System (230 V, 50/60 Hz)

or

9983-1009931 Basic Set for Kröncke Optical System (115 V, 50/60 Hz)

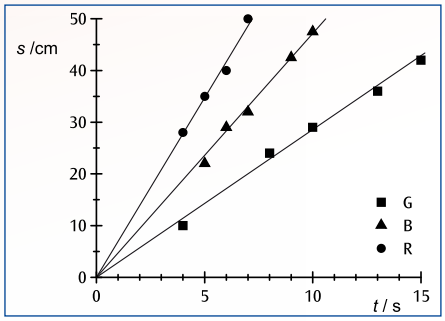
9983-1009700 Supplementary Set for Interference



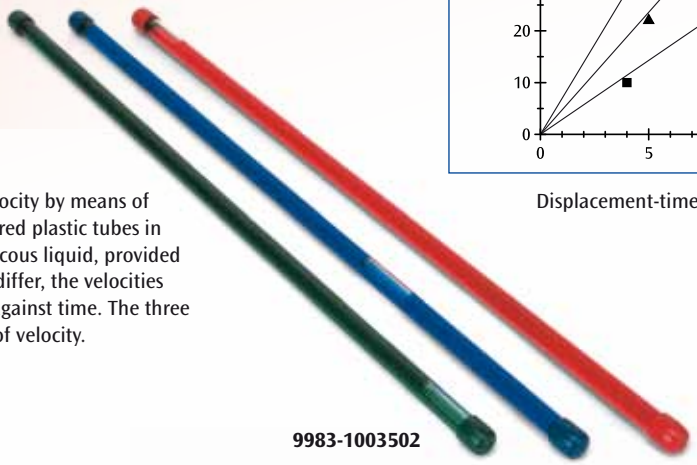
www.EngineeringBooksPDF.com

Experiment Topics:

- Displacement-time graphs
- Linear gradients
- Velocity



Displacement-time graph for air bubbles



9983-1003502

Constant Velocity Student Kit
Set of equipment for investigating the concept of velocity by means of student experiments. Consisting of three small coloured plastic tubes in which an air bubble rises at constant velocity in a viscous liquid, provided the tubes are aligned vertically. Since the viscosities differ, the velocities also differ. The position of the air bubble is plotted against time. The three different resulting straight lines lead to a definition of velocity.
Length: 500 mm approx.
Diameter: 13 mm approx.

9983-1003502

Additionally required:
9983-1003369 Mechanical Stop Watch, 15 min
9983-1002603 Pocket Measuring Tape, 2 m

Experiment Topics:

- Determining mass of evacuated air and density of air
- Effect of air pressure on a slightly inflated hot-air balloon and on a suction cap
- Lowering of the boiling point of liquids at decreased air pressure



Effect of air pressure on
a slightly inflated balloon

Vacuum Student Kit
Set of equipment for introducing the fundamentals of vacuum physics by means of student experiments.

Contents:
1 Experiment plate with washer
1 Vacuum bell jar
2 Beakers
1 Pressure hose with check valve
1 Pressure hose with T-connector and check valve
1 Simple hand pump in storage container
1 Suction cap
2 Balloons

9983-1003494



9983-1003494

Additionally recommended:
9983-1009772 Electronic Scales 200 g (230 V, 50/60 Hz)
or
9983-1003426 Electronic Scales 200 g (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

Experiment Topics:

Colours:
- Coloured light and coloured objects
- Mixture of colours

Shadows:
- Casting shadows
- Coloured shadows

Reflection:
- Reflection from a plane mirror
- Reflected images, image reversal
- Multiple reflections from a mirror
- Reflection from a concave mirror (focal point and spherical aberration)
- Reflection from a parabolic mirror
- Reflection from a convex mirror

Refraction:
- Determining refractive index with a semi-circular object
- Determining refractive index with a parallel block
- Angle of minimum deflection for a prism
- Total internal reflection in a semi-circular object
- Total internal reflection in a prism
- Focal point of a converging lens
- Focal point of a diverging lens
- Spherical aberration



9983-1003209

Light Box

Set of equipment for optical experiments to be carried out on a table, consisting of a light box in a sturdy plastic housing and numerous optical components. Complete set in sturdy wooden storage case. The light box has four light outlets: the two side outlets have two hinged mirrors for experiments on colour mixing and shadows. All openings are equipped with mounts for optical components in 50x50 mm² slide frames. Parallel, convergent and divergent light can be generated by adjusting a converging lens attached in front of the lamp. There are two double-sided slit diaphragms available so that four different beam configurations can be created.

Lamp:	12 V, 36 W
Connections:	4-mm socket
Light box:	175x100x65 mm³ approx.
Storage case:	250x240x100 mm³ approx.

9983-1003209

Additionally required:
9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1006780 Transformer 12 V DC, 60 VA (115 V, 50/60 Hz)

Contents:
1 Light box
8 Colour charts
1 Plane mirror (glass)
1 Concave mirror (metal)
1 Convex mirror (metal)
1 Bi-convex lens, large (transparent acrylic)
1 Bi-convex lens, small (transparent acrylic)
1 Bi-concave lens (transparent acrylic)
1 Parallel plate (transparent acrylic)
1 Semi-circular object (transparent acrylic)
1 60° prism (transparent acrylic)
1 Asymmetrical 90° prism (transparent acrylic)
1 Symmetrical 90° prism (transparent acrylic)
2 Slit diaphragms
8 Colour filters (in slide frame)
1 Pair of connector leads with 4-mm plugs
1 Spare lamp

Spare Lamp for Light Box (not shown)

Spare lamp for light box, 12 V, 36 W.

9983-1003231



9983-1010210

Optikit

Inexpensive set of optical components of cardboard to create instruments such as telescope, spectroscope, microscope and pinhole camera.

Contents:
3 tubes
1 eyepiece f = +30 mm
1 plane-convex lens, f = +180 mm, 38 mm diam.
1 biconvex lens, f = + 30 mm, 16 mm diam.
1 shutter
1 grating 140 r/mm
1 slit
5 diaphragms with 0.8 to 20 mm diam.

9983-1010210

www.EngineeringBooksPDF.com

Enhance your lessons with a multitude of easily conducted experiments using the GASTEC gas detector.



GASTEC Gas Detector
Easy to use gas detector for analysing gas content in the atmosphere. For use in countless fundamental experiments. Includes hand pump and accessories for pumping air into specific test tubes, from which the gas content can be read off by means of the degree of coloration of the adsorption material.

Contents:
1 Hand pump for pumping in samples
1 Break-off tip for test tubes
1 Set of 10 pairs of protective rubber stoppers
1 Sealing grease
1 Carrying case
1 Teaching poster with suggested experiments, many illustrations and detailed instructions

9983-1012504

Additionally required:
9983-1012524 Set of 10 CO_2 Test Tubes, 0.03 – 1.00% by vol.
or
9983-1012526 Set of 10 CO_2 Test Tubes, 0.5 – 8.0% by vol.
or
9983-1012527 Set of 10 O_2 Test Tubes, 6 – 24% by vol.



9983-1012504

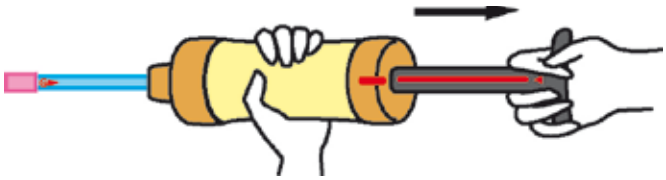
Experiments:

Analysis of stuffy and of fresh air in a room.

Investigation of how carbon dioxide and oxygen content changes in the atmosphere due to the following processes:
- Burning of a candle.
- Breathing of people and animals.
- Photosynthesis of plants.
- Burning of organic substances.

Gas Analysis Made Child's Play:

- Open glass test tube using the tip to break off both ends and close the ends using protective rubber stoppers.
- Push the test tube into the hand pump and hold it at the required position.
- Suck air into the tube using the pump and wait 30 seconds.
- Take the test tube out of the hand pump and read off the gas content from the degree of coloration.



Set of 10 CO_2 Test Tubes, 0.03 – 1.00% by vol. (not shown)
Set of 10 test tubes for the GASTEC gas detector, used for detecting changes in carbon dioxide content in the atmosphere due to combustion processes, for comparison of fresh and stuffy air or observing photosynthesis in plants.

9983-1012524

Set of 10 CO_2 Test Tubes, 0.5 – 8.0% by vol. (not shown)
Set of 10 test tubes for the GASTEC gas detector, used for detecting changes in carbon dioxide content in the atmosphere due to combustion of organic materials or the breathing of people and animals.

9983-1012526

Set of 10 O_2 Test Tubes, 6 – 24% by vol. (not shown)
Set of 10 test tubes for the GASTEC gas detector, used for detecting oxygen content of air in the atmosphere.

9983-1012527

Set of 10 Pairs of Protective Rubber Stoppers (not shown)
Set of spares including 10 pairs of protective rubber stopper s for test tubes used with the GASTEC gas detector.

9983-1012528

www.EngineeringBooksPDF.com



NEW

9983-1008703

"Renewable Energy" Kit

Inexpensive modular equipment set for investigating the functioning of a complete system for renewable energy. Consisting of a wind turbine, solar module, electrolyser, fuel cell, motor with propeller and voltage display. Includes a battery box as an alternative power supply to the fuel cell. Batteries not included. Some components must be assembled by the user.

Contents:
1 Wind turbine on mast
1 Electrolyser
1 Fuel cell
1 Solar cell
1 Motor with propeller
1 Voltage display with 2 LEDs
1 Gas reservoir for hydrogen
1 Gas reservoir for oxygen
2-mm experiment leads, connecting tubes and accessories

9983-1008703

Additionally required:
2 Batteries, 1,5 V AA
Distilled water



9983-1008703



www.EngineeringBooksPDF.com

The experiment case for fuel cells allows students to gradually investigate the world of fuel cells and solar-hydrogen technology in many illustrative and quantitative experiments.



Experiment Topics:

- Current-voltage curve of a solar cell.
- Power curve and efficiency of a solar cell.
- Current-voltage curve of a PEM electrolyser
- Energy efficiency and Faraday efficiency of a PEM electrolyser
- Current-voltage curve of a PEM fuel cell
- Power curve of a PEM fuel cell
- Current-voltage curve of a direct methanol fuel cell

9983-1002690

Fuel Cell Experiment Case
Solar-hydrogen cell system and accessories for carrying out student experiments. In storage case with foam inlay.

Contents:
1 Solar-hydrogen cell system (9983-1002689, refer to p. 108) consisting of solar module, PEM electrolyser, hydrogen and oxygen reservoirs, PEM fuel cell and fan
1 Resistor decade with maximum load capacity of 1 W
2 Multimeters
3 Connector leads, 50 cm, red
3 Connector leads, 50 cm, black
1 Stop watch
250 ml Distilled water
1 Storage case

9983-1002690



9983-1002690



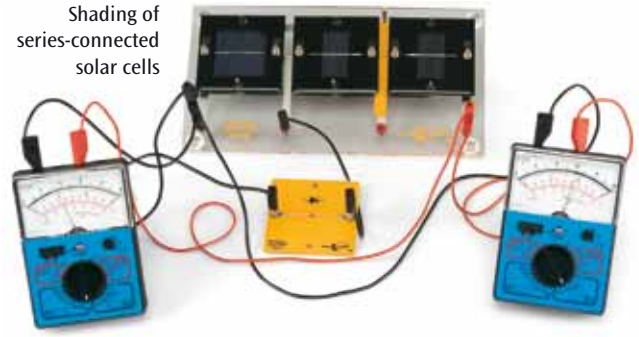
www.EngineeringBooksPDF.com

The set of photovoltaic equipment can be used for numerous qualitative and quantitative student experiments on the subject of photovoltaics for secondary school teaching. The supplementary set "Measuring without instruments" opens up a wide field of scientific experiments at pre-secondary level.

Photovoltaics:

- Series and parallel connection of solar cells
- Output of solar cell depending on the surface
- Output of solar cell depending on the angle of incidence of light
- Output of solar cell depending on the brightness of the illumination
- Efficiency of energy conversion
- Internal resistance of solar cells
- Diode nature of solar cells
- Current-voltage curve and bulk factor of solar cells
- Output of solar cells depending on temperature
- Shading of solar cells
- Output of solar cells depending on frequency of incident light

Equipment:
9983-1002693 Photovoltaics Equipment Set
9983-1003073 Analogue Multimeter (2x)
9983-1002840 Set of 15 Experiment Leads, 75 cm

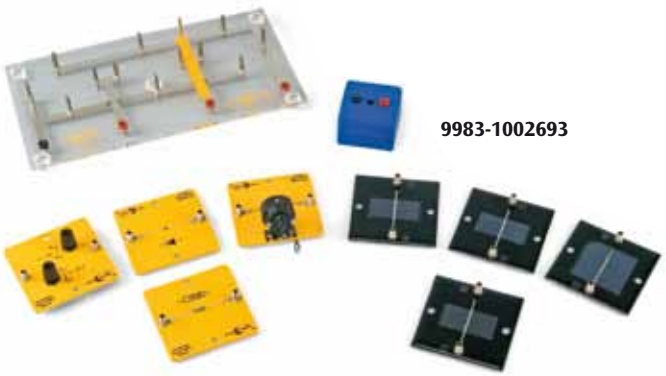


Shading of series-connected solar cells

Photovoltaics Equipment Set
Set of equipment on the topic of photovoltaics for one student workplace. Includes storage container with inlays and circuit diagram overlay.

Contents:
1 Basic unit
1 Circuit diagram
3 Solar cells 50x25 mm²
1 Solar cell 50x50 mm²
1 Lighting module
1 Diode module
1 Motor module
1 Potentiometer module
1 Resistor module
4 Plastic covers and colour filters

9983-1002693



9983-1002693



9983-1002695

Supplementary Set "Measurement without Measuring Devices"
Supplement to the photovoltaic equipment set (9983-1002693) for student experiments at pre-secondary level.

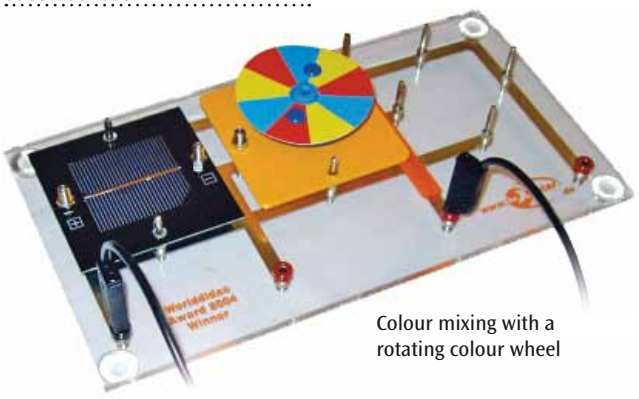
Contents:
1 Plug-in horn
1 Plug-in incandescent lamp
1 Plug-in motor
1 Set of 8 rotary discs including holder

9983-1002695

Simple Experiments on Electricity and Optics:

- Electrical loads
- Series and parallel connection of incandescent lamps
- Direction of rotation and velocity of an electric motor
- Brightness
- Diffuse radiation
- Albedo radiation
- Rotating discs
- Colour mixing
- Colour illusions

Equipment:
9983-1002693 Photovoltaics Equipment Set
9983-1002695 Supplementary Set "Measuring without Instruments"
2 Experiment Leads from 9983-1002840



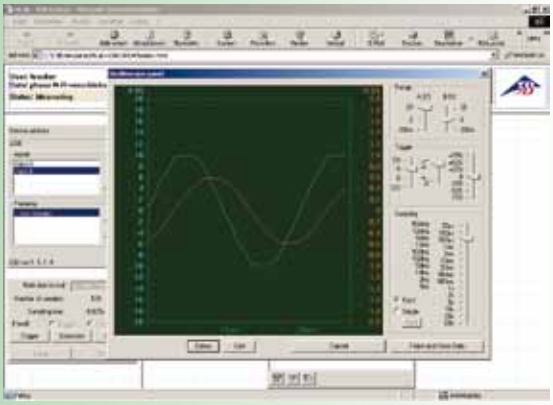
Colour mixing with a rotating colour wheel

www.EngineeringBooksPDF.com

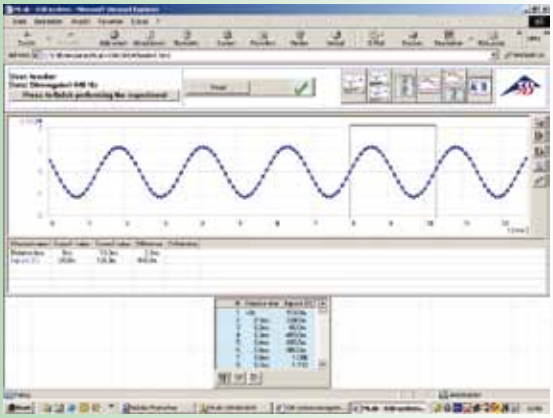
3B NET*lab*™:

- Comprehensive range of data processing functions, including tangents, integration, curve matching, all kinds of formula calculations and interpolation.
- Data acquisition with date and time of each measurement.
- Recording and processing several series of measurements.
- Presentation of data in the form of graphs or tables, analogue or digital multimeter functions.
- Easy configuration of sensor and experiments on the basis of predefined experiment files.
- Text windows for comments about the experiment.
- Support for analogue and digital sensors.
- Automatic identification of sensors.

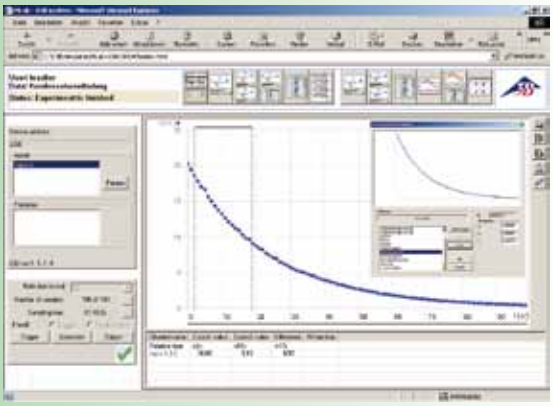




Oscilloscope: Voltage phase shift in RL series resonant circuit



Sound amplitude of a tuning fork as a function of time



Discharge curve of a capacitor

3B NET*lab*™

3B NET*lab*™ is a data acquisition and data processing program for the 3B NET*log*™ interface that can also be operated in a network. As it is based on ActiveX technology, all the available functions can be integrated into web pages that can be displayed and used with the Microsoft Internet Explorer browser. The main function of 3B NET*lab*™ is computer aided experimentation for science education. For that purpose, a large number of experiment instructions are available in the form of web pages. Users can navigate through these in the same way as they would browse the Internet and all the operations can be controlled with the help of facilities incorporated into the web pages at appropriate points. Experiment Instructions for carrying out experiments can also be written by teachers using standard HTML tools and the programming environment made available for the purpose. All kinds of Internet tools and technologies, such as multimedia sequences, animations, films, etc. can be incorporated into the experiment files. A software measuring lab is available for solo experimentation that utilizes all the functions of the functions of 3B NET*log*™ interface device. A wide range of graphical tools is available for processing experimental data. Thanks to its networking capability, 3B NET*lab*™ is ideally suited for use in schools. It enables teachers to check on the status and results of students' experiments from their own desk. Conversely, an experiment that is being carried out by the teacher can be followed by students on their own monitor screens.

9983-1000544

Licensing:
3B NET*lab*™ contains a specified location license for the normal use of the computer program throughout a school or educational establishment, including the preparation of school or student work at home.

System requirements:
Windows 2000/XP Prof. (SP3) with Internet Explorer 7, Vista Business (SP2) with Internet Explorer 7, Win 7 Prof. with Internet Explorer 8
Intel Pentium III / AMD Athlon 600 MHz or higher
128 MB RAM
100 MB free hard-disk space
Monitor with a resolution of 1024x768 pixels or higher
USB port

Can be operated in a network

www.EngineeringBooksPDF.com

3B NET*log*™

3B NET*log*™can be used as an interface for data acquisition linked to a computer, or as a hand held instrument with a data-logger for measurements of current and voltage or in combination with various sensors. It incorporates sensor connectors with automatic identification of sensors. It can be connected to a computer via USB. Can optionally be connected via Ethernet to the same sub-net of an Intranet. Includes USB cable and installation CD with data transfer program and plug in power supply.

Channels:	2 Differential amplifiers (A and B)
Measuring ranges:	0 – ±200 mV, 0 – ±2 V, 0 – ±20 V
Connectors:	Two twin 4 mm safety sockets
Current input:	
Channel:	Parallel to A
Measuring ranges:	0 – ±200 mA, 0 – ±2 A
Connector:	One twin 4 mm safety socket
Analogue sensor inputs:	
Channels:	2 (A and B)
Connectors:	Two 8-pin miniDIN sockets
Sensor identification and calibration:	Automatic
Triggering:	Quasi-continuous
Sampling rate:	50 kilosamples/s
Resolution:	12 bit
Voltage outputs:	
Channels:	2 (A' and B'), with common ground connection
Voltage amplitude:	0 – ±5 V
Connectors:	Two twin 4 mm safety sockets
Analogue sensor outputs:	
Channels:	2 (A' und B')
Connectors:	Two 8 pin miniDIN sockets
Sampling rate:	10 kilosamples/s
Resolution:	12 bit
Digital Inputs:	
Channels:	4 (A, B, C, D)
A:	TTL
B:	TTL, high-speed sampling rate, 100 kilosamples/s
C, D:	High-speed optical coupler (galvanically isolated)
Connector:	One 8 pin miniDIN socket
Digital outputs:	
Channels:	6 (A', B', C', D', E', F')
Signal:	TTL
Connector:	One 8 pin miniDIN socket
Additional data:	
Computer connection:	USB port
Internal data storage:	128 k
Monitor display:	Large display (64x122) for data on all channels
Power supply:	4.5 V DC/300 mA or 3 batteries LR6 AA alternatively 3 NiCd or 3 NiMH rechargeable batteries

3B NET*log*™ (230 V, 50/60 Hz)

9983-1000540

3B NET*log*™ (115 V, 50/60 Hz)

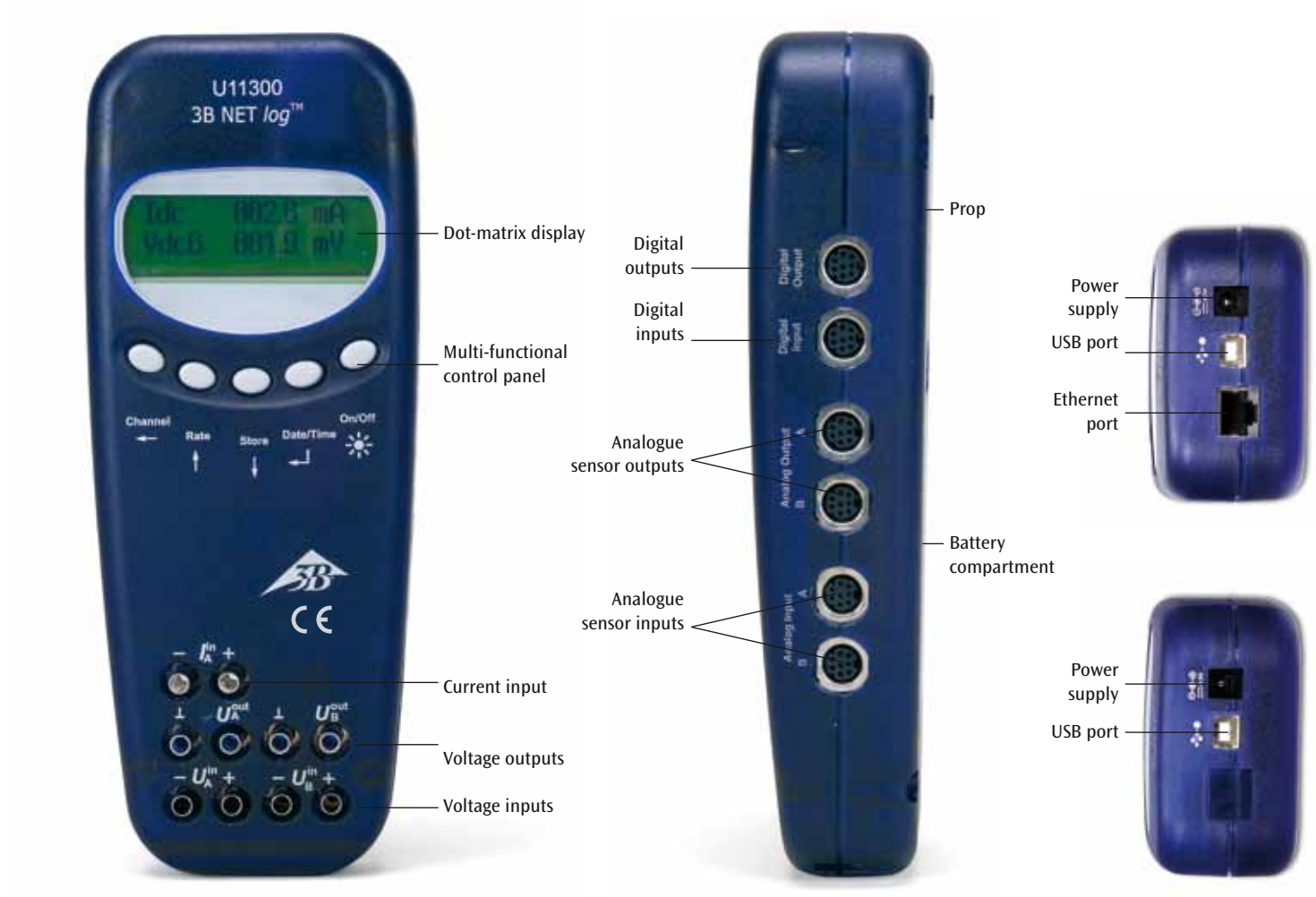
9983-1000539

3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)

9983-1000009

3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)

9983-1000541



www.EngineeringBooksPDF.com



9983-1009955
9983-1009954



9983-1001034



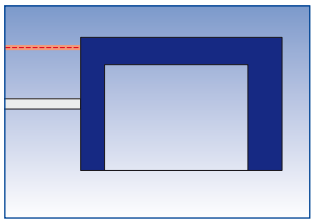
9983-1000563

Photo Gate

Infrared photo gate for triggering the 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) or a digital counter (9983-1001033 resp. 9983-1001032). For time measurements in experiments on free fall, motion on a track or pendulum oscillations and for counting pulses. It can be operated in internal mode using the built-in infra-red light source or in external mode with the aid of a laser pointer, which needs to be obtained separately. It then acts as a wide-range light barrier, allowing it to be used at sporting events, for example. The gate includes an operational indicator light, stand rod with screw thread, M6 bolt for attachment to a roller track (9983-1003318) and connector lead with 8 pin miniDIN plugs.

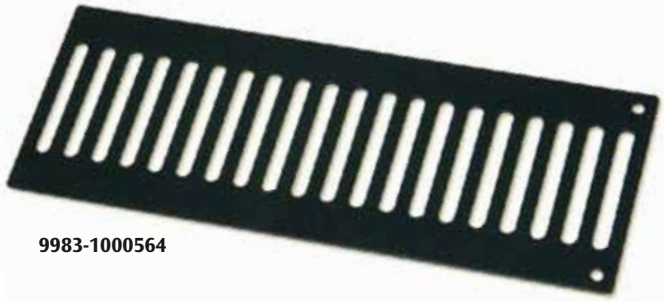
Barrier spacing:	82 mm
Rise time:	60 ns
Spatial resolution:	< 1 mm
Time resolution:	0.1 ms

9983-1000563



Additionally required for attaching multiple light barriers to 3B NET*log*™ unit:
9983-1000571 Digital Input Box

Also recommended for use connecting of photo gate to external digital counters:
9983-1009955 Connector Box (230 V, 50/60 Hz)
9983-1009954 Connector Box (115 V, 50/60 Hz)



9983-1000564

Connector Box

Connector box for use in connecting light barrier (9983-1000563) or laser reflection sensor (9983-1001034) to external digital counters. Includes plug-in power supply 12 V AC.

Input: 8-pin miniDIN socket
Output: Two 4-mm safety sockets

Connector Box (230 V, 50/60 Hz)
9983-1009955

Connector Box (115 V, 50/60 Hz)
9983-1009954

Laser Reflection Sensor

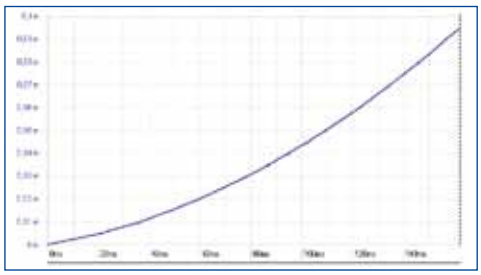
Sensor for triggering the 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) or a digital counter (9983-1001033 resp. 9983-1001032) in time measurements on moving objects. Suitable for opto electronic scanning of light and dark markings on moving objects or in conjunction with a reflecting foil to form a wide spaced obstruction sensor. The intensity of the laser beam is adjusted automatically according to the distance of the object. Includes reflecting foil, stand rod with screw thread and connector lead with 8 pin miniDIN plugs.

Maximum range:	2.5 m
Laser power:	<1 mW
Laser protection class:	II

9983-1001034

Additionally required for attaching multiple laser reflection sensors to 3B NET*log*™ unit:
9983-1000571 Digital Input Box

Also recommended for use connecting laser reflection sensor to external digital counters:
9983-1009955 Connector Box (230 V, 50/60 Hz)
9983-1009954 Connector Box (115 V, 50/60 Hz)



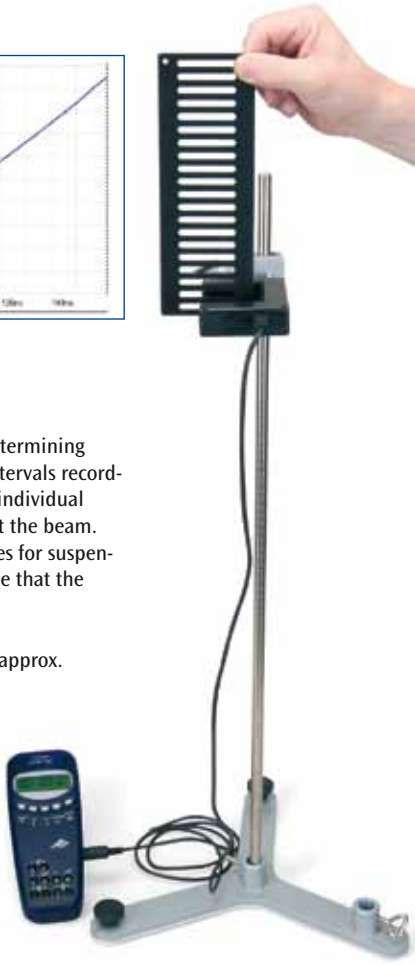
Distance travelled as a function of time

Picket Fence

Aluminium strip with 21 openings for determining gravitational acceleration g from time intervals recorded for a light beam passing through the individual openings of the strip as it falls freely past the beam. Anodised sheet aluminium with two holes for suspension of additional weights to demonstrate that the acceleration is independent of the mass.

Distance between rungs:	10 mm
Dimensions:	205x75 mm² approx.

9983-1000564



Measurement of free fall using a picket fence

www.EngineeringBooksPDF.com



9983-1000559



9983-1000557

9983-1000568



Ultrasonic Motion Sensor

Sensor for the measurement of unidimensional motion, e.g. on an air cushion track or in free fall. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs and grill for protection against falling objects.

Measurement range:	0.15 m to about 11 m
Resolution:	2 mm
Accuracy:	±1%
Sensor type:	Electrostatic 50 kHz converter
Sampling frequency:	10 Hz

9983-1000559

Acceleration Sensor, ±25g

Sensor for the measurement of unidimensional collisions and all kinds of high acceleration motion. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±250 m/s²
Resolution:	0.2 m/s²
Accuracy:	±1%
Sensor cable:	2 m
Sensor type:	Capacitive acceleration sensor

9983-1000560



9983-1000560

9983-1000561

Acceleration Sensor, ±5g

Sensor for the measurement of unidimensional acceleration, e.g. of a rider on an air cushion track, of a coil spring pendulum or of a lift. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±50 m/s²
Resolution:	0.03 m/s²
Accuracy:	±1%
Sensor cable:	2 m
Sensor type:	Capacitive acceleration sensor

9983-1000561

Displacement Sensor

Sensor with rotating wheel for detecting displacement via a string. Includes stand rod with thread and connector lead with 8-pin miniDIN plugs.

Wheel:	24 mm diam.
Maximum displacement:	66 mm approx.
Displacement resolution:	1/6 mm approx.

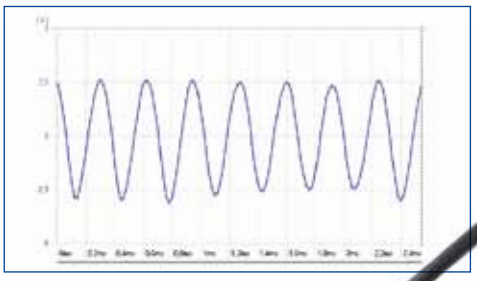
9983-1000568

Force Sensor, ±50 N

Force sensor for the measurement of unidimensional forces, with tare function. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges:	0 – ±5 N, 0 – ±50 N
Accuracy:	±1%
Sensor type:	Metal strip strain gauges

9983-1000557



Sound amplitude of a tuning fork as a function of time

9983-1000565

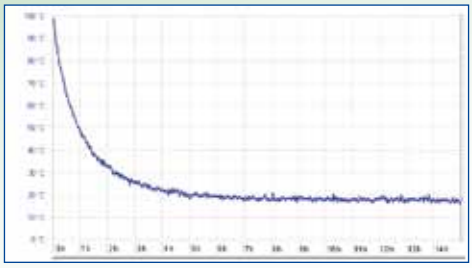
Microphone

Sensor for the measurement of the relative acoustic pressure or for plotting sound wave patterns, e.g. of voices or musical instruments. With built in electret microphone. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Frequency range:	50 Hz – 20 kHz
Microphone cable:	2 m

9983-1000565

www.EngineeringBooksPDF.com



Fall in temperature as a function of time



9983-1000550

9983-1009922



Demonstration of Newton's law of cooling

UV-A/B Sensor

Sensor box with built-in photodiode for measurements in the UV A/UV B spectra. For use in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or measurement acquisition via computer. Includes screw-in aperture, UV-A filter (SCHOTT UG-1) and connector lead with 8-pin miniDIN plugs.

Measuring ranges:	0 – 70 mW/m², 0 – 7 W/m², 0 – 700 W/m²
Max. spectral sensitivity:	21 mA/W approx. at 300 nm
Filter level for visible light:	50
Sensor type:	Titanium dioxide Schottky diode with built-in filter for visible light

9983-1000567

Temperature Sensor, Pt100

Temperature sensor for the measurement of temperatures in organic liquids, solutions of salts, acids, and bases. The stem and tip of the temperature sensor are of stainless steel. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-50°C – 150°C
Resolution:	0.1° C
Accuracy:	0.1% of measured value plus 0.25°C
Sensor cable:	1 m, with silicone insulation
Sensor type:	Pt100 thermocouple

9983-1000550

Temperature Sensor, Pt100 with Measurement Terminal

Temperature sensor for the measurement of temperatures on the copper tubing of a heat pump (9983-1000820/9983-1000819). Temperature sensor shaft made of rust-proof stainless steel. Tip with matching copper terminal. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-50°C – 150°C
Resolution:	0.1° C
Accuracy:	0.1% of measured value plus 0.25°C
Sensor cable:	1 m, with silicone insulation
Sensor type:	Pt100 thermocouple

9983-1009922



9983-1000558

Temperature Sensor, TC – K

Temperature sensor for the measurement of extremely low and extremely high temperatures, for example in liquid nitrogen or liquid oxygen, or inside a flame. With room temperature compensation. The immersible NiCr-Ni sensors (9983-1002804 and 9983-1002805) can also be connected to the sensor box. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-270°C to 400°C
Accuracy:	0.2% plus 3°C (-270°C – 0°C) 0.1% plus 2°C (0°C – 400°C)
Resolution:	1°C
Sensor type:	NiCr-Ni (type K)
Sensor length:	60 cm approx.

9983-1000551

Magnetic Field Sensor ±2000 mT

Sensor for the measurement of magnetic flux density in the tangential direction. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges:	0 – ±200 mT, 0 – ±2000 mT
Resolution:	0.1 mT, 1 mT
Accuracy:	±1.5%
Sensor type:	Linearised Hall sensor

9983-1009941

Magnetic Field Sensor ±100 mT

Sensor for the measurement of magnetic flux density in the tangential direction. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges:	0 – ±2 mT, 0 – ±20 mT, 0 – ±100 mT
Resolution:	0.01 mT, 0.1 mT, 1 mT
Accuracy:	±1.5%
Sensor type:	Linearised Hall sensor

9983-1000558



9983-1000567



9983-1000551



9983-1009941

www.EngineeringBooksPDF.com

9983-1000545



9983-1000554



9983-1000569



9983-1000549



High Current Sensor, 10 A

Sensor for the measurement of high electric currents in DC and AC circuits using a shunt resistor. Capable of withstanding loads up to 20 A for short periods. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±10 A
Max. current loading:	±20 A for 15 s
Accuracy:	<1%
Sensor type:	Shunt resistor, 5 mΩ / 2 W

9983-1000545

Humidity Sensor

Sensor for the measurement of relative humidity (RH). Suitable for weather studies and for monitoring conditions in a greenhouse or terrarium. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – 95% (non condensing)
Sensor type:	Capacitive sensor
Accuracy:	3% of RH plus 1% in the range from 0% – 95% 5% of RH plus 1% in the range from 0% – 5%
Resolution:	0.1%
Response time:	15 s

9983-1000554

Absolute Pressure Sensor, 2500 hPa

Sensor for the measurement of absolute pressure, e.g. in experiments on the Boyle-Mariotte law. Can also be used for measuring the production of O_2 during photosynthesis and for experiments on transpiration in closed systems. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes plastic syringe, silicone tube, and connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – 2500 hPa
Accuracy:	±1%
Resolution:	1 hPa
Sensor type:	Semiconductor sensor
Hose nipple:	4 mm diam.
Plastic syringe:	20 ml
Silicone tube:	1 m

9983-1000546

Electrometer Box

Impedance converter with high input resistance for the measurement of very small charges and currents. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Input resistance:	≥ 10^{11} Ω
Measurement error:	≤ 1.5%
Connectors:	4 mm sockets

9983-1000569

Barometer

Sensor for the measurement of atmospheric pressure. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes silicone tube and connector lead with 8-pin miniDIN plugs.

Measurement range:	700 hPa – 1200 hPa
Resolution:	0.1 hPa
Accuracy:	1.5% of the maximum value of the measuring range
Sensor type:	Semiconductor sensor

9983-1000549

Relative Pressure Sensor, ±100 hPa

Sensor for the measurement of relative pressure, e.g. the hydrostatic pressure in a column of water or the pressure difference in a Stirling engine D (9983-1000817). Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes silicone tube and connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±100 hPa
Accuracy:	±1%
Sensor type:	Semiconductor
Hose nipple:	4 mm diam.
Silicone tube:	1 m

9983-1000547

Relative Pressure Sensor, ±1000 hPa

Sensor for the measurement of relative pressure, e.g. the pressure difference in the Stirling motor G (9983-1002594). Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes silicone tube and connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±1000 hPa
Accuracy:	±1%
Sensor type:	Semiconductor
Hose nipple:	4 mm diam.
Silicone tube:	1 m

9983-1000548

9983-1000546





9983-1000548

9983-1000547



www.EngineeringBooksPDF.com

Important note: Our sensors for use with the 3B NET*log*™ system are exclusively intended for educational purposes. No measurements obtained with them may be used for diagnosing the health of any individual.



9983-1000579



9983-1000578

ECG/EMG Box

Sensor box for reading electrocardiograms (ECGs) and electromyograms (EMGs) on skeletal musculature in three standard leads as defined by Einthoven. Feeds can be selected at the press of a button and are indicated by LEDs. For use in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for computer-linked measurements. A connecting lead with 8-pin miniDIN plugs is included.

Input resistance: > 10 MΩ
Output voltage: max. ±1 V
Blocked frequency: 50 – 60 Hz

9983-1000579

Blood Pressure Sensor

Sensor box for measuring blood pressure of a test subject using the oscillometric method with the aid of a cuff to fit around the extremities. It is possible to determine the highest systolic and lowest diastolic pressures, evaluation of pulse rate by means of an acoustic sensor and illustrate the Korotkov sound. For use in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for computer-linked measurements. A connecting lead with 8-pin miniDIN plugs is included.

Pressure range: 0 mm Hg to 300 mm Hg (0 to 400 hPa)
Overload-proof: up to 1500 hPa
Sensor type: Precision pressure sensor, calibrated and temperature compensated

9983-1000578

Set of Electrodes for ECG/EMG

Set of electrodes for ECG/EMG box for single use.

9983-5006578



9983-5006578

Light Sensor

Light sensor for the measurement of luminous intensity. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges: 0 – 600 lux, 0 – 6000 lux, 0 – 150,000 lux
Resolution: 0.8 lux, 8 lux, 200 lux

9983-1000562

9983-1000576



9983-1000562



9983-1000575



Skin Resistance Box

Sensor for measuring the resistance of a person's skin as influenced by external factors (stress, "lie detection"). Designed to conform to the latest safety requirements. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range: 1 MΩ – 10 MΩ
Input resistance: >100 kΩ
Safety category: Safety class II, classification BF

9983-1000576

Human Pulse Sensor Box

Sensor for measuring frequency of the human pulse at an earlobe or fingertip using an infrared signal transmitter clip. Automatic adjustment of signal level. Designed to conform to the latest safety requirements. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range: Pulse rates from 40 – 160 beats/min
Safety category: Safety class II, classification BF

9983-1000575

www.EngineeringBooksPDF.com

Set of 3 Conductivity Standards
Set of 3 conductivity standards with conductivities 147, 1413 and 12880 µS/cm, each with a volume of 0.5 l.

9983-1000552

Buffer Solution
Set of buffer solutions in three flasks with pH values of 4.00, 7.00 and 9.00.
Volume: 250 ml each

9983-1002753

Quinhydrone Buffer Solution (not shown)
Ready-to-use buffer solution with a pH of 7.00 for use with redox sensor.
Volume: 250 ml per container

9983-1002754



9983-1002753

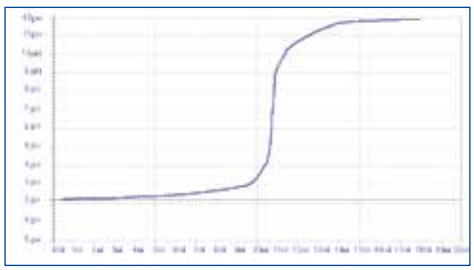
9983-1000552

Determination of the pH value of an aqueous solution

pH-Sensor
Sensor for the measurement of pH values and redox potentials in aqueous solutions. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.
Measurement range: pH 0 – 14
Sensor type: Ag-AgCl combination electrode, gel filled, not refillable
Accuracy: pH 0.05 in range from 20°C – 25°C
Resolution: pH 0.01
Response time: ≤ 1 s to reach 95% of final value

9983-1000556

Additionally recommended:
9983-1002753 Buffer Solution



Titration of acetic acid solution with sodium hydroxide solution



9983-1000556

9983-1000553



9983-1000555

Conductivity Sensor
Sensor for measuring the specific electrical conductivity of liquid media, the total concentration of dissolved substances and the diffusion of ions through membranes, and for showing the difference in conductivity between ionic and molecular compounds and between strong and weak acids. The accessories supplied include a calibrating solution. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.
Measurement ranges: 0 – 200 µS, 0 – 2 mS, 0 – 20 mS
Resolution: 1 µS, 10 µS, 100 µS
Sensor type: measurement electrode using four wire technology, with graphite cells and integrated Pt100 temperature sensor
Accuracy: 5% without calibration, 0.5% with calibration
Sensor cable: 1.5 m

9983-1000553

Redox Sensor
Sensor for measuring redox potentials in aqueous solutions. For use in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or measurement acquisition via computer. Includes connector lead with 8-pin miniDIN plugs.
Measuring range: -450 mV to +1100 mV
Sensor type: Ag/AgCl combined electrode filled with gel, non-refillable
Precision: ±4.5 mV in a temperature range from 20°C to 25°C
Resolution: 0.9 mV
Response time: ≤ 1 s for 95% of final value

9983-1000555

Additionally recommended:
9983-1002754 Quinhydrone Buffer Solution

www.EngineeringBooksPDF.com



9983-1000543
9983-1000542





9983-1000571



9983-1000570

3B POWER*log*

Programmable voltage and current source with power output for connection to the two analogue outputs of the 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539). Includes plug in power supply and two connector leads with 8 pin miniDIN plugs.

Output power:	6 W
Current:	0 – ±1 A
Voltage:	0 – ±10 V
Bandwidth:	0 – 50 kHz

3B POWER*log* (230 V, 50/60 Hz)

9983-1000543

3B POWER*log* (115 V, 50/60 Hz)

9983-1000542

Additionally required:
9983-1000544 3B NET*lab*™
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)
or
9983-1000009 3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)
or
9983-1000541 3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)

Digital Output Box

Output box for connecting the digital outputs A, B, C and D of the 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) to four pairs of 4 mm safety sockets. Includes connector lead with 8 pin miniDIN plugs.

Output signal:	TTL level
Connectors:	4 mm safety sockets

9983-1000570

Digital Input Box

Input box for connecting the digital inputs A, B, C and D of the 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) to four miniDIN8 sockets. Includes connector lead with 8 pin miniDIN plugs.

Input and output signal:	TTL level
Connectors:	8 pin miniDIN sockets

9983-1000571



9983-1000577

Response Box

Microprocessor-controlled box with a foot switch and three coloured finger-operated buttons (blue, green and red) and a combined LED, which can light up in the same colours as the hand buttons or in white to indicate use of the foot switch. Once the LED has lit up in some arbitrary colour, the response time before the appropriate switch has been activated is measured. For use in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or measurement acquisition via computer. Includes connector lead with 8-pin miniDIN plugs.

Duration of measurement:	max. 9.2 s
Display resolution:	1/100 s
Footswitch connector:	3.5 mm jack plug

9983-1000577



9983-1000566

Relay

Power relay with a set of change over contacts for initiating measurements using 3B NET*lab*™ software. The relay is controlled by the digital output of the 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) and it features both normally open and normally closed contacts. Safe potential separation between coil and contact set in accordance with VDE 0160. The contacts are made of a high performance silver alloy. Includes connector lead with 8 pin miniDIN plugs.

Max. switched voltage:	250 V AC / 220 V DC
Max. switched current:	6 A AC / 0.12 A DC
Max. switched power:	1500 VA
Min. switched power:	1 mW
Connectors:	4 mm safety sockets

9983-1000566

Additionally required:
9983-1000544 3B NET*lab*™
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)
or
9983-1000009 3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)
or
9983-1000541 3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

SW Sensors Set

Set incorporating two dynamometers and an amplifier board for recording and analysing mechanical oscillations using a standard oscilloscope. The dynamometers can be fitted to 10-mm diameter stands or the SW tie bar in order to measure dynamic forces along their axes. The amplifier board converts signals from both dynamometers so that they can be recorded and also evaluates the phase differences between both oscillation signals, outputting them as a DC signal. If the MEC amplifier board is connected to the 2x40 MHz USB oscilloscope (9983-1012879), it is possible to perform detailed analysis and evaluation of measured signals using the oscilloscope software on a PC.

Dynamometers:

Maximum force:	5 N
Frequency range:	0.3 – 200 Hz
Connectors:	3.5-mm jack plugs
Dimensions:	52x37x26 mm³

MEC amplifier board:

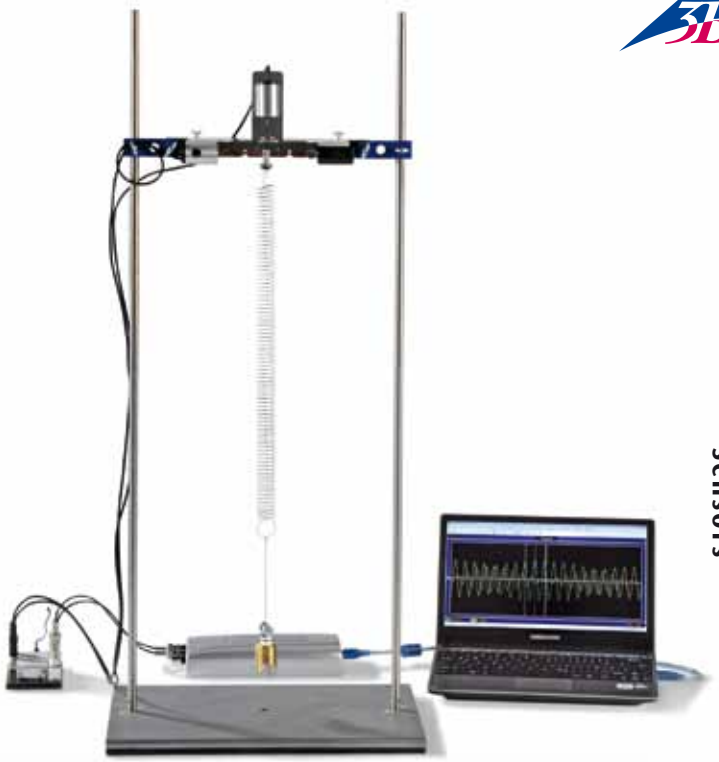
Input sockets:	3.5-mm jack sockets
Output sockets:	BNC
Dimensions:	65x100x40 mm³

Contents:
2 Dynamometers
1 MEC amplifier board
1 Power supply, 12 V AC, 700 mA

SW Sensors Set (230 V, 50/60 Hz)
9983-1012850

SW Sensors Set (115 V, 50/60 Hz)
9983-1012851

Additionally recommended:
9983-1012879 USB Oscilloscope 2x40 MHz
or
9983-1008695 Analogue Oscilloscope 2x20 MHz



Wilberforce pendulum



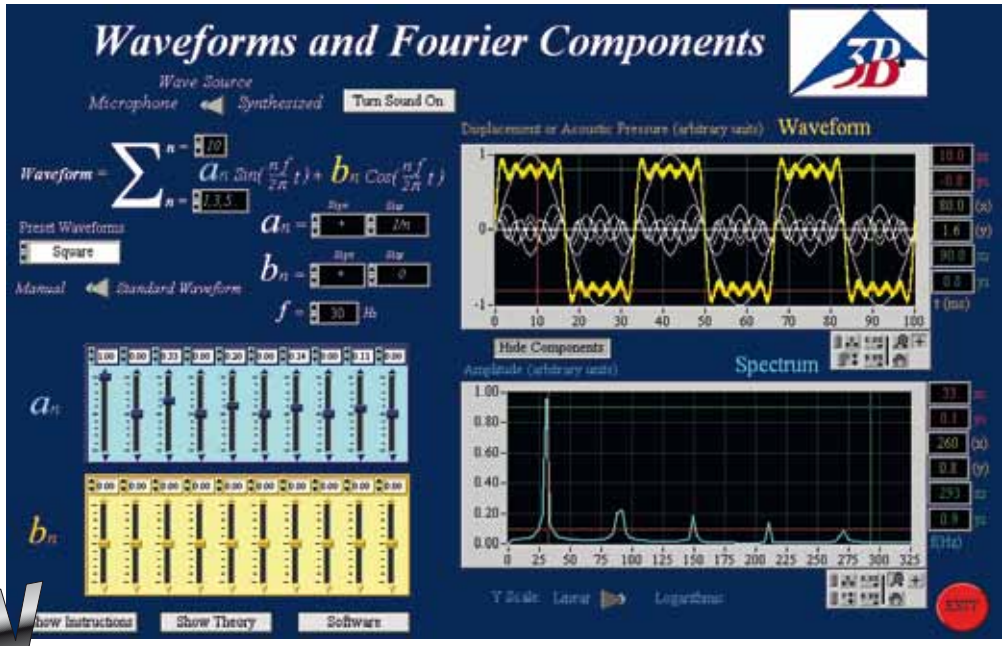
9983-1012850
9983-1012851

NEW

Software for Fourier Analysis

Software for Fourier analysis and synthesis with depiction of waveform and amplitude spectrum. Analysis of audio signals recorded using a microphone and sound card. Synthesis of Fourier components with an arbitrary choice of fundamental frequency for periodic signals. Signals can be listened to on audio. System requirements: Windows XP or higher, 512 MB RAM or higher, 128 MB graphics card or higher, 16 bit sound card or higher, microphone and speaker

9983-1012587



NEW

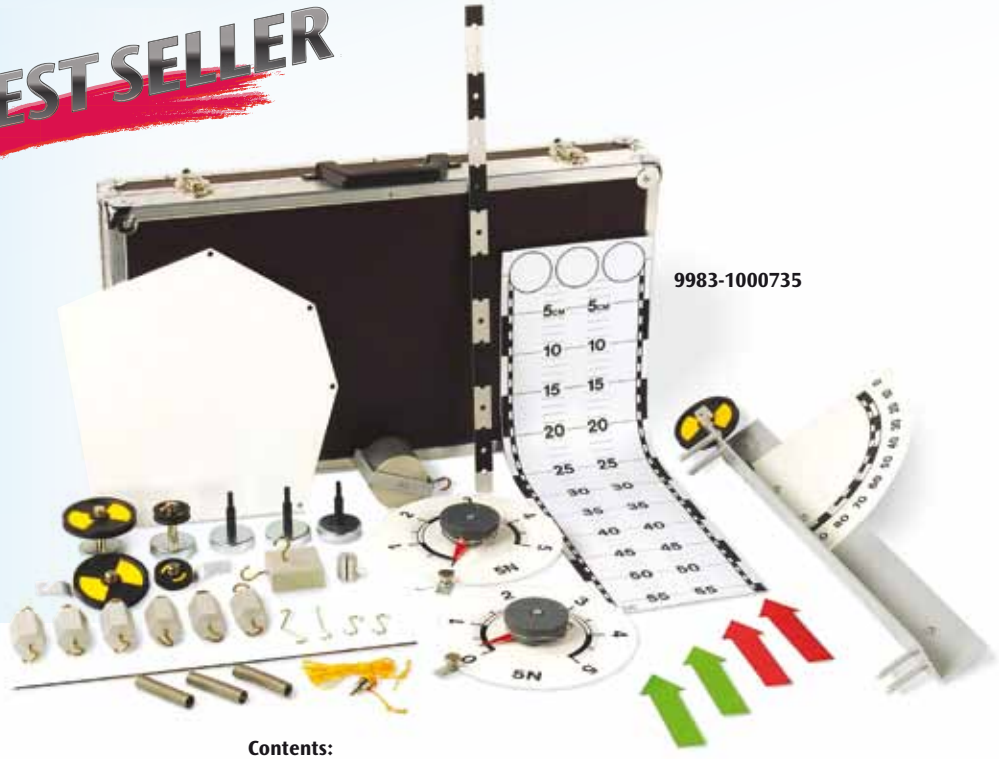
9983-1012587

www.EngineeringBooksPDF.com

Experiment Topics:

- Inclined plane
- Lever laws
- Torques and forces
- Forces acting on a lever arm
- Force as a vector
- Pendulum motion
- Physical pendulum
- Fixed and movable pulleys
- Block and tackle
- Hooke's law
- Coupled resonance
- Centre of gravity
- Friction

BEST SELLER



9983-1000735

Mechanics Kit for Whiteboard

The mechanics kit for whiteboard demonstrations includes more than 25 large, coloured and easily distinguished components stored in a case with foam inlay. More than 30 experiments can be set up in rapid time.

- Large components ensure that experiments can be viewed from a distance.
- Secure attachment is guaranteed by high-grade AlNiCo magnets.
- Quick and easy configuration of experiments.
- Measuring units, vector diagrams and explanations can be provided right next to the experimental configuration on the blackboard.

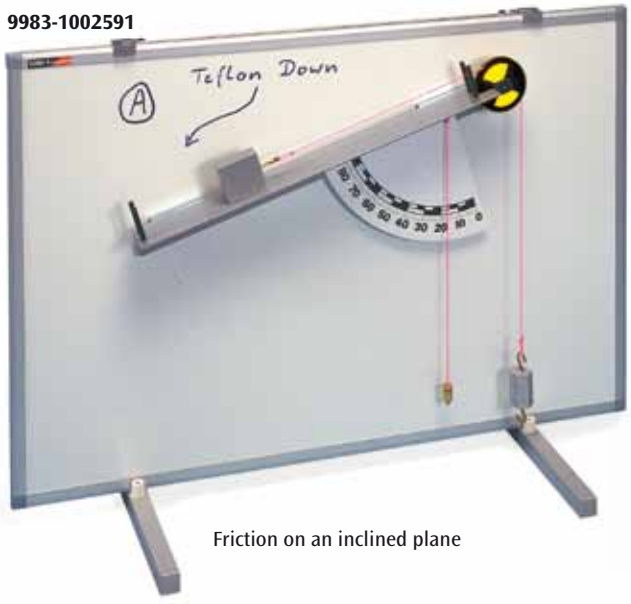
9983-1000735

Additionally required:
9983-1002591 Whiteboard, 600x900 mm²
or
9983-1002592 Whiteboard, 900x1200 mm²

Contents:

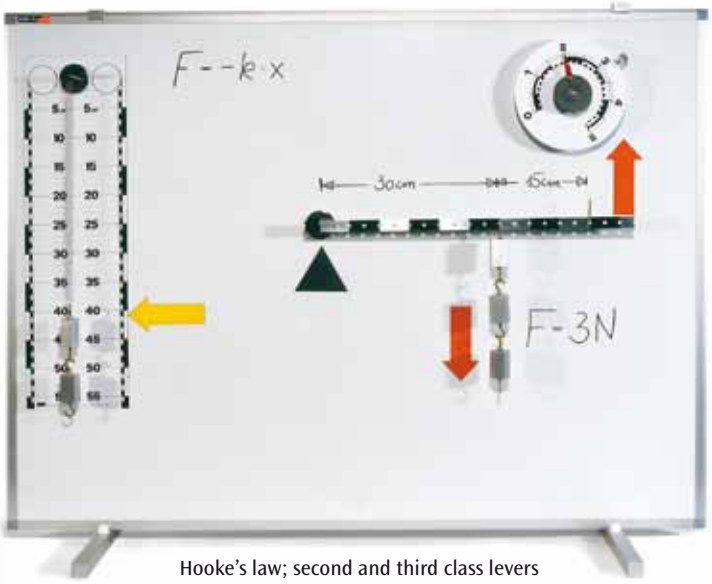
1 Inclined plane with pulley and angle scale
1 Rolling mass, 500 g
1 Lever with 20 holes, 545 mm long
1 Pointer for lever, 400 mm long
1 Slotted counterweight with knurled screw, approx. 20 g
1 Pulley, double, 70 mm diam., 40 mm diam.
1 Pulley, 70 mm diam.
1 Pulley, 40 mm diam.
2 Round scale dynamometers, 5 N
3 Magnetic tabs with 8 mm axis
3 Springs with hook, k = 6.2 N/m
1 Dual scale on a magnetic foil, 600x180 mm²
4 Arrows and one equilateral triangle on a magnetic foil
6 Weights with 2 hooks, 100 g each
1 Friction block
1 Set of nylon cords
1 Centre-of-gravity plate
1 Plumb
3 Rubber grommets
3 Brass hook
1 Brass clip
1 Storage case
1 Manual

9983-1002591



Friction on an inclined plane

9983-1002592



Hooke's law; second and third class levers

www.EngineeringBooksPDF.com

Mechanical Cumulative Stopwatch

Cumulative stopwatch with start, stop and reset buttons in shock-resistant plastic casing. Dual dial for minutes and seconds. With pendant cord.

Measuring range: 15 min
Scale accuracy: 1/10 s
Diameter: 55 mm

9983-1002810



9983-1002810

Mechanical Stopwatches

Stopwatch in stainless steel casing with dual dial for minutes and seconds. In pouch with pendant cord.

Art. No.	Measuring range	Reading accuracy	Diameter
9983-1003368	30 min	0.2 sec	45 mm
9983-1003369	15 min	0.1 sec	45 mm



9983-1003369

9983-1003368

BEST SELLER

Digital Stopwatch

Stopwatch with 7-digit LCD display in robust plastic casing with start/stop and split/reset buttons for starting and stopping, cumulative, lap-time and dual-time measurement. Includes pendant cord.

Measuring range: 9 h, 59 min, 59 s, 99/100 s
Accuracy: 1/100 s
Battery: button cell 1.55 V, Type 389
Dimensions: approx. 65x65x18 mm³

9983-1002811



9983-1002811

Timer

Stopwatch for counting up or down with acoustic alarm. Magnetic holder for attachment to metal surfaces and fold-away support legs.

Display: 4-digit LCD, 18 mm
Timer range: 99 min 59 s
Ticking rate: 1 s
Dimensions: ca. 60x60x20 mm³

9983-1003009



9983-1003009



9983-1002809

Table-Top Stop-Clock

Large quartz-controlled stop-clock with start stop and reset buttons, cumulative time and lap-time settings (clock resets to zero and starts timing again immediately). 2 hands, dial with dual scale for minutes/seconds and hundredths of a minute.

Measuring range: 60 min / 60 s
Graduations: 1 s / 1/100 min
Dial: 110 mm diam.
Dimensions: approx. 175x130x95 mm³

9983-1002809

Digital Timer

We recommend the use of the digital timer (9983-1001033 or 9983-1001032) along with one or two photo gates (9983-1000563) for reliable measurement of the time a carriage on a track takes to cover a distance or when it obscures the light sensors. Also suitable for measuring oscillation periods of a swinging pendulum or similarly the times when it obscures the sensors. As an alternative to a light barrier, a laser reflection sensor (9983-1001034) can also be used for the opto-electronic sampling of light and dark markings on moving objects or can be used as a long-distance light barrier when connected in conjunction with reflective foil.

Digital Timer (230 V, 50/60 Hz)

9983-1001033

or

Digital Timer (115 V, 50/60 Hz)

9983-1001032

Photo Gate

9983-1000563

or

Laser Reflection Sensor

9983-1001034



9983-1001034



9983-1000563

9983-1001033
9983-1001032



9983-1001046

For measuring times when, e.g. a swinging pendulum obscures a sensor

...going one step further
www.EngineeringBooksPDF.com

Vertical Ruler, 1 m
Ruler with fastening pin (d = 12 mm) so th at it can be set up vertically in a stand base. Scale as per 9983-1000742.

9983-1000743



9983-1006494

9983-1000743

9983-1001045

Pocket Measuring Tape, 2 m
Made of spring band steel, with locking button and rewinding spring.

Length: 2 m / 79 inch
Scales: cm, mm / 1/32 inch

9983-1002603



9983-1002603

Callipers S
Inexpensive callipers with 125 mm scale suitable for measuring internal and external dimensions and depths.

9983-1010217



9983-1010217

Set of Riders for Rulers
The set of riders consists of two red plastic pointers to match rulers 9983-1000742 and 9983-1000743 that can be used as movable cursors.

Dimensions: 120x40x20 mm³

9983-1006494

9983-1000742



Ruler, 1 m
Wooden ruler with mm scale on one side and two-coloured cm scale on the reverse.

Cross section: 25x8 mm²

9983-1000742

Digital Callipers, 150 mm
For measuring internal and external dimensions and depth. Tempered stainless steel, LCD display. Including locking screw, adjustment from cm to inch, zero-calibration in any position, with plastic pouch.

Measuring range: 150 mm / 6 inch
Graduation: 0,01 mm / 1/128 inch
Display: 5-digit LCD, 6 mm

9983-1002602



9983-1002602



9983-1002600



9983-1002601

External Micrometer
Precision micrometer with thimble and locking system. Measuring surfaces coated with hardened metal, polished with fine lapping. Tempered measuring spindle with polished thread, chromed micrometer arc with insulation, scale drum and sleeve in matt-chrome finish. In plastic pouch.

Measuring range: 0 – 25 mm
Graduation: 0,01 mm

9983-1002600

Callipers, 150 mm
Precision callipers for measuring internal and external dimensions and depth. Tempered stainless steel, precision polished measuring surfaces, gauge with matt-chrome finish. In imitation leather pouch.

Measuring range: 150 mm / 6 inch
Graduation: 1/20 mm / 1/128 inch

9983-1002601

9983-1002947



Precision Sphereometer
For measuring plate thicknesses, depressions and radii of curvature of spherical surfaces, for example, lenses. The device consists of a tripod with three steel tips which form an equilateral triangle. A micrometer screw with a measuring tip is recessed in the middle. Attached to the micrometer screw is a disc with circular divisions from 0 to 500 and a vertical scale with millimeter divisions from -10 to 15 mm at the tripod.

Measuring ranges: 0 – 25 mm and -10 – 15 mm
Screw pitch: 0,5 mm
Measuring accuracy: 0,001 mm
Support spacing: 50 mm

9983-1002947

Additionally recommended:
9983-1003190 Plane Mirror

Watch Glasses from 9983-1002868 and 9983-1002869

9983-1002868
9983-1002869

www.EngineeringBooksPDF.com

Callipers Model
Model of a set of callipers suitable for measuring internal and external dimensions and depths of up to 300 mm.
Dimensions: 420x195 mm²

9983-1010214



9983-1010214

Vernier Model
For demonstrating Vernier readings on length measuring devices and protractors.

Length:	600 mm
Vernier length:	260 mm
Height:	190 mm

9983-1002951



9983-1002951



9983-1003233

9983-1003234

Wooden Rulers
These wooden rulers are a classroom staple.

Wooden Ruler, 1 m, Set of 10
9983-1003233

Wooden Ruler, 0.5 m, Set of 10
9983-1003234



9983-1009713



9983-1003518

Vessel with Overflow, metal
Vessel with overflow, 900 ml, made of metal.

9983-1009713

Vessel with Overflow, Transparent
Vessel with overflow, 275 ml, made of Plexiglas.

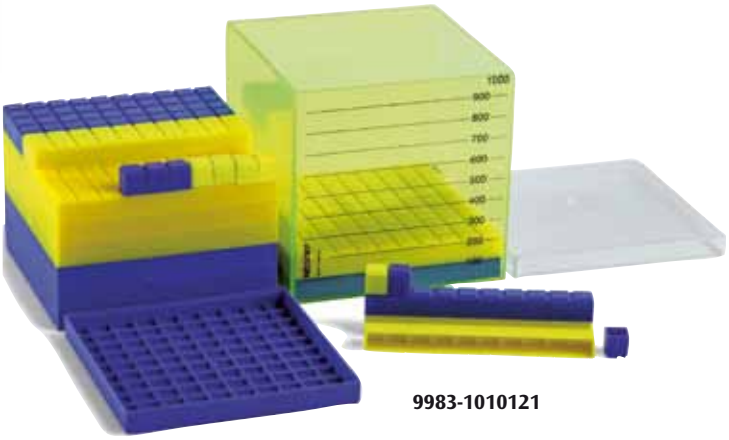
9983-1003518



9983-1006889

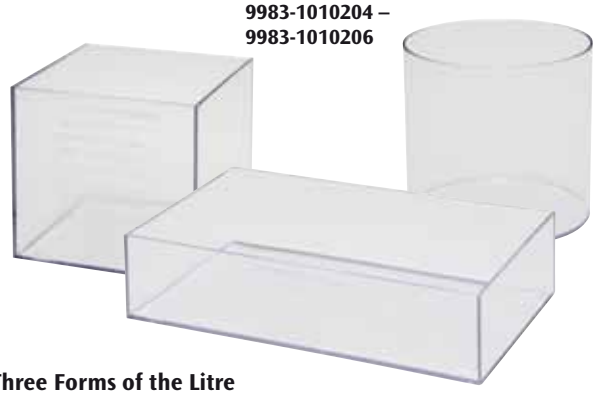
Object for Measurement Exercises
Irregularly shaped body, which is especially well suited for practising measurement using Vernier callipers.

9983-1006889



9983-1010121

9983-1010204 – 9983-1010206



Broken Down Cubic Decimetre
Transparent and graduated cube of 100x100x100 mm³ with contents:
9 cuboids, 100 cm³ (4 yellows and 5 blues)
9 cuboids, 10 cm³ (4 yellows and 5 blues)
10 cubes, 1 cm³ (5 yellows and 5 blues)

9983-1010121

Three Forms of the Litre
Fully transparent; the graduations are engraved.

Art. No.	Designation	Inner Dimensions
9983-1010204	Graduated Cube 1l	approx. 100x100x100 mm³
9983-1010205	Graduated Cuboid 1l	approx. 200x100x50 mm³
9983-1010206	Graduated Cylinder 1l	approx. 100 mm Ø x 120 mm

Set of 1-Litre Bodies
Set of equipment consisting of 5 transparent hollow bodies with engraved volume scale.

Cylinder, 1 l	100 mm (diam.) x 120 mm approx.
Cylinder, 0.5 l	75 mm (diam.) x 115 mm approx.
Cylinder, 1 l	160 mm (diam.) x 50 mm approx.
Cube, 1 l	100x100x100 mm³ approx.
Cuboid, 1 l	200x100x50 mm³ approx.

9983-1012882



9983-1012882

www.EngineeringBooksPDF.com



9983-1002698 – 9983-1002701

Dynamometer, Transparent

Dynamometer with easily read scale printed on a transparent plastic sleeve. Suitable for projection using a projector. With protection against over extension of the spring.

Precision: ±3% of total measuring range
Length: 185 mm
Scale length: 60 mm

Art. No.	Measuring Range	Scale Division
9983-1002698	1 N	0.02 N
9983-1002699	2 N	0.04 N
9983-1002700	5 N	0.1 N
9983-1002701	10 N	0.2 N

Dynamometer with Round Dial

Spring dynamometer for experiment demonstrations. Grooved pulley on ball bearings and cord with hook. Large, easily read round dial. Zero-point calibration via knurled screw. With magnet for attachment to a whiteboard.

Diameter: 200 mm

Art. No.	Measuring range	Scale Division
9983-1009738	1 N	0.02 N
9983-1009739	2 N	0.05 N
9983-1009740	5 N	0.1 N
9983-1009741	10 N	0.1 N

9983-1009738



9983-1009739



9983-1009740



9983-1009741



Dynamometer, Colour Coded

Colour coded dynamometer for measuring weights or masses as well as forces. Scaled in newtons or grams and kilograms with zero-point calibration.

Art. No.	Colour	Measuring Range	Scale Division
9983-1003370	Blue	250 g /2.5 N	5 g / 0.05 N
9983-1003371	Green	500 g / 5 N	10 g / 0.1 N
9983-1003372	Brown	1000 g / 10 N	20 g / 0.2 N
9983-1003373	Red	2000 g / 20 N	50 g / 0.5 N
9983-1003374	White	3000 g / 30 N	50 g / 0.5 N
9983-1003375	Yellow	5000 g / 50 N	100 g / 1 N



9983-1003370 – 9983-1003375



9983-1003102 – 9983-1003110

Precision Dynamometer

Colour coded precision dynamometer in a transparent plastic casing with easy-to-read scale, protection against over extension of the spring and zero-point calibration capability.

Precision: < 1% of total measuring range
Scale division: 1% of total measuring range
Dimensions: 280 mm x 16 mm diam.

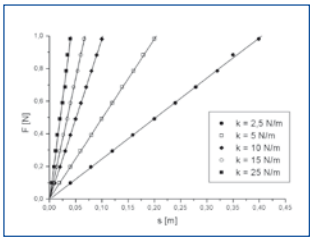
Art. No.	Colour	Measuring range
9983-1003102	Silver	0.1 N
9983-1003103	Beige	0.2 N
9983-1003104	Yellow	1 N
9983-1003105	Red	2 N
9983-1003106	Blue	5 N
9983-1003107	Green	10 N
9983-1003108	Violet	20 N
9983-1003110	Brown	100 N

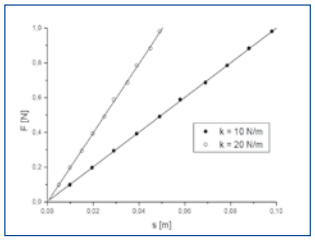
www.EngineeringBooksPDF.com

Set of Helical Springs for Hooke's Law

5 helical springs with a hook and an attached pointer for determining spring constants

9983-1003376





Spring constant	2.5 N/m	5 N/m	10 N/m	15 N/m	25 N/m
Length	122 mm	145 mm	150 mm	147 mm	142 mm
Diameter	15 mm	15 mm	19 mm	20 mm	20 mm

Additionally recommended:
9983-1000773 Set of Slotted Weights 10x10 g, Red and Grey
9983-1000743 Vertical Ruler
9983-1006494 Set of Riders for Rulers





Dynamometers for Demonstrating Hooke's Law

Two colour coded dynamometers in transparent plastic sleeve with easy-to-read cm/mm scale for demonstrating Hooke's law and calculating the spring constant. Protection against over extension of the spring and zero-point calibration.

Spring constants: 10 N/m and 20 N/m
Length of scale: 115 mm
Dimensions: 280 mm x 16 mm Ø

9983-1003109

Additionally recommended
9983-1003227 Set of Slotted Weights 10 g

9983-1003109



9983-1003376

9983-1002946

9983-1002703

9983-1002702



9983-1002704

9983-1000741

9983-1002945

9983-1003515

9983-1000786



Helical Springs

For experiments on expansion and oscillation, with two suspension eyelets.

Art. No.	Spring constant	Maximum loading capacity	Length	Diameter
9983-1000786	1.5 N/m	0.75 N	120 mm	20 mm
9983-1003515	2.5 N/m	0.5 N	120 mm	16 mm
9983-1002945	3 N/m	1.5 N	80 mm	32 mm
9983-1000741	5 N/m	2 N	60 mm	20 mm
9983-1002702	16 N/m	2.5 N	115 mm	6 mm
9983-1002703	43 N/m	6.5 N	110 mm	9 mm
9983-1002946	20 N/m	8.0 N	180 mm	9 mm
9983-1002704	86 N/m	13.5 N	95 mm	10 mm

www.EngineeringBooksPDF.com

Set of 10 Weights
Brass weights with hooks on both sides so that they can be suspended from one another.

Set of 10 Weights, 10 g
9983-1000770

Set of 10 Weights, 20 g
9983-1000769

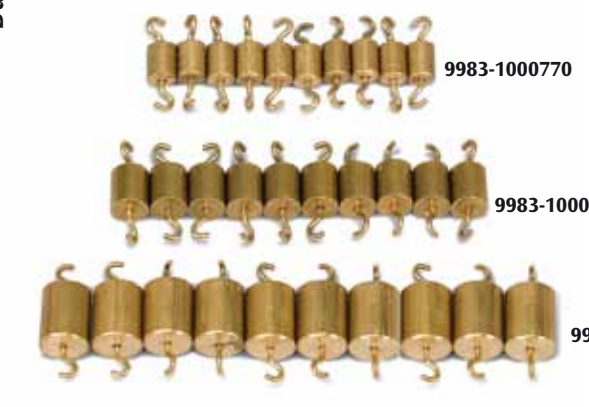
Set of 10 Weights, 50 g
9983-1000771

Sets of Slotted Weights on Weight Holder
Slotted brass weights and holder.

Art. No.	Designation	Weights (incl. holder)	Holder diam.
9983-1003226	Set of slotted weights, 20-100 g	2x 5 g, 1x 10 g, 4x 20 g	22 mm
9983-1003227	Set of slotted weights, 10x 10 g	10x 10 g	18 mm
9983-1003229	Set of slotted weights, 5x 50 g	5x 50 g	32 mm
9983-1003228	Set of slotted weights, 5x 100 g	5x 100 g	38 mm

Set of Slotted Weights on Holder, red and grey
Coloured slotted weights with holder for use in experiment demonstrations.

Art. No.	Designation	Weights (incl. holder)	Holder diam.
9983-1000773	Set of slotted weights, 10x 10 g, red and grey	10x 10 g	25 mm
9983-1000775	Set of slotted weights, 8x 50 g, red and grey	8x 50 g	25 mm
9983-1000777	Set of slotted weights, 4x 100 g, red and grey	4x 100 g	25 mm







Set of Weights 10 g to 1000 g
9-piece set of brass weights in storage box, each with hooks on both sides. 1x 10 g, 2x 20 g, 1x 50 g, 1x 100 g, 2x 200 g, 1x 500 g, 1x 1000 g

9983-1003214

Set of Weights, 1 g to 1000 g
13-piece set of brass weights in storage block. 1x 1 g, 2x 2 g, 1x 5 g, 1x 10 g, 2x 20 g, 1x 50 g, 1x 100 g, 2x 200 g, 1x 500 g, 1x 1000 g

9983-1003212

Set of Weights 1 g to 50 g
8-piece set of brass weights, delivered in storage box. 1x 1 g, 2x 2 g, 1x 5 g, 2x 10 g, 1x 20 g, 1x 50 g

9983-1003210

Set of Weights 100 g to 2000 g
7-piece set of weights with hooks. 1x 100 g, 2x 200 g, 1x 500 g, 2x 1000 g, 1x 2000 g

9983-1001052

Set of Weights 1 g to 500 g, slotted
12-piece set of brass weights on convenient storage rack. 1x 1 g, 2x 2 g, 1x 5 g, 1x 10 g, 2x 20 g, 1x 50g, 1x 100 g, 2x 200 g, 1x 500 g

9983-1003211

Weight Holder, 50 g
Weight holder for weight set 9983-1003211.

9983-1003215













www.EngineeringBooksPDF.com

Set of Weights 1 g to 500 g
12-piece set of brass weights in storage block. 1x 1 g, 2x 2 g, 1x 5 g, 2x 10 g, 1x 20 g, 1x 50 g, 2x 100 g, 1x 200 g, 1x 500 g

9983-1010189



9983-1010189

Set of Weights 1 mg to 500 mg
Set of 12 aluminium weights in a plastic box. 1x 0.5 g, 1x 0.2 g, 2x 0.1 g, 1x 0.05 g, 2x 0.02 g, 1x 0.01 g, 1x 5 mg, 2x 2 mg, 1x 1 mg.

9983-1010234



9983-1010234



9983-1000676

Set of Three Weight Holders with Slotted Weights
Slotted brass weights on holder comprising 3 sets with 2x 5 g, 2x 10 g, 2x 20 g, 3x 50 g.

9983-1000676



9983-1010168

Set of Weights with Hooks
11-piece set of weights with hooks on both sides so that they can be suspended from one another. Tolerance: 10%. 1x 1 g, 2x 2 g, 1x 5 g, 2x 10g, 1x 20 g, 1x 50 g, 2x 100 g, 1x 200 g.

9983-1010168



9983-1012872

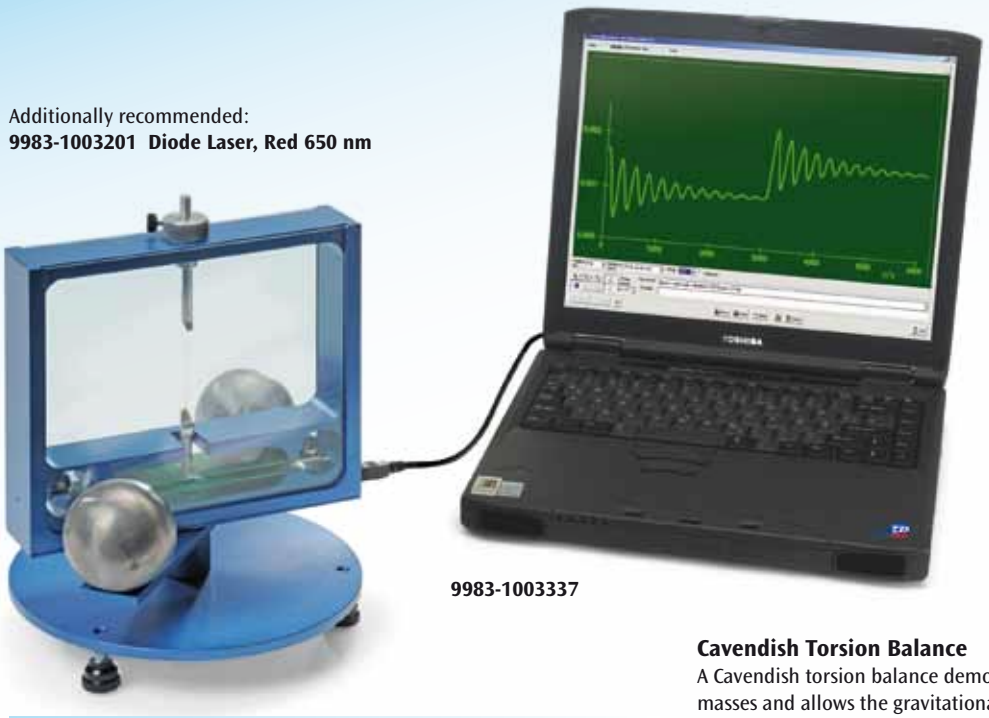
Bench Scales, Harvard Junior
Inexpensive and colourful two-pan scales made of plastic. No less stable or accurate than many more expensive scales. With high-precision manufactured metal beam, interchangeable pans and zero adjustment. Includes a set of 8 weights. Built-in interlock to protect against vibration during transport or during long-term storage. Stackable.

Maximum load:	2 kg
Precision:	0.5 g
Pans:	150 mm diam., plastic, shallow and high-sided versions
Set of weights:	Set of 8, 370 g

9983-1012872

www.EngineeringBooksPDF.com

Additionally recommended:
9983-1003201 Diode Laser, Red 650 nm



Oscillation about the two equilibrium positions

9983-1003337

Tungsten Wire (not shown)
Roll of torsion wire for Cavendish torsion balance (9983-1003337).
Diameter: 25 µm

9983-1009718

Experiment Topics:

- Day and night
- Motion of the sun across the sky
- Seasons
- Changing periods of daylight
- Sundial and the shadow of a gnomon
- Phases of the moon
- Crescent moons of various different widths
- Solar and lunar eclipses and their cycles
- Lunar months and festivals based on lunar periods

Cavendish Torsion Balance

A Cavendish torsion balance demonstrates the force of gravity between two masses and allows the gravitational constant to be determined. Thanks to the short oscillation period of just 2 – 4 minutes, the gravitational constant can be determined within the space of a single lesson with an accuracy of better than 10%. The core of the apparatus is a torsion pendulum made of a light bar with two small lead spheres, which is suspended horizontally from a thin wire. The apparatus is moved from its equilibrium position by the attraction of the two spheres to two larger lead spheres. When the two large spheres are rotated to a new position, the torsion balance will oscillate about a new equilibrium position. The rotary motion is measured using a capacitive differential sensor, which largely suppresses noise and vibration components in the signal. The output is then recorded using a computer. For subsequent evaluation, the data can be exported to a spreadsheet. Alternatively, the motion can be demonstrated with the aid of a light pointer.

Mass of large lead spheres:	1 kg
Mass of small lead spheres:	15 g
Gravitational attraction:	$< 10^{-9}$ N
Torsion wire:	Tungsten, 25 µm
Period of oscillation:	2–4 mins
Angular resolution:	25 microradians
Sampling rate:	0.5, 1, 2, 5, 10 samples/s
Dimensions:	190x180x200 mm³
Weight:	5 kg

Includes:
1 Cavendish torsion balance
1 Measurement software
1 USB cable

9983-1003337

Orbit™ Tellurium

Attractive and easy-to-operate three-dimensional model of the sun, moon and earth, for comprehensive demonstration of their motions. Earth and moon in two different sizes in order to demonstrate day and night, motion of the sun across the sky, annual seasons, the changing amounts of daylight, phases of the moon, as well as solar and lunar eclipses and the cycles they exhibit. Shadows have clear edges since the sun is represented by a bright lamp with a Sunbeam™ reflector. As an alternative to turning the whole system together, the rotation of the earth on its axis and the position of the moon in its orbit can be adjusted individually by hand.
Dimensions: 650x250x300 mm

Includes:
Tellurium with earth and moon in two sizes; display cards showing dates, solar eclipses, lunar eclipses and phases of the moon; small figure; sundial; detailed instructions in English; mains transformer, 100–240 V/6V

9983-1008661

NEW





9983-1008661

www.EngineeringBooksPDF.com

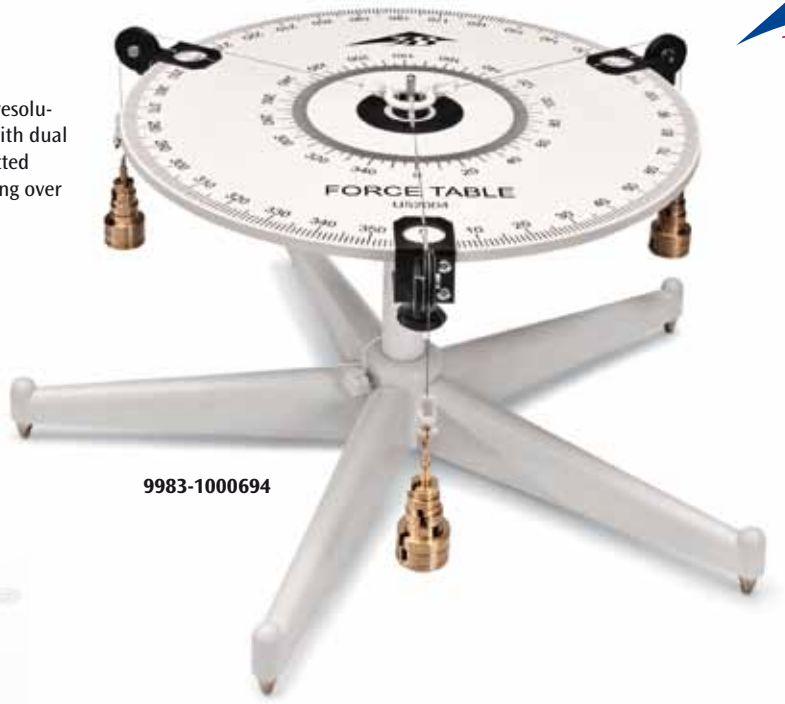
Force Table

Equipment for quantitative investigation of the combination and resolution of forces, consisting of a circular workplate on a stable base with dual protractor scale. Weights from set of three weight holders with slotted weights 9983-1000676 (included), are suspended from 3 cords strung over pulleys with ball bearings.

Dimensions: approx. 300 mm x 390 mm Ø
Weight: approx. 3,1 kg

9983-1000694

Additionally recommended:
9983-1000699 Extra Pulley



9983-1000694



9983-1000699

Extra Pulley

Additional pulley for use with the force table (9983-1000694) with clamp, cord and holder with set of slotted weights 2x 5 g, 2x 10 g, 2x 20 g and 3x 50 g.

9983-1000699



9983-1002604

Universal Spirit Level, 250 mm

Spirit level made of shock resistant plastic for measuring angles to horizontal, vertical and inclined planes and for joinery. With two plexiglass level gauges, resistant to breakage and leakage. Horizontal gauge built-in and accurately calibrated. Gauge for measuring inclination can be rotated and fixed in place. Scale markings for 45°, 60° and 120°, mm scale on measuring surface, protractor scale for inclination gauge.

Scales: 250 mm/1 mm, -90° – +90°/2°
Dimensions: 250x54x15 mm³

9983-1002604

Stability Apparatus

For demonstrating the stability of an object as a function of the position of its centre of gravity above the supporting surface. The position of the centre of gravity can be adjusted by tilting the device. The position of the centre of gravity over the base of the stand is indicated by a built-in plumb bob.

Dimensions: 180x150x290 mm³

9983-1002950



9983-1002950

Centre-of-Gravity Plate

Plastic plate with 6 boreholes for introducing the concept of centre of gravity and determining centroids.

9983-1008513

Additionally required:
9983-1002940 Plumb with Line



9983-1002940



9983-1008513

Plumb with Line

Brass body with a line.

Height: 100 mm
Diameter: 20 mm
Weight: 220 g
Line length: 1600 mm

9983-1002940

9983-1002940

Roman Arch Kit

Kit for building a Roman arch, which demonstrates static equilibrium and the resolution of forces in clear fashion. The arch is designed in such a way that the downward and sideways forces are distributed through all of the individual blocks. The kit consists of 23 hardwood blacks of 6 different shapes and a base plate with two supporting pillars. When it is assembled, the arch is capable of supporting the weight of a student.

Supported weight: max. 70 kg
Dimensions: 455x50x180 mm approx.
Weight: 2 kg approx.

9983-1009717

NEW



9983-1009717

www.EngineeringBooksPDF.com



9983-1009942

Friction Measuring Apparatus

Demonstration apparatus with movable friction surface for measuring static and dynamic friction between two surfaces as a function of area, force between the surfaces or the combination of materials. For easy measurement of dynamic friction, the movable surface is moved at constant speed under a static body connected to a dynamometer. The friction track can be inclined along its length in order to vary the force between the two surfaces.

Dimensions: 600x140x150 mm³
Weight: 3 kg

Contents:
Basic apparatus with movable friction surface, 2 N dynamometer, three different static bodies, three rails for holding static bodies, three 100 g weights.

9983-1009942



9983-4003876

Wooden Blocks for Friction Experiments

Two wooden blocks with plastic coated surfaces and hook for attaching a dynamometer.

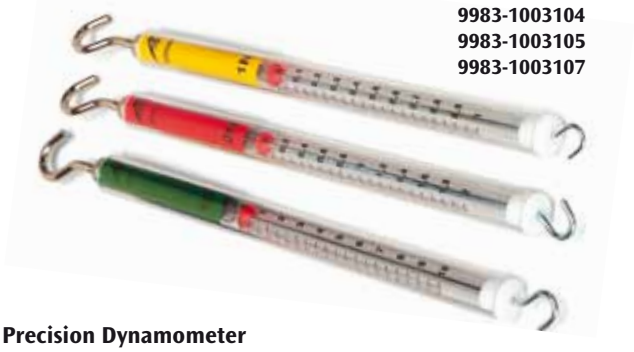
Dimensions: approx. 120x60x60 mm³ and 120x60x30 mm³

9983-1002944

Additionally recommended:
9983-1003104 Precision Dynamometer, 1 N
9983-1003105 Precision Dynamometer, 2 N
9983-1003107 Precision Dynamometer, 10 N
9983-1003212 Set of Weights, 1 g to 1000 g



9983-1002944



9983-1003104
9983-1003105
9983-1003107

Precision Dynamometer

Colour coded precision dynamometer in a transparent plastic casing with easy-to-read scale, protection against over extension of the spring and zero-point calibration capability.

Precision: < 1% of total measuring range
Scale division: 1% of total measuring range
Dimensions: 280 mm x 16 mm diam.

Art. No.	Colour	Range
9983-1003104	Yellow	1 N
9983-1003105	Red	2 N
9983-1003107	Green	10 N

Block for Friction Experiments

Aluminium block with a teflon-coated surface and 2 hooks.

Dimensions: 55x50x25 mm³

9983-4003876



9983-1003212

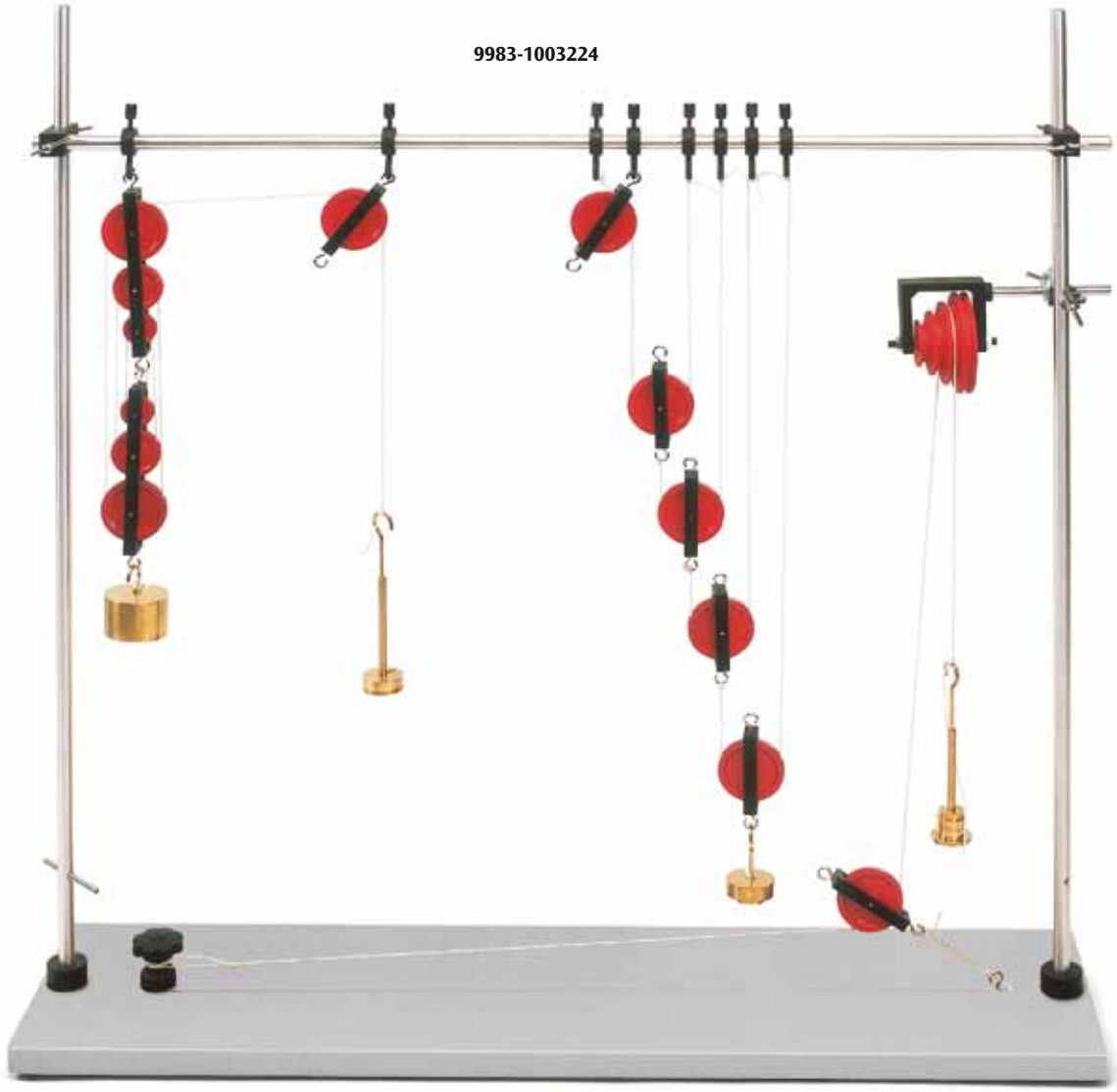
Set of Weights, 1 g to 1000 g

13-piece set of brass weights in storage block. 1x 1 g, 2x 2 g, 1x 5 g, 1x 10 g, 2x 20 g, 1x 50 g, 1x 100 g, 2x 200 g, 1x 500 g, 1x 1000 g

9983-1003212

www.EngineeringBooksPDF.com

9983-1003224





Experiment Set Pulleys and Block and Tackle

For demonstrating how forces can be altered in direction and distributed over an area by simple machines (fixed and movable pulleys, block and tackle) and introducing the concepts of mechanical work, power and energy. Complete set of equipment consisting of a stable base plate, retort stand rods, pulley blocks, block and tackle, a set of pulleys of various diameters on an axle, weight holders, slotted weights and a reel of cord. All the experiments can be set up quickly and easily since the closed plastic frame around the pulleys prevents the cord from slipping.

Base plate:	810x200 mm²
Pulleys:	50 mm diam.
Stand rods:	810 mmx12,5 mm diam.
Slotted weights:	2x 10 g, 2x 20 g, 2x 50 g, 4x 100 g, 4x 200 g, 1x 500 g
Holders:	1x 10 g, 1x 20 g, 5x 50 g

Contents:

1 Base plate
3 Stand rods
2 Plastic clamps
1 Universal sleeve
8 Hooks
7 Pulley blocks with 1 pulley
2 Pulley blocks with 4 pulleys
2 Tandem pulley blocks with 3 pulleys
1 Wheel on axle
15 Slotted weights
7 Weight holders
1 Reel of cord
1 Screw pin

9983-1003224

Additionally required:
9983-1002603 Measuring Tape, 2 m
9983-1002700 Dynamometer 5 N
9983-1003369 Mechanical Stopwatch, 15 min

9983-1001055



Cord for Experiments

Red and white plaited hemp string on a bobbin. For a variety of uses, e.g. setting up block and tackle using pulleys 9983-1003216 to 9983-1003223 or making a pendulum with bobs 9983-1003230.

Length:	100 m
Diameter:	1 mm
Maximum tension:	50 N

9983-1001055

www.EngineeringBooksPDF.com

Pulley with Table Clamp

Pulley for altering the direction of forces. Plastic pulley with ball bearings and cord groove plus securing clamp. Also has a bore so that it can be attached to a retort stand of up to 12.5 mm diameter

Pulley: 50 mm diam.
Span of bracket: up to 35 mm span

9983-1003221



9983-1003221

Pulleys and Block and Tackle

For experiments with fixed and movable pulleys. Non-deformable, low-friction pulleys with cord grooves and hooks at the ends of both axles for suspending from fixed supports or other pulleys. The enclosed design of the plastic frame prevents the cord from slipping off the pulley.



9983-1003216

9983-1003217



9983-1003223

9983-1003222

Experiment Topics:

- Inclined planes
- Uniformly accelerated motion
- Static friction
- Kinetic friction
- Rolling friction
- Elastic and inelastic collisions

Art. No.	Designation	Pulleys	Diameter	Material
9983-1003216	Pulley block	1	50 mm	plastic
9983-1003217	Pulley block	2	50 mm	plastic
9983-1003218	Pulley block	3	50 mm	plastic
9983-1003219	Pulley block	4	50 mm	plastic
9983-1003222	Tandem pulley	2	37 / 50 mm	aluminium
9983-1003223	Tandem pulley	3	25 / 37 / 50 mm	aluminium

Inclined Plane

Equipment for investigating forces acting on a body on an inclined plane, and determining the holding friction as a function of the angle of inclination. Metal base and inclined plane. The plane is hinged with scales for angle, length and height. Angle of inclination can be adjusted between 0 and 45°. Includes adjustable pulley, roller, weight pan and cord.

Length of inclined plane: 600 mm
Length of base: 450 mm
Scales: divided into cm or degrees

9983-1003213

Additionally recommended:
9983-1002701 Dynamometer, 10 N
9983-1003212 Set of Weights 1 g to 1000 g



9983-1003213



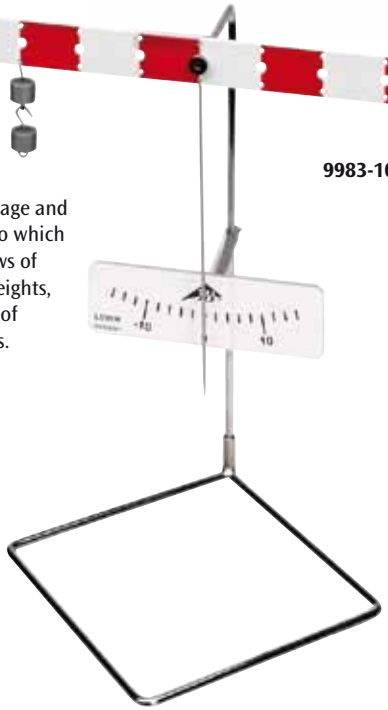
9983-1008539

Lever

Complete set of equipment for demonstrating laws of leverage and for experiments on equilibrium. Consists of a retort stand to which is attached a lever mounted on ball bearings with three rows of holes for adjusting the axis of rotation or for suspending weights, red and white block scale with pointer for accurate display of equilibrium state. Can also be used to model balance scales. Includes set of weights 10x 50 g.

Length of lever: 1 m
Mass of lever: 0.458 kg
Number of holes: 21
Separation of holes: 50 mm

9983-1008539





www.EngineeringBooksPDF.com

Experiment Topics:

- Regular movements and movements with uniform acceleration
- Newton's laws of motion
- Conservation of energy
- Elastic and inelastic collisions

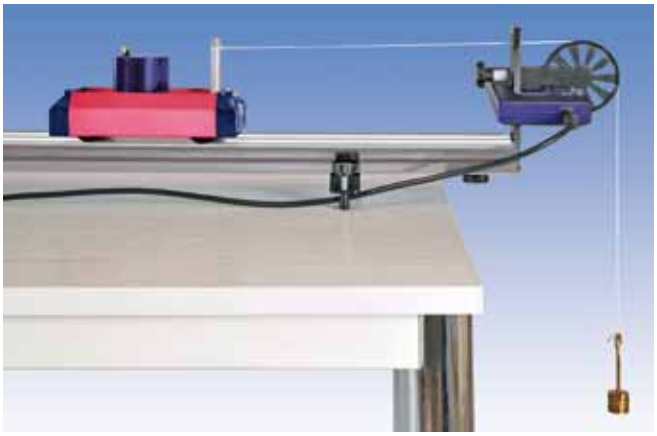


9983-1003318

Trolley Track

Track with two trolleys and other accessories for investigating linear motion, plus three adjustable point supports for setting horizontal alignment. The trolleys move with minimum friction on wheels with high-quality ball-bearings. They are fitted with magnets at their front ends for experiments involving both elastic and inelastic collisions. Including a spoked wheel suitable for use as a pulley with the trolley track. It can be used in combination with a light barrier (9983-1000563) for recording the motion of a trolley.

Mass of trolleys:	500 g
Length of distance scale:	1800 mm
Overall length:	1800 mm



Contents:
1 Track, 1.8 m
1 Two-point support
1 Single point support with end stop
1 Trolley
1 Trolley with interchangeable buffer pad
1 Additional weight, 500 g
2 Holder for light barrier
1 Holder for pulley
1 Pulley
1 Clamp for stand rods
1 Set of contact-breakers
1 Set of magnets

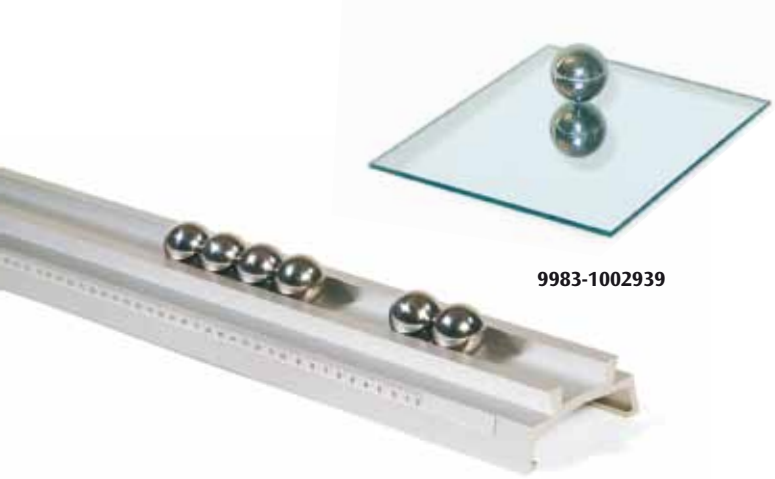
9983-1003318

Additionally recommended:
9983-1000563 Photo Gate
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)

9983-1000559 Ultrasonic Motion Sensor
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)

9983-1000563 Photo Gate (2x)
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)

Physics on a small budget



9983-1002939

Set of 6 Steel Balls

Ball bearings made of hardened and polished steel. Can be used with a guide rail for experiments on elastic collisions or in combination with watch glasses to demonstrate various states of equilibrium. Rail not included.

Diameter:	30 mm each
Weight:	110 g each

9983-1002939

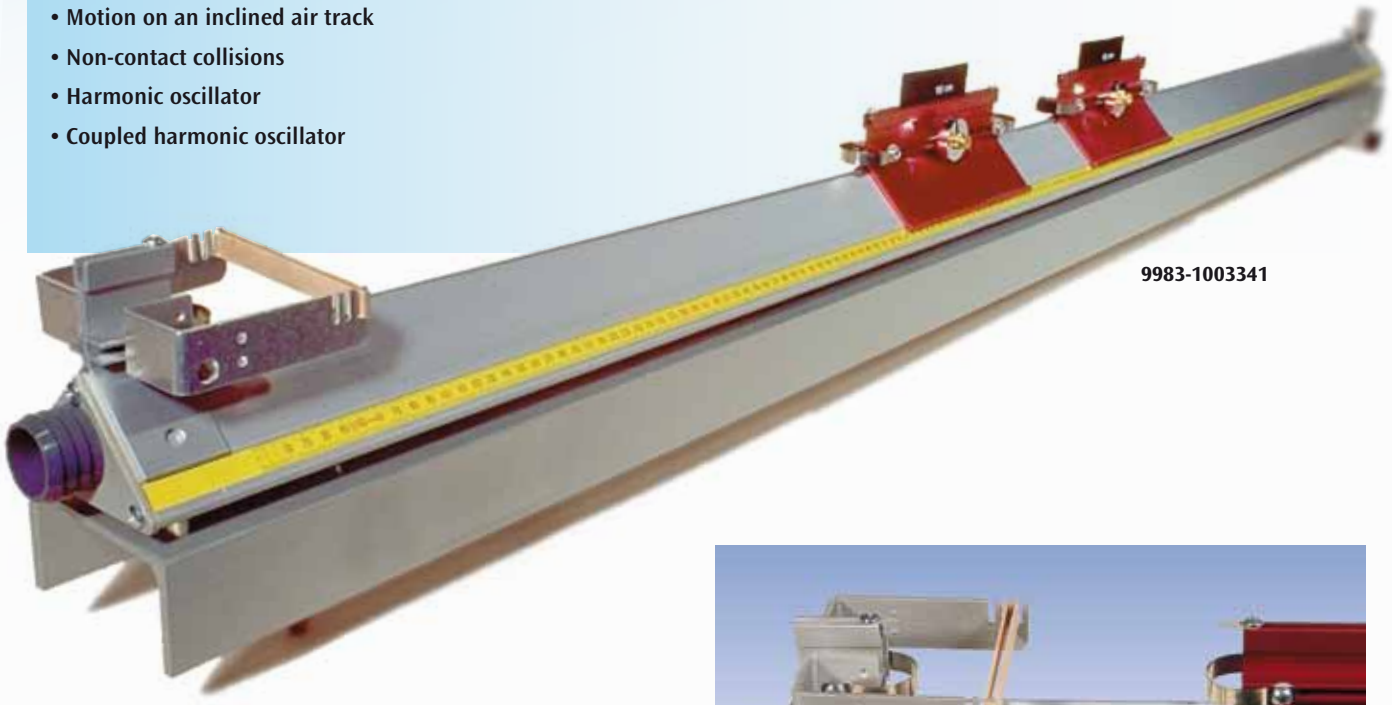
Additionally recommended:
9983-1003039 Optical Bench U, 1200 mm
9983-1002868 Set of 10 Watch Glass Dishes, 80 mm
9983-1002869 Set of 10 Watch Glass Dishes, 125 mm
9983-1003190 Plane Mirror

www.EngineeringBooksPDF.com

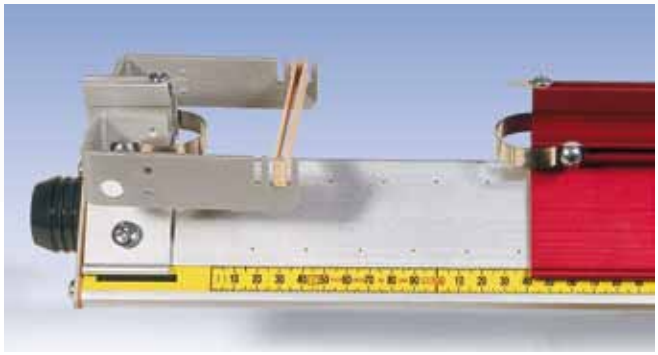
Experiment Topics:

- Regular movements and movements with uniform acceleration
- Newton's equations of motion
- Laws on the conservation of momentum and energy
- Elastic and inelastic collisions
- Motion on an inclined air track
- Non-contact collisions
- Harmonic oscillator
- Coupled harmonic oscillator

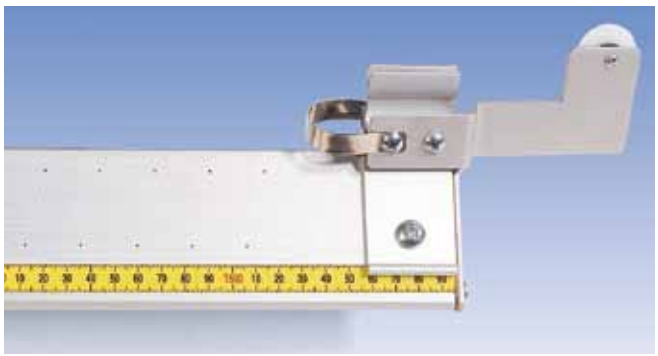
Note:
Air tracks of differing lengths are available on request.



9983-1003341



Left-hand end of track with air inlet nozzles and launch mechanism for riders



Right-hand end of track with buffers and pulley

Air Track on U-shaped Base Profile, 1.9 m
Track with triangular profile and riders for investigating frictionless linear motion. The air is blown in from the front and escapes through small air outlets arranged in 2 rows along the track. This allows for practically frictionless movement of the riders on the triangular track with no tilting. A millimetre rule is set into a groove on one side. Mounted on a robust U-shaped base resting on three feet that can be adjusted to ensure horizontal alignment.

Material:	Anodised aluminium
Total length:	2.07 m
Working length:	1.90 m
Maximum deviation from straight line over complete length:	0.04 mm
Track profile:	Equilateral triangle
Width of base:	94 mm
Sides of triangle:	67 mm
Thickness of walls:	3 mm
Separation of air outlets holes:	24 mm
Base profile:	U-shaped profile
Width of base:	100 mm
Height of base:	50 mm
Wall thickness of base:	5 mm

Contents:
1 Air track on U-shaped base profile resting on three feet
2 Gliders 300 g (red) with additional 50 g weights, spring buffers for elastic collisions and velcro strip for inelastic collisions
3 Helical springs, 50 mm, 1.7 N/m
2 Velocity flags, 10 cm
2 Magnets for contactless impact

9983-1003341

Additionally required:
9983-1000606 Air Flow Generator (230 V, 50/60 Hz)
or
9983-1000605 Air Flow Generator (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

Air Track, 1.6 m

Track with triangular profile and riders for investigating frictionless linear motion. As 9983-1003341 with three feet that can be adjusted to ensure horizontal alignment.

Total length: 1.67 m
Operating range: 1.50 m

Contents:

1 Air track with a three-point base and adjustment screw
1 Glider 150 g (gold) with spring buffers
2 Glider 300 g (red) with spring buffers
3 Helical springs, 25 mm, 3.3 N/m
2 Magnets for contactless collisions
1 English operating manual for the air track

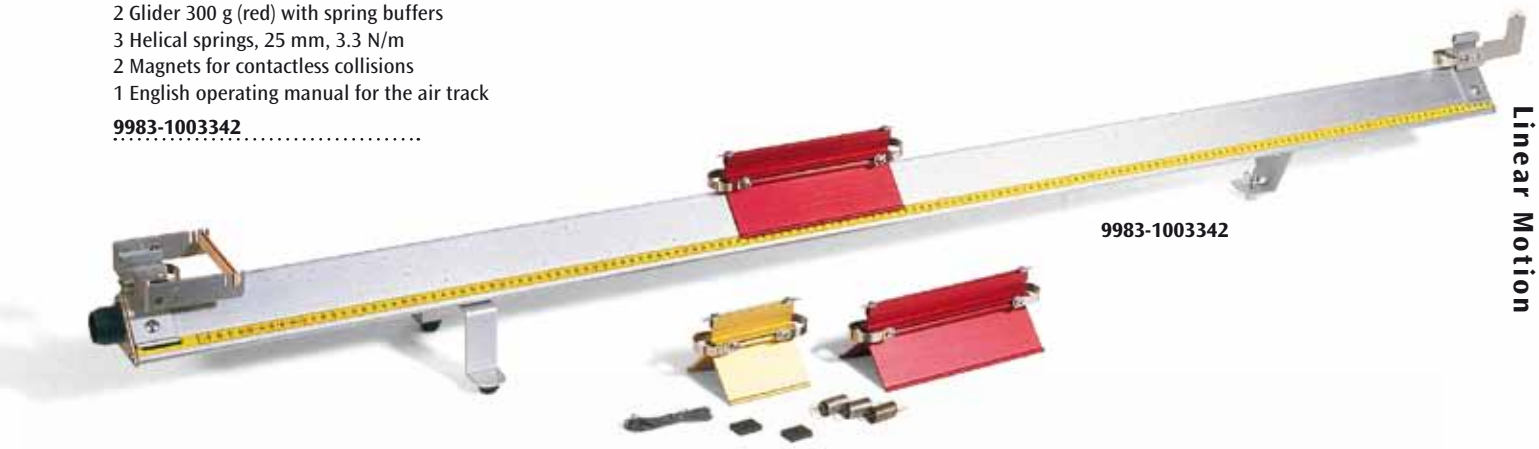
9983-1003342

Coupled Harmonic Oscillator

Equipment set consisting of 5 150 g riders, 6 coupling springs and 5 damping magnets for modelling molecular oscillations using air tracks 9983-1003341 or 9983-1003342.

Length of springs: 75 mm
Magnets: Ceramic magnets

9983-1003354



9983-1003342

9983-1003354



9983-1003342



9983-1000606
9983-1000605

Air Flow Generator

Fan allowing continuous adjustment of air flow. Includes a hose.

Hose length: approx. 1.5 m
Power consumption: max. 1100 W
Dimensions: 300x180x170 mm³
Weight: 4.4 kg

Air Flow Generator (230 V, 50/60 Hz)

9983-1000606

Air Flow Generator (115 V, 50/60 Hz)

9983-1000605

Accessories:

Art. No.	Designation	Uses
9983-1003344	**Glider 150 g (gold)**	–
9983-1003345	**Glider 300 g (red)**	–
9983-1003346	**Glider 450 g (blue)**	–
9983-1003347	**Air Cushion Deflector**	Frictionless deflection of accelerated masses
9983-1003348	**Set of 20 Bumper Springs**	Investigation of elastic collisions
9983-1003349	**Set of 20 Soft Bumper Springs**	Investigation of the collision process
9983-1003350	**Set of 4 Velocity Flags**	Trip flags made of aluminium in widths 5 cm, 10 cm, 20 cm and 30 cm
9983-1003351	**Set of Magnets**	Investigation of collisions with no actual contact
9983-1003352	**Inelastic-Collision Accessories**	2 Pairs of spring buffers with velcro surface for investigating inelastic collisions
9983-1003360	**Set of 4 Riser Blocks**	Aluminium base block in heights 3 mm, 6 mm, 13 mm and 26 mm

www.EngineeringBooksPDF.com

Experiment Topics:

- Newton's equations of motion
- Conservation of momentum and energy
- Elastic and inelastic collisions between equal and different masses
- Harmonic motion and coupled harmonic motion
- Trajectories
- Magnetic repulsion

Air-Cushion Table

The air-cushion table possesses a flat glass surface serving as a base for recording paper and carbon paper. Compressed air is supplied to the pucks via light hoses. The air emerges from the bottom of the pucks, making them hover over the recording paper. The motion of the pucks is traced by means of spark recording. The air hoses contain thin metal chains via which a connection to the spark generator is established. The sparks jump over from a contact in the centre of the puck, leaving marks on the recording paper. As the pucks weigh 550 grams, their motion is not affected by the hoses or the attached spark wire.

Contents:

1 Experiment table with a glass surface, 580x580 mm²
1 Spark generator with a footswitch
1 Compressor with a hose
2 Steel pucks, 75 mm diam., 550 g
2 Puck collars with velcro fastener
2 Springs
1 Auxiliary puck weight, 150 g
1 Edge pulley, 45 mm diam.
1 Centre rod with sucker
1 Set of plotter paper
1 Set of special carbon paper
1 Operating manual

Air-Cushion Table (230 V 50/60 Hz)

9983-1013210

Air-Cushion Table (115 V 50/60 Hz)

9983-1012569



www.EngineeringBooksPDF.com



9983-1003362 9983-1003363

Acrylic Puck
Acrylic puck for air-cushion table, for use as a second very light puck to demonstrate collisions between unequal masses. A steel puck is hardly deflected at all on collision with an acrylic puck.
Diameter: 75 mm
Weight: 90 g

9983-1003362

Aluminium Puck
Aluminium puck for air-cushion table, for use as a second very light puck to demonstrate collisions between unequal masses.
Diameter: 75 mm
Weight: 210 g

9983-1003363



9983-1003364

Pair of Magnetic Pucks
A pair of pucks with extremely powerful magnets positioned such that the pucks repel each other. Intended for performing contactless collisions on the air-cushion table.

9983-1003364

Puck Guide
Long acrylic rod with an internal spring which can be clamped between the inner edges of the air-cushion table. Intended to guide pucks for the purpose of recording harmonic oscillations.
Length: 590 mm

9983-1003359

9983-1003359



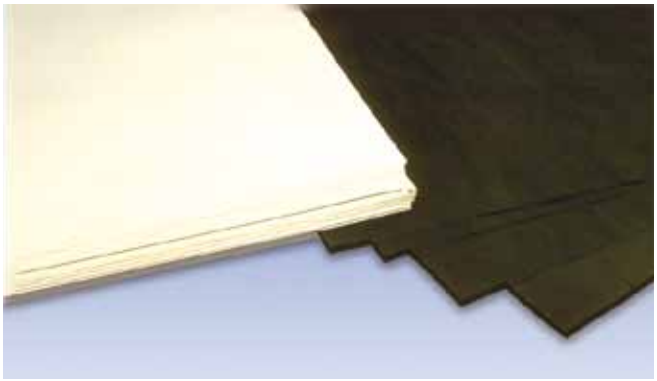
Set of Plotter Paper
100 sheets of printer paper for making pen plots in conjunction with an air-cushion table.
Dimensions: 510x580 mm²

9983-1003361

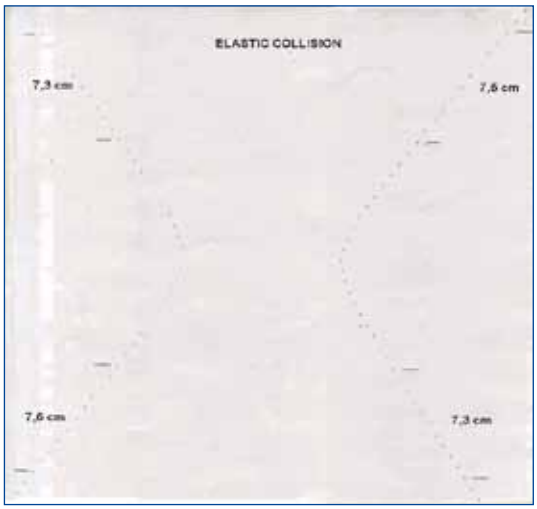
Additionally required:
9983-1003366 Set of Special Carbon Paper

Set of Special Carbon Paper
10 sheets of carbon paper.
Dimensions: 550x550 mm²

9983-1003366



9983-1003361 9983-1003366



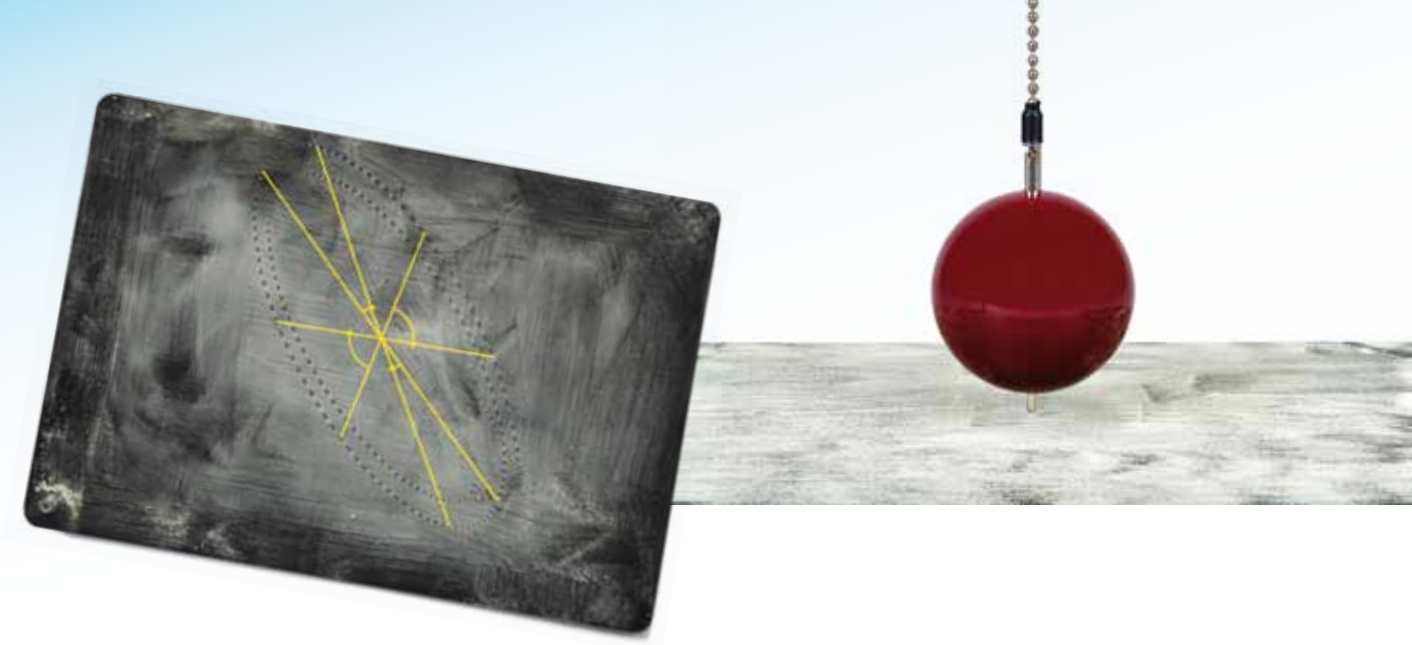
Document your experiments with the air cushion clearly with the aid of the paper sets 9983-1003361 and 9983-1003366.
Example:

Elastic collision



Measuring acceleration due to gravity

...going one step further
www.EngineeringBooksPDF.com



Plotting Movements in a Plane Using Powder Tracing

A plotting electrode slides over a plane counter electrode that is insulated and covered in powdered sulphur. An AC voltage across the two electrodes results in the sulphur powder being attracted or repelled depending on the polarity of the plotting electrode. A trace thus appears in the powder with ridges that are formed at constant intervals of time. The distance between the ridges reflects the speed of the plotting electrode.

Pair of Elastic Balls with Plotting Electrode

Pair of balls with identical mass and sliding plotter electrode for experiments on elastic collisions that can be demonstrated by means of powder tracing. Made of red plastic with metal ball chain.

Diameter: 70 mm each
Weight: 300 g each

9983-1000779

Additionally required:
9983-1000739 Equipment Set for Powder Tracing



9983-1000779

Pendulum with Plotting Electrode

Cylindrical pendulum bob with sliding plotter electrode for experiments to confirm Kepler's law governing areas covered by a body subject to a central force that can be demonstrated by means of powder tracing.
Steel, with metal ball chain.

Dimensions: 60 mm x 40 mm Ø
Weight: 500 g

9983-1000780

Additionally required:
9983-1000739 Equipment Set for Powder Tracing



9983-1000780

Equipment Set for Powder Tracing

Set consisting of an insulated plate with 4-mm connector socket, a pulse generator and a transformer with two 4-mm plugs for its secondary winding, 35 g of powdered sulphur and a flat brush.

Transformer: Safety isolating transformer, short-circuit proof
Output voltage: 115 V – 230 V, safe to touch
Protective resistance: 1 MΩ
Plate dimensions: 390x270 mm²

9983-1000739



9983-1000739

www.EngineeringBooksPDF.com

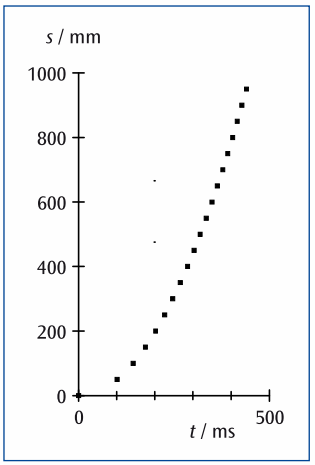
Free-Fall Apparatus

Apparatus for measuring the time it takes for a ball to fall a certain distance using a digital timer. Very easy to set up and use but nevertheless highly accurate. Includes 3 steel balls. A micro-magnet holds the ball in its start position. Three contact pins under the release mechanism ensure that the start position of the ball can be reproduced and act as the contacts of a switch that opens when the ball is released, thus triggering the beginning of the timing measurement. When the ball strikes the contact plate at the bottom, the timer is stopped. The ball is also held firmly on the plate so that it does not bounce. The height through which the ball drops can be adjusted to a fraction of a millimetre and read off a scale on the column.

Height scale	20 – 960 mm
Scale divisions:	10 mm
Scale precision:	0.2 mm
Balls:	Steel, 16 mm diam.
Dimensions:	200x130x1000 mm³ approx.
Weight:	1.6 kg approx.

9983-1000738

Additionally required:
9983-1012832 Millisecond Counter (230 V, 50/60 Hz)
or
9983-1012833 Millisecond Counter (115 V, 50/60 Hz)
or
9983-1001033 Digital Counter (230 V, 50/60 Hz)
or
9983-1001032 Digital Counter (115 V, 50/60 Hz)
9983-1002848 Set of 3 Safety Experiment Leads for Free-Fall Experiments



Set of 3 Steel Balls (not shown)

Spare balls for the free fall apparatus (9983-1000738) and launcher S (9983-1000740).

Diameter:	16 mm

9983-4003748



Maxwell's Wheel

Spoked wheel with large moment of inertia for demonstrating the conversion of kinetic energy into potential energy and vice versa. Includes suspending rod and adjustable suspension mechanism. The rotating axle is held in a horizontal position by two strings attached to a suspending rod and is moved upward by winding in the strings. If the equipment is released from its wound in position, the spoked wheel acquires kinetic energy on the way down, which can be seen by the constant increase in its speed of rotation. Two stops on the ends of the axle prevent the wheel from spinning free. At the lowest point when the strings are fully unwound, they start rewinding around the axle and the wheel rises upward again, losing its kinetic energy as it gets higher. To measure the inertial force during acceleration, the whole apparatus complete with stand is placed on a set of scales.

Moment of inertia:	10 kg cm² approx.
Diameter of wheel:	130 mm approx.
Mass of wheel:	370 g approx.
Suspending rod:	370 mm x 12 mm diam.

9983-1000790

Additionally required:
9983-1002936 Stainless Steel Rod 1000 mm (2x)
9983-1001042 Stand with H-Shaped Base
9983-1002830 Universal Clamp (2x)

Atwood's Machine

Experiment for studying motion under constant acceleration, demonstrating Newton's second law and determining the acceleration due to gravity g. Includes an aluminium stand for affixing to a wall. A string with weights at both ends is passed over a rotating pulley. The set-up undergoes relatively slow but constant acceleration if the weights are slightly different. This motion is initiated by a tug on one string and stops when the dropping weight strikes a movable platform. To show the rotation of the pulley, it is divided into 20 segments of equal angle. It can easily be removed to measure its moment of inertia.

Axis:	Mounted on ball bearing
Diameter of pulley:	152 mm
Thickness of pulley:	10 mm
Weights:	150 g each
Slotted weights:	1x 5 g, 2x 2 g, 1x 1 g each

9983-1003367

Additionally required:
9983-1003369 Mechanical Stopwatch, 15 min



...going one step further
www.EngineeringBooksPDF.com



9983-1002654

9983-1002655

Experiment Topics:

- Vertical, angled and horizontal launch
- Recording of the trajectory with an angled launch
- Determination of range and height from the projection angle
- Determination of launch speed from the range and height
- Determination of launch speed using a ballistic pendulum
- Elastic and inelastic collisions

Projectile Launcher

Experimental equipment for the quantitative investigation of projectile laws: vertical horizontal and angled launch, recording of flight trajectories depending on launch angle and projectile range. Three different reproducible launch speeds, continuously adjustable launch angles, constant height of trajectory at various angles since the launch point is coincident with pivot point of the cannon. Projectile is launched with almost no spin. The encapsulated design and the use of spherical plastic projectiles ensure that experiments are safe. The launcher is attached to a table via clamp (9983-1002655) or can be used in conjunction with ballistic pendulum (9983-1002656).

Horizontal projectile range (Launch angle 45°):	1.1 m, 2.3 m and 4.5 m
Launch angle:	0° – 90°
Reproducibility at 45°:	standard deviation less than1%
Standard deviation of launch ranges:	< 1%
Diameter of projectiles:	25 mm
Mass of projectiles:	7 g
Dimensions:	205x65x60 mm³ approx.
Mass:	480 g approx.

Contents:
1 Launcher
3 Plastic projectile balls
1 Ramrod
1 Wing nut M8x20

9983-1002654

Additionally required:
9983-1002655 Clamp for Projectile Launcher
or
9983-1002656 Ballistic Pendulum
Protective Goggles



Photo Gate Holder for Projectile Launcher (not shown)

Holder for mounting the photo gate (9983-1000563) at the exit of the projectile launcher (9983-1002654).

9983-1002657

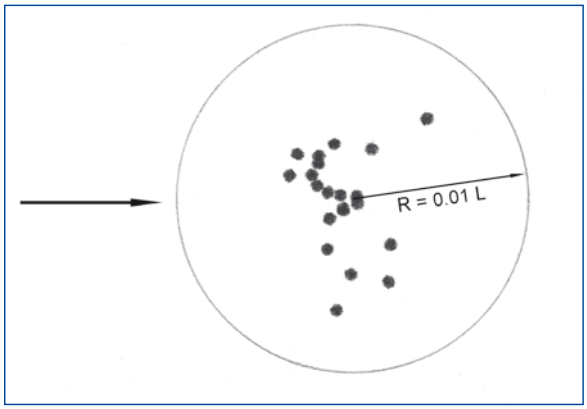
9983-1002657

Clamp for Projectile Launcher

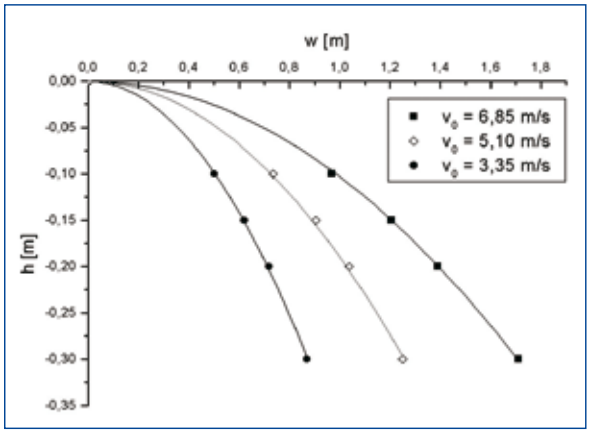
Table clamp for Projectile Launcher (9983-1002654) made of anodized aluminium.

Span:	10 mm – 65 mm
Dimensions:	approx. 150x70x80 mm³
Mass:	approx. 710 g

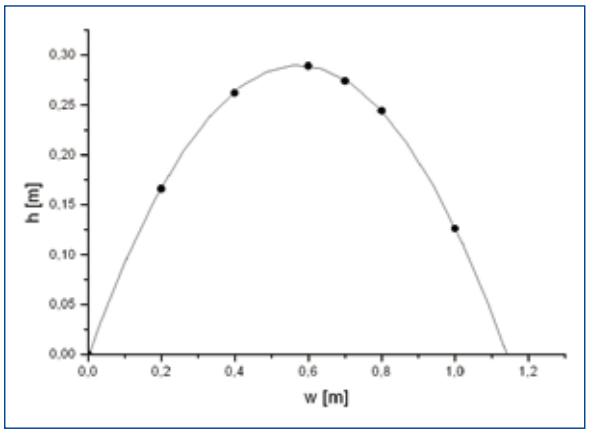
9983-1002655



Typical results for measurement of 20 shots. L=range.



Horizontal launch: projectile height as a function of the projectile distance



Oblique launch: projectile height as a function of the projectile distance (launch angle: 45°)

www.EngineeringBooksPDF.com

Ballistic Pendulum

Accessories for the (9983-1002654) launcher for use in experiments on elastic and inelastic collision or to be used as a holder for experiments on trajectory. The speed of the balls as measured in launcher experiments or pendulum experiments agree to within approximately ±3%. Additional weights can be used to investigate how pendulums behave with differing angles of deflection at the same speed. For experiments investigating trajectories, the launcher can be set to 5 different launch heights 5, 10, 15, 20 and 30 cm when it is attached to the rear of the ballistic pendulum.

Height of pendulum:	370 mm
Extra weights:	17.5 g each
Base plate:	130x130 mm²
Span of bench clamp:	10 – 65 mm
Mass:	2.1 kg

Contents:
1 Ballistic pendulum with table clamp
2 Extra weights

9983-1002656

Additionally required:
9983-1002654 Projectile Launcher



9983-1002654 **9983-1002656**



9983-1000588

Free Fall and Horizontal Launch Equipment

Equipment for demonstrating the independence of the horizontal and vertical components of motion (for projectiles). A launching rail with returning spring is mounted on a wooden base. Two steel balls are used as test bodies. Upon triggering, one ball starts to fall downwards and simultaneously the other is launched horizontally. Both balls hit the ground at the same time. Two holes in the base plate are provided for storing the balls.

Ball diameter:	15 mm
Dimensions:	200x120x30 mm³ approx.
Mass:	230 g approx.

9983-1000588

Launcher S

Experimental apparatus for studying vertical and horizontal trajectories as well as trajectories starting at intermediate angles. Also demonstrates the independence of the horizontal and vertical components of motion (for projectiles). Provides for three different launch velocities. Angle of launch can be adjusted to any arbitrary angle and read off from a protractor scale with a plumb line. The projectile ball is held in place by a magnet until the moment of launch so that the height of the trajectory is independent of the launch angle. When a projectile is launched, a second ball can be released simultaneously from the other side of the launcher that then descends in free fall. The latter should strike the floor at the same time as the projectile if the launch angle is horizontal.

Launch angle:	0° – 90°
Maximum range:	4 m
Projectile diameter:	16 mm
Projectile weight:	17 g
Diameter :	280x90x90 mm³ approx.
Total weight:	950 g approx.

9983-1000740

Additionally required:
9983-1002934 Stainless steel rods, 470 mm (2x)
9983-1002832 Table clamps (2x)



9983-1000740

Set of 3 Steel Balls (not shown)

Spare balls for the free fall apparatus (9983-1000738) and launcher S (9983-1000740).

Diameter:	16 mm

9983-4003748

www.EngineeringBooksPDF.com

Experiment Topics:

- Rotational motion: uniform and under constant acceleration
- Newton's equations of motion for rotational motion
- Moment of inertia and torque
- Moment of inertia as determined by experiment
- Simple harmonic motion of rotating objects

Rotating System on Air Bed

Apparatus for investigating frictionless rotation. A small rotating disc with a protractor scale supports a cross bar to which weights can be attached. The disc is supported by a bed of air in which its axis is centred. A driving weight is suspended from a hook at the end of a string that is passed over a single pulley on one side and a multiple pulley on the other. The rotation is very slow and can be measured using a stopwatch by hand. Alternatively, a digital timer may be used. This can be started by a mechanism that is supplied with the kit and halted by a signal from a laser reflection sensor when the wheel passes through angle zero.

Rotating System on Air Bed (230 V, 50/60 Hz)

9983-1000782

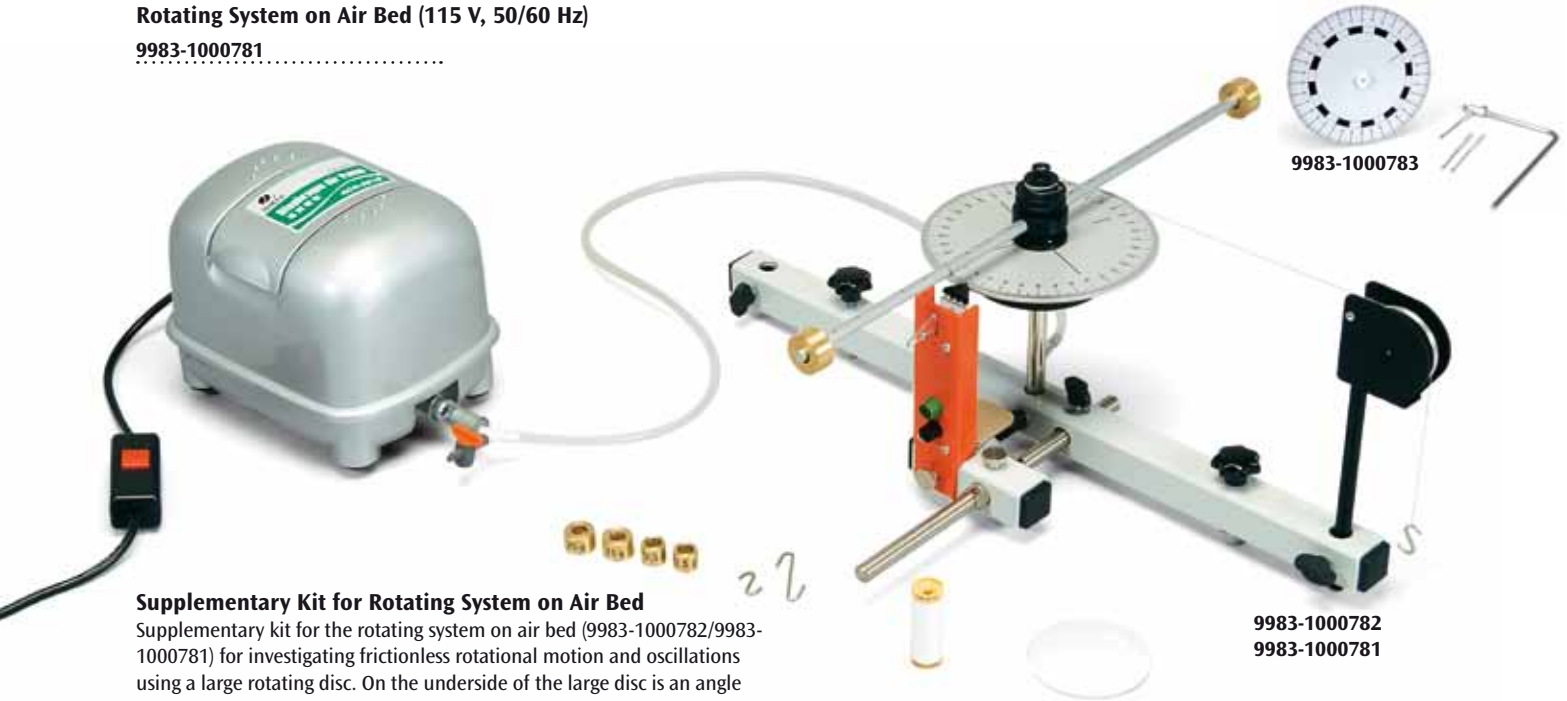
Rotating System on Air Bed (115 V, 50/60 Hz)

9983-1000781

Protractor scale:	0 – 360°
Scale divisions:	1°
Length of cross bar:	ca. 440 mm
Radii of perforations:	30 – 210 mm
Separation of perforations:	20 mm
Radii of multiple pulley:	5.0 mm/10.0 mm/15.0 mm
Moment of inertia of disc with cross bar:	0.9 g m² approx.
Maximum moment of inertia:	7.1 g m² approx.
Minimum driving torque:	0.05 mN m approx.
Maximum driving torque:	0.60 mN m approx.

Contents:

1 Air bed
1 Rotating disc with cross bar
1 Multiple pulley
1 Release mechanism
2 S-shaped hooks 1.00g
1 S-shaped hook 2.00 g
1 Set of weights (2x 12.5 g, 2x 25 g, 2x 50 g)
1 Compressor for connection to mains
1 Silicon tubing with by-pass valve (not illustrated)
1 Pulley
1 Stand rod with 3 securing screws and 2 screws for levelling
1 Stand rod with 2 securing screws
1 Stand rod, 250 mm
1 Levelling disc
1 Roll of cotton thread



9983-1000783

9983-1000782
9983-1000781

Supplementary Kit for Rotating System on Air Bed

Supplementary kit for the rotating system on air bed (9983-1000782/9983-1000781) for investigating frictionless rotational motion and oscillations using a large rotating disc. On the underside of the large disc is an angle grid that can be used to provide triggers to a laser reflection sensor (9983-1001034) if the rotation is to be recorded with the help of the 3B NET*log*™ interface unit.

Typical oscillation periods: 20 s approx. to 2 mins approx.
Moment of inertia of large disc: 2.2 g m² approx.

Contents:

1 Large disc with protractor scale, 350 mm
1 Scaffold stand
1 Cross sleeve
1 Set of coupling springs with magnet (1 N, 2 N, 5 N)

9983-1000783

Additionally recommended:
9983-1001034 Laser Reflection Sensor and
9983-1001033 Digital Counter (230 V, 50/60 Hz) or
9983-1001032 Digital Counter (115 V, 50/60 Hz) or
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz) or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)



9983-1000783

Measuring the period of oscillation and determining the moment of inertia

www.EngineeringBooksPDF.com

Rotation Apparatus

Rotating apparatus for determining angular acceleration as a function of the torque and for determining the moment of inertia depending on mass and distance from an axis. An axle on agate bearings supports a cross bar to which weights can be attached. The force from a driving weight is conveyed to the axle via a string wrapped around the axle and passed over a pulley and a second multiple pulley on the axle itself.

Length of crossbar:	600 mm
Radii of multiple pulley:	4.5 mm / 9.0 mm
Driving weights:	10 g / 20 g / 30 g / 40 g / 50g
Inertial mass of disc(s):	100 g / 200 g / 300 g
Dimensions of base plate:	200x140 mm²
Total weight:	1.3 kg approx.



9983-1006785

Contents:

1 Basic apparatus	2 Slotted weights 10 g
2 100-g discs	1 Slotted weight 20 g
2 200-g discs	1 Pulley
1 Holder for slotted weights 10 g	1 Roll of string

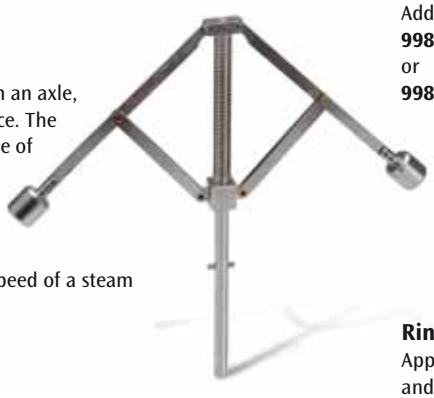
9983-1006785

Additionally recommended:
9983-1003331 Digital Stroboscope (115 V, 50/60 Hz)
or
9983-1003330 Digital Stroboscope (230 V, 50/60 Hz)

Watt's Governor

Symmetrical pendulum system on an axle, for demonstrating centrifugal force. The pendulum arms are held in a state of rest by a coil spring. Depending on the rotational speed, they are lifted against the force of gravity as the axle turns. This can then be used to control the speed of a steam engine.

Rotation diameter:	350 mm
Height:	250 mm
Diameter of axle:	10 mm



9983-1009695

9983-1009695

Additionally required:
9983-1002663 Experiment Motor with Gearbox
9983-1002836 Stand Base, Tripod, 185 mm
9983-1003312 DC Power Supply 0 – 20 V, 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 5 A (115 V, 50/60 Hz)

Rings Demonstrating Flattening of the Earth

Apparatus on axle for demonstrating and explaining flattening of the earth and other planets due to their rotation. Two steel bands crossed over and bent into a ring with a guide rod.

Ring:	240 mm diam.
Guide rod:	10 mm diam.



9983-1000750

9983-1000750

Additionally required:
9983-1002663 Experiment Motor with Gearbox
9983-1002836 Stand Base, Tripod, 185 mm
9983-1003312 DC Power Supply 0 – 20 V, 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 5 A (115 V, 50/60 Hz)

Rotary Motion Apparatus

Apparatus for studying rotary motion held in a stable frame. Designed for investigating the effect of a constant torque on a rotating body with variable moment of inertia. Rotating arm with equidistant grooves to accommodate weights of equal mass in symmetry around an axis rotating on ball bearings. For safety, the weights are fixed in place with screws. The torque is generated by a rotating plate with hooks and up to three slotted weights, acting via a string threaded over a multiple pulley with four different pulley diameters.

Rotating arm:	600 mm x 8 mm diam.
Groove separation:	40 mm
Weights:	2x 50 g, 2x 100 g and 2x 200g
Diameters of multiple pulley:	30 mm, 45 mm, 60 mm and 75 mm
Overall weight:	7 kg

9983-1010084

Additionally required:
9983-1003369 Mechanical Stopwatch, 15 min



9983-1010084

www.EngineeringBooksPDF.com

Experiment Topics:

- Moment of inertia of a disc
- Torque
- Angular momentum
- Precession
- Nutation



9983-1000695

Gyroscope Accessories

Accessories kit for Gyroscope (9983-1000695) consisting of a gyroscope disc and counterweight. For demonstrating the canceling out of gyroscopic phenomena in the case of two discs rotating at the same speed in opposite directions.

9983-1000698

Gyroscope S

Gyroscope with low-profile, dynamically balanced metal rotor in a Cardan gimbal mount. Ideal for studying gyroscopic stability phenomena, precession and nutation. Also supplied is a pendulum mounting that can be used for investigating the rolling or tipping moment. The set includes plastic Cardan discs, Cardan gimbal mount, pendulum mounting and starting cord.

Dimensions: 170x120 mm² approx.

9983-1012328



9983-1003490

9983-1003489

Gyroscope

High quality precision made gyroscope for demonstration as well as for quantitative determination of gyroscopic laws by means of practical experiments. Experiment apparatus with a shaft that can be tilted and rotated while attached to a stand rod. On one side of the shaft there is a disc mounted on dual ball bearings, while on the opposite side there is a movable counterweight for establishing equilibrium. Fine adjustment is performed by thumb screw at the end of the shaft. To generate external torque an additional weight is provided that can also be moved along the shaft. The shaft's angle of inclination can be read from an easily readable scale. A spirit level allows the gyroscope to be adjusted to the horizontal. The disc can be set rotating by hand or by means of a cord. The dual ball bearing system ensures that rotation is nearly frictionless and that rotation continues for lengthy periods of time. The open construction of the gyroscope allows gyroscopic phenomena to be observed easily and clearly.

Scale:	- 40° to + 40°	Mass of counterweight:	1400 g
Scale divisions:	1°	Mass of additional weight:	50 g
Disc:	250 mm diam.	Total weight:	4650 g
Mass of disc:	1500 g		

9983-1000695



9983-1000698



9983-1012328

Bicycle Wheel Gyroscope

Spoked wheel with weighted rim for demonstrating conservation of angular momentum. Simple to use due to small wheel radius and ease of suspension.

Diameter: 500 mm

9983-1003489

Additionally recommended:
9983-1003490 Turn Table
9983-1001055 Experiment Cord

Turn Table

Intended for use with the bicycle wheel gyroscope, this rotary platform allows operation on a laboratory stool or as a base surface.
Anti-skid design.

Diameter: 300 mm

9983-1003490

www.EngineeringBooksPDF.com

Rod Pendulum with Angle Sensor

Pendulum with low-friction pointed bearings and electromagnetic angle sensor for measuring simple harmonic motion of a weighted pendulum with movable weight. Including plug-in power supply. The deflection of the pendulum is detected by a Hall sensor that converts the angle to an electrical signal proportional to the angle so that the oscillation can be recorded using an interface unit, a Y-t plotter or a storage oscilloscope.

Length of pendulum:	1 m
Mass of pendulum:	1 kg
Output voltage:	± 5 V
Output resistance:	500 Ω
Power supply:	12 – 16 V AC
Diameter of tube:	10 mm
Weight:	1,4 kg approx.

Rod Pendulum with Angle Sensor (230 V, 50/60 Hz)

9983-1000763

Rod Pendulum with Angle Sensor (115 V, 50/60 Hz)

9983-1000762

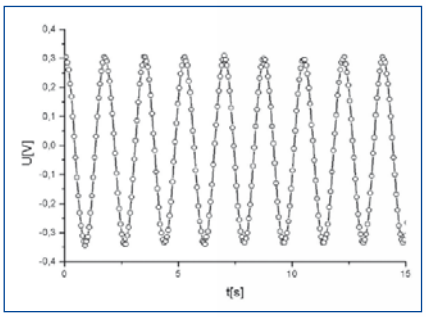
Additionally required:
9983-1002832 Table clamp
9983-1002936 Stainless steel rod, 1000 mm
9983-1002830 Universal clamp

Additionally recommended:
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)

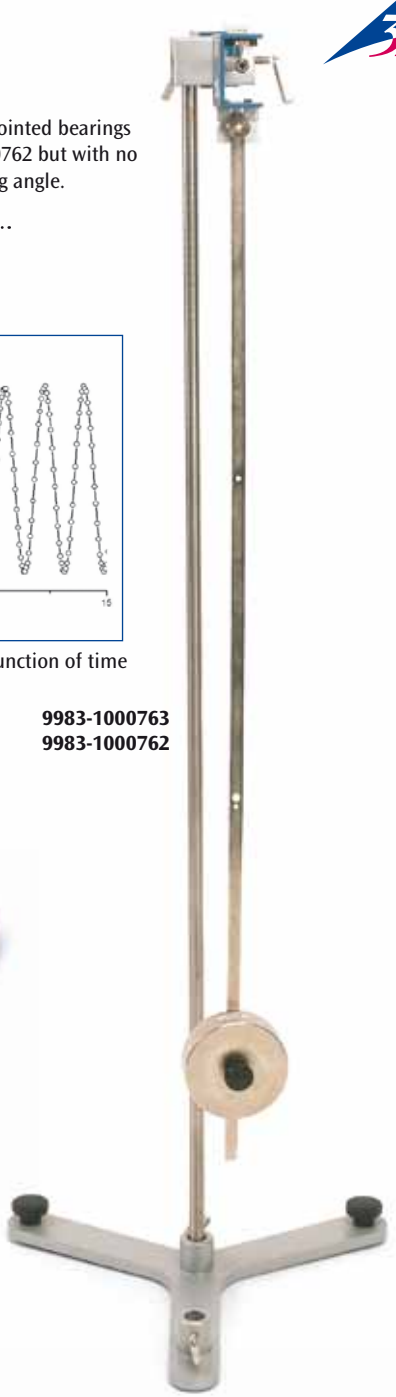
Rod Pendulum

Rod pendulum with low-friction pointed bearings as per 9983-1000763 or 9983-1000762 but with no Hall sensor or magnet for detecting angle.

9983-1000764



Deflection of the pendulum as a function of time



9983-1000763
9983-1000762

See physics experiments catalogue



9983-1003230

Set of 4 Pendulum Bobs

4 balls with securing eyes: made of brass, aluminium, steel and plastic for constructing a mathematical pendulum.

Diameter:	25 mm
Weights:	71.2 g, 25.2 g, 61 g, 10.5 g

9983-1003230

Additionally required:
9983-1001055 Experiment Cord
Stand Equipment

Variable g Pendulum

Pendulum with continuously adjustable plane of oscillation for observing pendulum oscillations where the acceleration due to gravity g can appear to be varied.

Max. length of pendulum:	280 mm
Mass of pendulum:	0.5 kg
Angle of plane of oscillation:	0° – 90°
Dimensions:	300x250x550 mm³
Mass:	approx. 5 kg

9983-1000755

Additionally required:
9983-1002836 Stand Base, Tripod, 185 mm
9983-1002934 Stainless Steel Rod, 470 mm

Additionally recommended:
9983-1000756 Photogate Holder for Pendulum
9983-1000563 Photo Gate
9983-1001033 Digital Counter (230 V, 50/60 Hz)
or
9983-1001032 Digital Counter (115 V, 50/60 Hz)



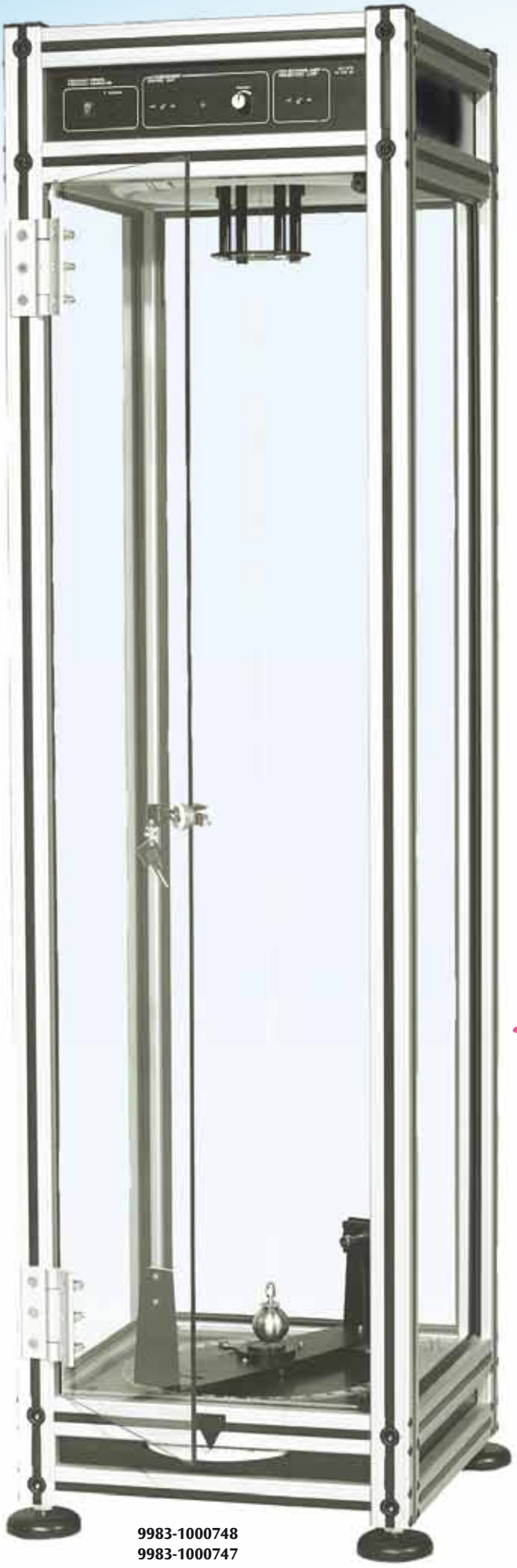
9983-1000755
9983-1000756
9983-1002934
9983-1000563
9983-1001033
9983-1001032
9983-1002836

Photogate Holder for Pendulum

Holder for mounting the light barrier (9983-1000563) with a variable-g pendulum, for which the plane of oscillation can be set at any angle.

9983-1000756

www.EngineeringBooksPDF.com



9983-1000748
9983-1000747

Experiment Topics:

- Pendulum oscillations
- Rotation of the earth
- Coriolis force

Foucault Pendulum

Pendulum for qualitative and quantitative demonstration of the rotation of the earth by means of observing the plane of oscillation. To prevent the oscillation taking an elliptical path, the thread upon which the pendulum bob is suspended impinges on a Charron ring during each oscillation. The plane of the oscillation is detected with high accuracy by projecting the shadow of the thread onto a protractor scale. The rotation of the plane can thus be identified in a very short period of time. For longer periods of observation, the gradual damping of the oscillation can be compensated for by means of an electromagnetic boost that can be adjusted to an arbitrary value. The apparatus is presented in decorative fashion inside a box with all sides made of glass, that is lit from inside to make for a very eye-catching appearance.

Length of pendulum:	1200 mm
Mass of pendulum:	230 g
Diameter:	38 mm
Vertical alignment:	By means of four height-adjustable feet
Angular resolution:	0.1°
Dimensions:	400x400x1400 mm³
Mass:	approx. 40 kg

Foucault Pendulum (115 V, 50/60 Hz)

9983-1000748

Foucault Pendulum (230 V, 50/60 Hz)

9983-1000747



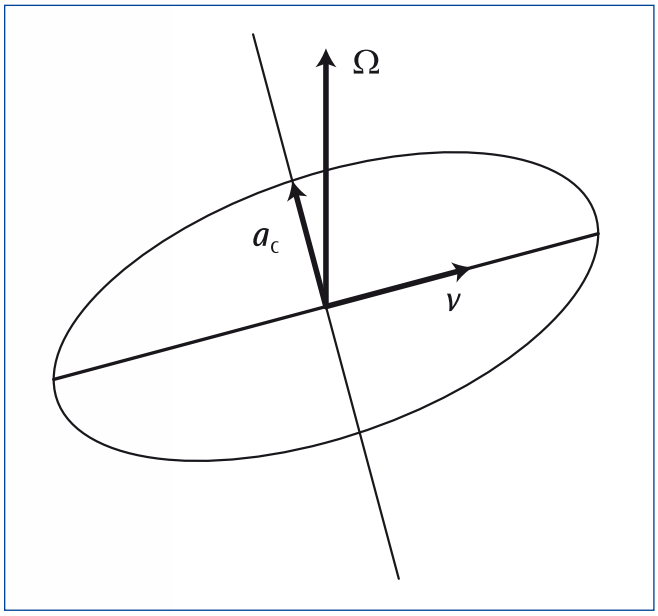


Diagram of Coriolis acceleration

www.EngineeringBooksPDF.com

Experiment Topics:

- Free rotary oscillations at various degrees of damping (oscillations with moderate damping, aperiodic oscillations and aperiodic borderline case)
- Forced oscillations and their resonance curves at various degrees of damping
- Phase displacement between the exciter and resonator during resonance
- Chaotic rotary oscillations

Pohl's Torsion Pendulum

For investigating free, forced and chaotic oscillations at various degrees of damping. With slotted scale ring and pointers on resonator and exciter. An electric motor is included for exciting forced oscillations. It features coarse and fine speed adjustment and is coupled via an eccentric wheel. For damping, an electromagnetic eddy brake is used. The equipment can also be used in demonstrations involving projection of shadows.

Natural frequency:	approx. 0.5 Hz
Excitation frequency:	0 to 1.3 Hz
Connectors:	4-mm safety sockets
Motor:	max. 24 V AC/DC, 0.7 A
Eddy brake:	0 – 2 A DC, 20 V
Scale ring:	300 mm diam.
Dimensions:	400x140x270 mm³
Weight:	4 kg

9983-1002956

Additionally required:
9983-1003312 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
9983-1000681 Plug-in Power Supply 24 V, 0.7 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)
9983-1000680 Plug-in Power Supply 24 V, 0.7 A (115 V, 50/60 Hz)

9983-1003369 Stopwatch, 15 min
9983-1003073 Analogue Multimeter AM50
Patch Cords

Plug-in Power Supply 24 V, 0.7 A

Plug-in power supply for the electric motor used with Pohl's pendulum 9983-1002956. Including cables and two safety plugs on the secondary side.

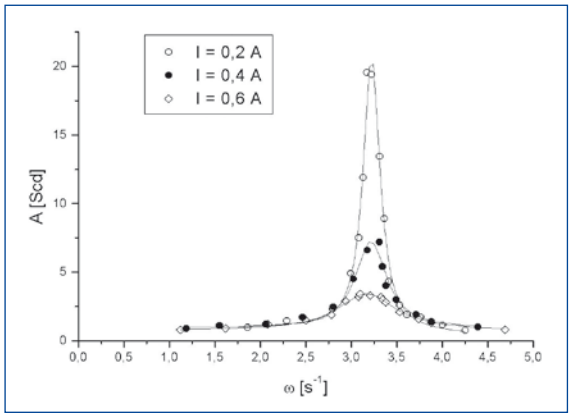
Output voltage:	24 V, 0.7 A
Length of cables:	1 m

Plug-in Power Supply 24 V, 0.7 A (230 V, 50/60 Hz)

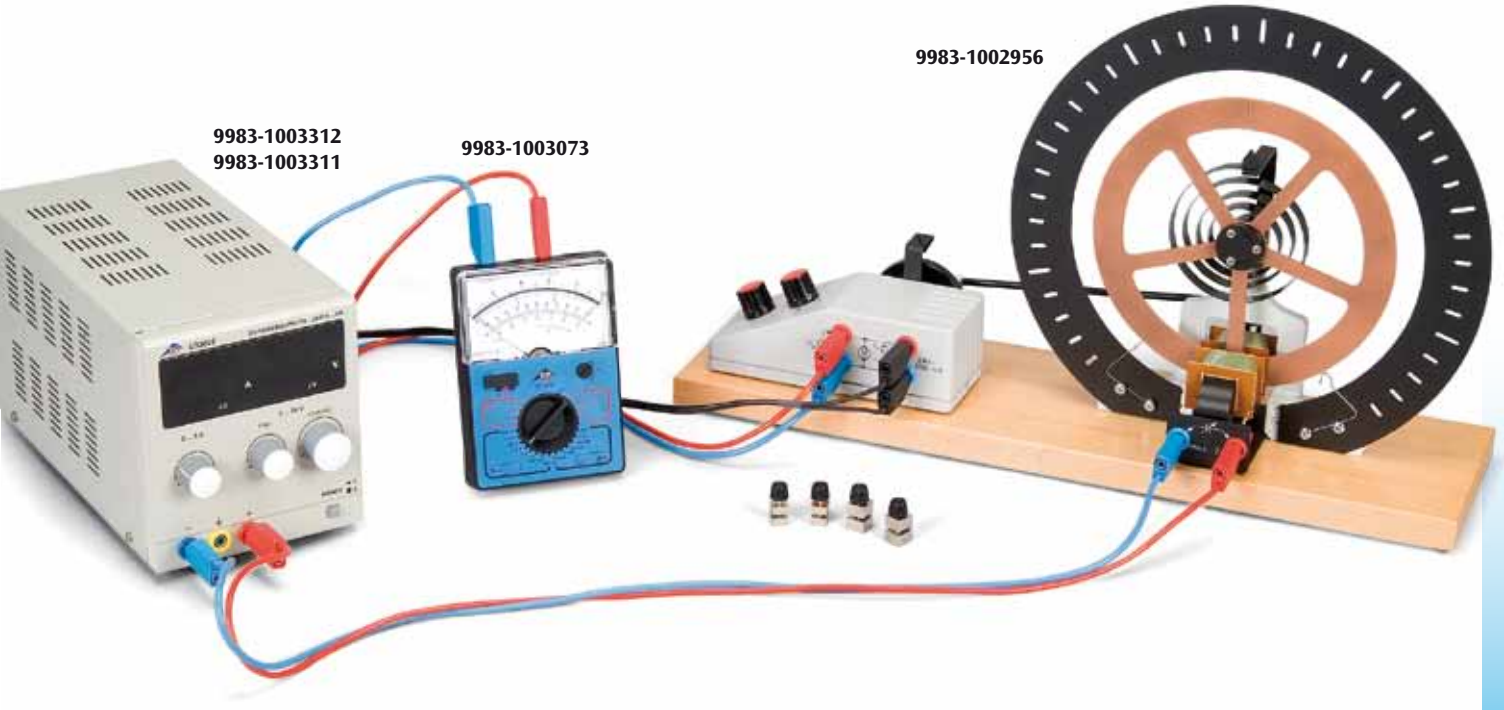
9983-1000681

Plug-in Power Supply 24 V, 0.7 A (115V, 50/60 Hz)

9983-1000680



Resonance curve for different degrees of damping



...going one step further
www.EngineeringBooksPDF.com

Experiment Topics:

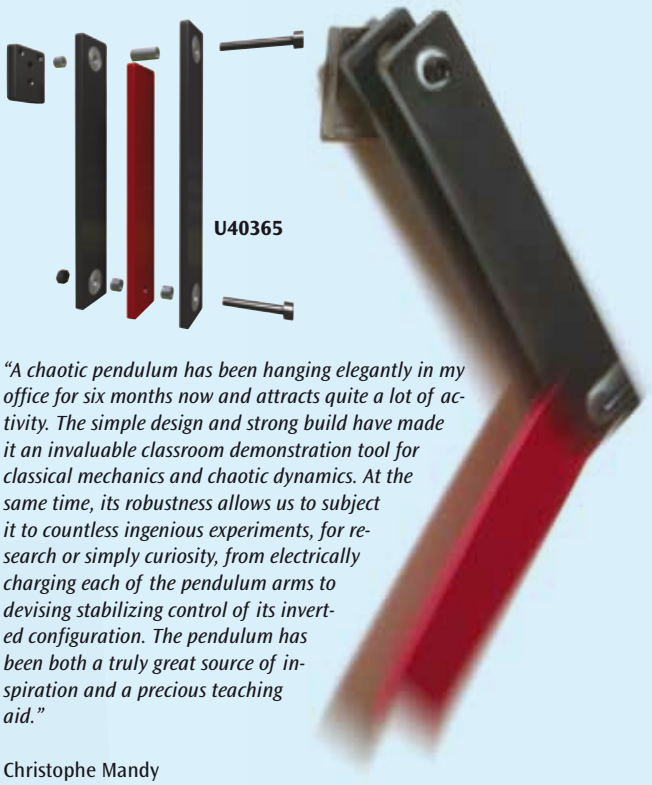
- Harmonic oscillations
- Determining unknown masses
- Gravitational mass and inertial mass

Chaotic Pendulum

Defined as an extreme sensitivity to initial conditions, chaos theory is an important field of study in modern physics. The addition of a second leg transforms the predictable pendulum into an outstanding demonstration of chaotic motion. The Chaotic Pendulum is made of Aluminium with brush-finished anodised coating. These pendulums have been manufactured to extremely high precision with a focus on fine finishing and attention to detail. The double pendulum comes packaged in a black case and includes equipment for mounting on either a wooden or concrete wall or a steel beam or structure.

Dimensions: approx. 350x38x52 mm³

9983-1003340



U40365

"A chaotic pendulum has been hanging elegantly in my office for six months now and attracts quite a lot of activity. The simple design and strong build have made it an invaluable classroom demonstration tool for classical mechanics and chaotic dynamics. At the same time, its robustness allows us to subject it to countless ingenious experiments, for research or simply curiosity, from electrically charging each of the pendulum arms to devising stabilizing control of its inverted configuration. The pendulum has been both a truly great source of inspiration and a precious teaching aid."

Christophe Mandy
Research Assistant
MIT Space Systems Laboratory
Cambridge, Massachusetts



9983-1003235

Inertia Balance

Inertia balance for determining inertial mass. After the apparatus is calibrated by determining the vibration frequency for objects of known mass, it can be used to determine the unknown masses. The Inertial Balance consists of two metal trays connected by stiff steel spring strips. One tray has 3 holes to hold up to three masses and the other tray may be anchored to a table edge or laboratory bench with the included table clamp.

Length of steel strip: approx. 350 mm
Masses: approx. 175 g each

Contents:
1 Inertia Balance
1 Table clamp
1 Cord, 1.85 m
3 Masses

9983-1003235

Additionally required:
9983-1003369 Mechanical Stopwatch, 15 min

SW Wilberforce Pendulum Set (photo p. 73)

Set for building a Wilberforce pendulum or a torsion pendulum in a space-saving table-top experiment. Adjustable rotating body for fine adjustment of moment of inertia in order to investigate couples translation and rotation oscillations as per Wilberforce's experiment. Includes components for connecting to dynamometers from the SW Sensors set in order to record and analyse oscillations using a standard oscilloscope.

Contents:
1 Spring, 5.25 N/m
1 Rotating body
1 Vertical plate
1 Body with hook
1 Spring set B for fitting to dynamometer

9983-1012844

Additionally required:
9983-1012849 SW Stand Equipment Set

Additionally recommended:
9983-1012850 SW Sensors Set (230 V, 50/60 Hz) or
9983-1012851 SW Sensors Set (115 V, 50/60 Hz)

9983-1012879 USB Oscilloscope 2x40 MHz or
9983-1008695 Analogue Oscilloscope 2x20 MHz

www.EngineeringBooksPDF.com

Mechanical Oscillations in a Space Saving Tabletop Experiment



9983-1012853,
9983-1012849,
9983-1012850/
9983-1012851,
9983-1012879

SW Physical Pendulum Set

Set for building a physical pendulum with a moveable weight, a reversing pendulum or a pair of coupled pendulums in a space-saving table-top experiment. Includes components for connecting to dynamometers from the SW Sensors set in order to record and analyse oscillations using a standard oscilloscope.

Contents:
2 Bearing bars
2 Pendulum rods
2 Moveable weights
1 Spring, 2.5 N/m
2 Coupling spring sets C
2 Rings

9983-1012853

Additionally required:
9983-1012849 SW Stand Equipment Set

Additionally recommended:
9983-1012850 SW Sensors Set (230 V, 50/60 Hz) or
9983-1012851 SW Sensors Set (115 V, 50/60 Hz)

9983-1012879 USB Oscilloscope 2x40 MHz or
9983-1008695 Analogue Oscilloscope 2x20 MHz

SW String Pendulum Set

Set for building a string pendulum and for investigating simple harmonic motion and chaotic oscillations in a space-saving table-top experiment. Features movable string pulley for setting string lengths and magnetic strips for generating chaotic oscillations. Other components are for connecting to dynamometers from the SW Sensors set in order to record and analyse oscillations with two degrees of freedom using a standard oscilloscope.

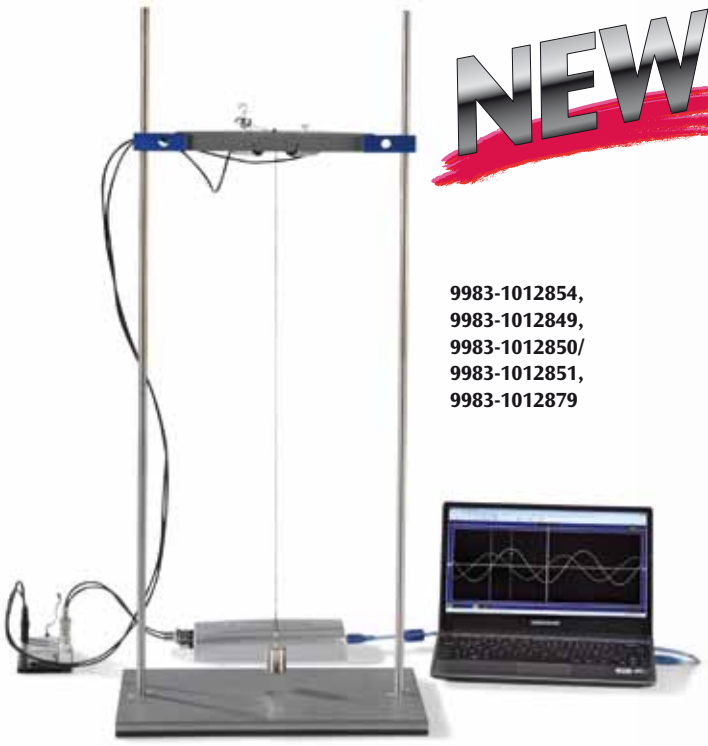
Contents:
1 String, 100 m
1 Weight, 100 g
1 Long magnetic strip
2 Short magnetic strips
1 Spring set A for fitting to dynamometer

9983-1012854

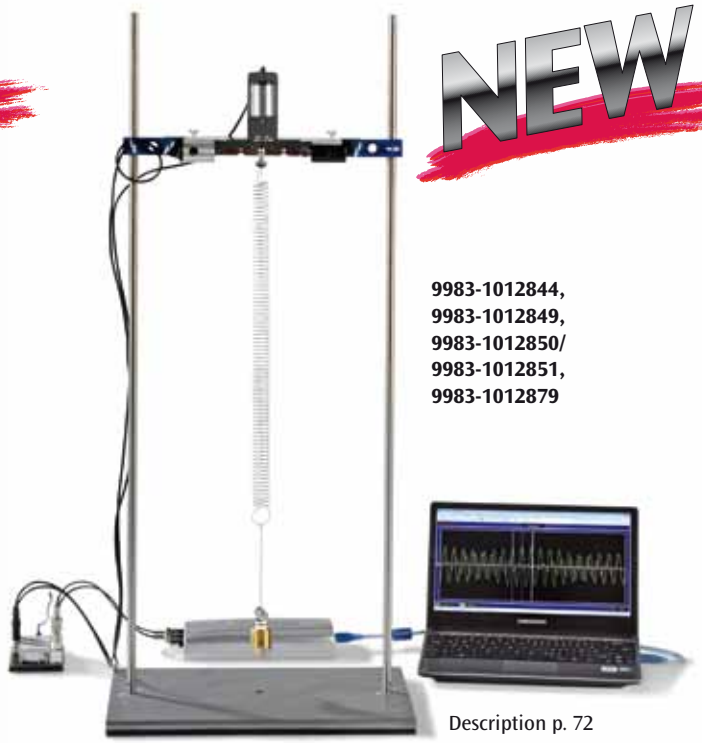
Additionally required:
9983-1012849 SW Stand Equipment Set

Additionally recommended:
9983-1012850 SW Sensors Set (230 V, 50/60 Hz) or
9983-1012851 SW Sensors Set (115 V, 50/60 Hz)

9983-1012879 USB Oscilloscope 2x40 MHz or
9983-1008695 Analogue Oscilloscope 2x20 MHz



9983-1012854,
9983-1012849,
9983-1012850/
9983-1012851,
9983-1012879



9983-1012844,
9983-1012849,
9983-1012850/
9983-1012851,
9983-1012879

Description p. 72

...going one step further
www.EngineeringBooksPDF.com

Experiment Topics:

- Rotary oscillations
- Determination of moments of inertia using the oscillation method
- Moments of inertia of various geometric bodies
- Steiner's theorem



9983-1008662

Torsion Axle

Robust axle for investigating rotational oscillation of various test bodies and for determining their moments of inertia from the period of oscillation. With ball-bearing mounted shaft, high-quality coil spring and holding lug. Tests are undertaken on weights, which can be moved along a thin transverse rod. A circular disc, which can be used for determining moments of inertia for eccentric axes of rotation and confirming Steiner's theorem is included.

Deflecting torque of the spring:	0.028 Nm/rad.
Height of the torsional axle:	approx. 200 mm
Transverse rod:	
Length:	620 mm
Weight:	135 g
Weights:	260 g each
Disc:	
Diameter:	320 mm
Weight:	495 g
Boreholes:	9
Borehole spacing:	20 mm

9983-1008662

Additionally required:
9983-1002836 Stand Base Tripod, 185 mm

Additionally recommended:
9983-1002811 Digital Stopwatch
9983-1003104 Precision Dynamometer 1 N
9983-1008663 Set of Test Bodies for Torsion Axle

NEW





9983-1008663

Set of Test Bodies for Torsion Axle

Accessories for the torsion axle (9983-1008662) used to demonstrate how moment of inertia depends on the distribution of weight around the axis of rotation. Consisting of two cylinders with nearly identical weights but different weight distributions, a mounting plate for the cylinders, a wooden disc and a wooden sphere.

9983-1008663

Hollow cylinder (metal):	
External diameter:	90 mm
Height:	90 mm
Weight:	approx. 425 g
Solid cylinder (wood):	
Diameter:	90 mm
Height:	90 mm
Weight:	approx. 425 g
Mounting plate:	
Diameter:	100 mm
Weight:	approx. 122 g
Wooden disc:	
Diameter:	220 mm
Height:	15 mm
Weight:	approx. 425 g
Moment of inertia:	0.51 kgm²
Wooden sphere:	
Diameter:	146 mm
Weight:	approx. 1190 g
Moment of inertia:	0.51 kgm²

www.EngineeringBooksPDF.com

Device for Archimedes' Principle

For demonstrating Archimedes' principle of buoyancy in liquids. Consists of a hollow cylinder with a stirrup and hook, as well as a precisely fitted solid cylinder with an eyelet.

Diameter: 55 mm
Height: 53 mm

9983-1003378



9983-1003378

Buoyancy Apparatus

Apparatus for demonstrating buoyancy of fluids, consisting of a flat ground glass tube and a metal disc with rubber covering to form a base plate to which a long string is attached. The base plate makes a watertight connection with the glass tube and when both are immersed in water, the plate does not sink because buoyancy keeps it pushed up against the tube.

Glass tube: 200 mm x 28 mm diam.
Metal disc: 2 mm x 42 mm diam.
Length of string: 35 cm

9983-1000791



9983-1000791

Free-Standing Cylinder, without Graduation

Made of Duran glass with round base and coarse ground rim, without graduation.

Height: 300 mm
Diameter: 40 mm

9983-1002871



9983-1002871



9983-1002867

Cartesian Diver

For demonstrating a body floating, sinking or rising in water. A hollow figure made of coloured glass, with a narrow opening. The figure floats upright in a cylinder filled with water and can be made to float, sink or rise by applying pressure to the rubber cap. The rubber cap fits cylinder diameters of approx. 30 mm to 40 mm, e.g. free-standing cylinder (9983-1002871).

Contents:
1 Cartesian diver
1 Rubber cap

9983-1002867

Additionally required:
9983-1002871 Free-Standing Cylinder, without Graduation



9983-1000768



Set of 5 density bodies

Set comprising five rectangular prisms made of various materials and a transparent block with a hollow body, all with the same dimensions for demonstrating Archimedes' principle. The bodies have 2-mm bores by which they can be suspended.

Materials: Wood, aluminium, iron, brass, copper
Dimensions of each body: 10x20x45 mm³

9983-1000768

Additionally required:
9983-1003104 Precision Dynamometer 1N



9983-1002952 – 9983-1002955

Immersion Blocks

Immersible block with hooks. Can be used for determining buoyancy in conjunction with a dynamometer.

Art. No.	Description
9983-1002952	Al, 50 cm³
9983-1002953	Al, 100 cm³
9983-1002954	Fe, 50 cm³
9983-1002955	Fe, 100 cm³

Additionally required:
9983-1003107 Precision Dynamometer 10 N

...going one step further
www.EngineeringBooksPDF.com

Set of 3 Cylinders, Equal in Volume

Set of three cylinders of equal volume and unequal mass each with a hook.

Materials: Aluminium, iron, brass
Dimensions of cylinders: 40 mm x 20 mm diam. approx.

9983-1000752

Additionally recommended:
9983-1003429 Electronic Scales 600 g (230 V, 50/60 Hz) or
9983-1012774 Electronic Scales 600 g (115 V, 50/60 Hz)
9983-1002870 Graduated Cylinder, 100 ml

Set of 3 Cylinders, Equal in Mass

Set of three cylinders of equal mass and unequal volume each with a hook.

Materials: Aluminium, iron, brass
Mass of cylinders: 100 g

9983-1000754

Additionally recommended:
9983-1003429 Electronic Scales 600 g (230 V, 50/60 Hz) or
9983-1012774 Electronic Scales 600 g (115 V, 50/60 Hz)
9983-1002870 Graduated Cylinder, 100 ml



9983-1003498



9983-1000752 **9983-1000754**



9983-1002952 – 9983-1002955

Density Paradox Set

Two identical plastic cylinders with a density close to that of water. If the first is immersed in hot water, it will initially sink but will then float up to the surface after a short time. If the second one is then put into ice-cold water, it will initially float but will then sink to the bottom. The reason for this is that the density of the plastic changes more than that of the water when it is heated or cooled.

9983-1003498

Additionally recommended:
2 Beakers from 9983-1002872

Immersion Blocks

Immersible body of known volume. Can be used in conjunction with scales to determine the density of solid bodies. With hook.

Art. No.	Description
9983-1002952	Al, 50 cm³
9983-1002953	Al, 100 cm³
9983-1002954	Fe, 50 cm³
9983-1002955	Fe, 100 cm³

Additionally recommended:
9983-1003429 Electronic Scales 600 g (230 V, 50/60 Hz) or
9983-1012774 Electronic Scales 600 g (115 V, 50/60 Hz)

9983-1002876

9983-1002875



9983-1002874

9983-1003012

Alcohol Meter

Gay-Lussac alcohol meter for determining the alcohol content in percentage by volume of ethanol/water mixtures at a reference temperature of 15°C. Without thermometer, in storage container.

Scale: 0 to 100% vol
Division: 1%
Length: 260 mm

9983-1002875

Universal Areometer

Areometer for determining the density of liquids in g/ml at a reference temperature of 20°C. Without thermometer, in storage container.

Measuring range: 0.7 – 2 g/ml
Scale division: 0.02 g/ml
Length: 310 mm

9983-1002876

Set of 3 Areometers

Set of areometers for determining the density of liquids in g/ml at a reference temperature of 20°C / 68°F. Without thermometer, in storage container.

9983-1003012

Measuring range	Scale division	Length
0.650 – 1.000 g/ml	0.005 g/ml	315 mm
1.000 – 1.500 g/ml	0.005 g/ml	235 mm
1.500 – 2.000 g/ml	0.005 g/ml	235 mm

Gay-Lussac Pycnometer

Glass body with ground capillary stopper for determining the density of liquids.

Volume: 50 ml

9983-1002874

www.EngineeringBooksPDF.com

Pressure Container for Determining Weight of Air

Airtight metal can with valve for demonstrating weight of compressed air. With bicycle valve for pumping in air. The weight of the air pumped in is determined by weighing and the volume can be determined by gauging the capacity.

Dimensions: 60x190 mm² approx.
Weight: 100 g approx.

9983-1000796

Additionally required:
9983-1003428 Electronic Scales 400 g (230 V, 50/60 Hz) or
9983-1003427 Electronic Scales 400 g (115 V, 50/60 Hz)
Bicycle Pump



9983-1000796

Set of 7 Cubes for Determining Density

Set of seven cubes made of various materials for determining densities by weighing. Supplied in a storage case.

Materials: Wood, plastic, aluminium, iron, copper, brass, zinc
Side of cubes: 10 mm

9983-1000766

Additionally required:
9983-1003429 Electronic Scales 600 g (230 V, 50/60 Hz) or
9983-1012774 Electronic Scales 600 g (115 V, 50/60 Hz)



9983-1000766



9983-1003519

Set of 2 Materials with 4 Different Masses Each

Two sets of test bodies made of the same material but with four different masses for deriving the concept of density in school experiments. Supplied in storage containers.

Materials: Aluminium, PVC

9983-1003499

Additionally recommended:
9983-1003429 Electronic Scales 600 g (230 V, 50/60 Hz) or
9983-1012774 Electronic Scales 600 g (115 V, 50/60 Hz)
9983-1002870 Graduated Cylinder, 100 ml

Sphere for Weighing Gases 1000 ml

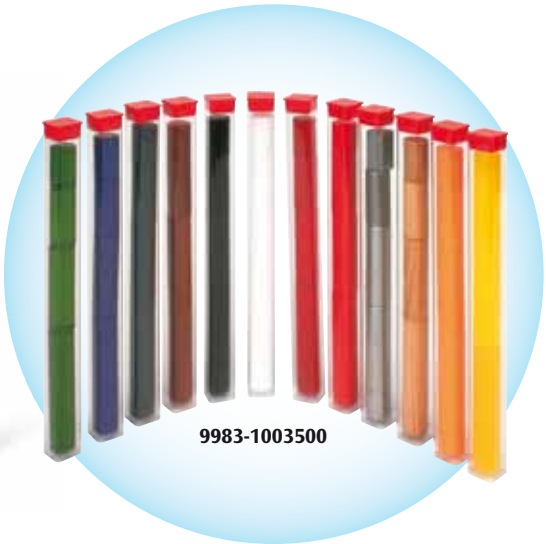
Glass sphere with two taps and nozzles for attaching tubing for demonstrating the weight of air from the difference in weight between the sphere when filled with air and when evacuated.

Weight: 200 g approx.

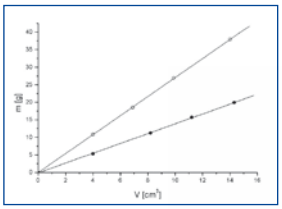
9983-1003519

Additionally recommended:
9983-1003428 Electronic Scales 400 g (230 V, 50/60 Hz) or
9983-1003427 Electronic Scales 400 g (115 V, 50/60 Hz)
9983-1012856 Vacuum Hand Pump

9983-1003499

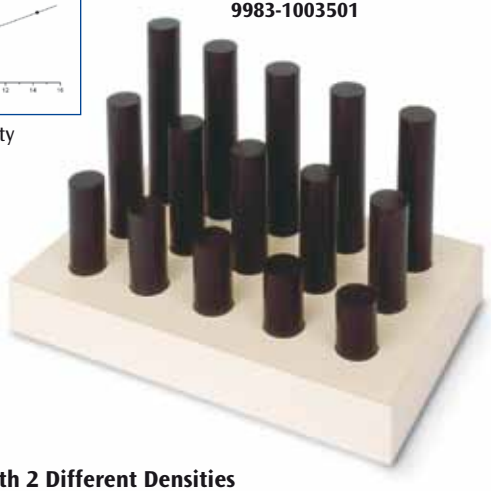


9983-1003500



Determining the density of Aluminum and PVC

9983-1003501



Set of 12 Materials with 4 Different Masses Each

Twelve sets of test bodies made of the same material but with four different masses for deriving the concept of density in school experiments. Supplied in storage containers.

Materials: Wood, polypropylene, polyamide, acrylic (2 colours), polyurethane, phenol, PVC (3 colours), Teflon and aluminum
Densities: 0.71 – 2.71 g/m²
Dimensions: 25 / 35 / 50 / 70 mm x 16 mm diam. approx.

9983-1003500

Additionally required:
9983-1003429 Electronic Scales 600 g (230 V, 50/60 Hz) or
9983-1012774 Electronic Scales 600 g (115 V, 50/60 Hz)
9983-1002870 Graduated Cylinder, 100 ml

Set of 15 Bodies with 2 Different Densities

Set of 15 test bodies of various masses made of two identical looking materials for deriving the concept of density in experiments at school. Supplied on a storage tray.

Materials: Plastic of density 1.41 g/cm³ and 1.15 g/cm³

9983-1003501

Additionally required:
9983-1003429 Electronic Scales 600 g (230 V, 50/60 Hz or
9983-1012774 Electronic Scales 600 g (115 V, 50/60 Hz)
9983-1002870 Graduated Cylinder, 100 ml

www.EngineeringBooksPDF.com



9983-1002653

Pressure Balance

Introducing the concept of pressure, for comparing pressures, for gas-compression experiments and for demonstrating overpressure and underpressure. Two precision glass syringes of different volumes with ground piston and weight pans on stand. Includes 15 disc weights on a storage rod for adding to plunger. Connection between the syringe hoses via a tubing clamp, safety catch for the smaller piston.

Volume of syringes:	10 ml and 50 ml
Ratio of piston cross-sections:	10:3
Ratio of piston masses with weight pans:	10:3
Mass of weights:	approx. 400 mN each
Baseplate dimensions:	approx. 140x100 mm²

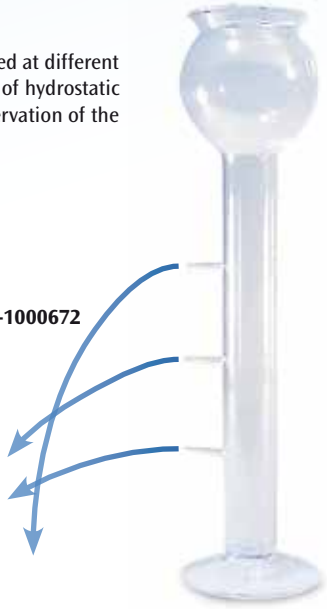
9983-1002653

Outlet Vessel, Glass

Glass cylinder with three outlets positioned at different heights for investigating the dependence of hydrostatic pressure on water depth through an observation of the outlet water jets.

Height:	350 mm
Diameter:	35 mm

9983-1000672



9983-1000672



9983-1009715

Outlet Vessel, Metal

Robust metal cylinder with three outlets at various heights for the purpose of investigating hydrostatic pressure due to depth of water by observing the jets of water emerging from the outlets under pressure.

Height:	430 mm approx.
Diameter:	125 mm approx.

9983-1009715

Indigo Solution

5 ml indigo solution in a flask, for colouring water in demonstration experiments.

9983-1000793



9983-1000792

U-tube Manometer S

Manometer for measuring pressures in the range 0 to 10 hPa (cm water column). U-tube open on both sides with overflow basin on aluminium base plate with scale. Includes stand rod on the reverse for attaching to stand base.

Length of arms:	200 mm
Stand rod:	33 mm x 10 mm diam.
Base plate:	210x70 mm² approx.
Weight:	80 g approx.

9983-1000792

Additionally required:
9983-1000793 Indigo Solution

Additionally recommended:
9983-1002622 Silicon Tube, 1 m

U-Shaped Manometer D

Demonstration manometer for measuring pressure in centimetres of water. The manometer consists of a U-tube open at both ends attached to a fiberboard (MDF) featuring a scale.

Length of each leg:	50 cm
Measuring range:	0 – 50 cm of water or 0 to 5 kPa
Tubing diameter:	10 m m
Dimensions:	200x150x530 mm³ approx.
Weight:	820 g approx.

9983-1009714

Additionally recommended:
9983-1000793 Indigo Solution



9983-1009714

www.EngineeringBooksPDF.com



9983-1002890

Glass Cylinder with 3 Tubes

Glass vessel for demonstrating communicating tubes; also suitable as an overflow vessel. Consists of a glass cylinder with two openings and GL screw connections. Includes three differently shaped glass tubes.

Height: approx. 300 mm
Diameter: 90 mm

9983-1002890



9983-1000793

9983-1003510

Apparatus for Investigation of Capillary Effects

A horizontal glass tube can be connected to a water reservoir through capillary tubes of different diameters. The smaller the diameter of the capillary tube, the higher the water climbs above the level of the reservoir due to the greater hydrostatic pressure.

Internal diameters of
the capillary tubes: 2.0 mm, 1.5 mm, 1.0 mm und 0.5 mm
Height: 165 mm approx.

9983-1003510



9983-1003513

Segner Turbine

Glass cylinder with two horizontally arranged water-jet holes, providing a vivid demonstration of the conversion of pressure energy into rotational kinetic energy. Segner's wheel first established the principles on which the jet turbine was produced many years later. Invented by Ján Andrej Segner in XVIII century, it consists of a glass cylinder with two horizontally mounted curved water outlets. This apparatus is useful for demonstrating the conversion of hydrostatic pressure to rotary motion.

Height: approx. 200 mm
Span of outlets: approx. 215 mm

9983-1003513



9983-1002891

Glass Cylinder with 2 Tubes

Glass vessel for demonstrating communicating tubes. Consists of a glass cylinder with two openings and GL screw connections, as well as two differently shaped glass tubes.

Height: approx. 220 mm

9983-1002891

...going one step further
www.EngineeringBooksPDF.com



9983-1002957

Pascal's Vane Apparatus

For demonstrating the hydrostatic paradox and for quantitative measurements of ground pressure. This pressure is measured through the curvature of a membrane and indicated in magnified form with the help of a lever multiplier. Compensation for comparative measurements is possible. Includes four differently shaped vessels made of glass.

Height of the vessels:	220 mm
Tube diameter at the bottom:	22 mm
Total height:	350 mm
Base-plate area:	260x110 mm²
Weight:	0.8 kg

9983-1002957



9983-1002892

Pascal's Pressure Sphere

Glass vessel with movable plungers for demonstrating equal distribution of pressure in all directions, observed by means of water jets forced out under pressure.

Total length:	450 mm
Diameter:	approx. 75 mm

9983-1002892



9983-1003495

Hydraulic/Pneumatic Lifting Platform

Complete equipment set for demonstration and practical training such as investigating transmission of hydraulic or pneumatic force, the relationship between force, surface area and pressure as well as verification of Boyle's law. A rugged stand holds a cylinder with piston (60 cm³ volume). The lifting platform is positioned on the piston. Various levels of pressure can be exerted on the piston using a system of tubing with 3 simple hand pumps of different volumes. A hose fitting for connection of a pressure sensor required to record measured values with a datalogger is also included.

Dimensions:	approx. 140 mm diam. x 190 mm
Pump volumes:	3 cm³, 6 cm³, 20 cm³

9983-1003495

Suction and Pressure Pump

The apparatus is a working model of a reciprocating type pump that uses a piston and cylinder arrangement with integrated suction and discharge valves. The transparent model demonstrates clearly the operation of valves working within the pump. The apparatus is supplied complete with a plastic water container.

Height:	525 mm
Base:	240x240 mm²
Water container:	175x135x67 mm³

9983-1003514



9983-1000801

9983-1003514

Free-Fall Tube (Guinea and Feather Apparatus)

This glass pipe can be evacuated to compare the free falling characteristics of different objects in a vacuum. A cork, duck feathers and plastic parts are included as falling objects.

Length:	approx. 800 mm
Diameter:	36 mm diam.
Hose nipple:	10 mm
Weight:	approx. 1 kg

9983-1000801

Additionally required:
9983-1012856 Vacuum Hand Pump

www.EngineeringBooksPDF.com

Viscosity measurements using the following substances

- Light oils, machine oils, petroleum, petroleum ether, diesel (mineral oils and fuels)
- Plastic solutions, resin solutions, adhesive solutions, latex dispersions (polymer chemicals)
- Printers' ink, varnish, water-based paints, inks (inks and paints)
- Emulsions, suspensions, solutions, extracts (cosmetics/pharmaceuticals)
- Emulsions, dispersions (paper industry)
- Liquid detergents, washing-up liquid, tenside solutions (detergents)
- Honey, fruit juice, beer, milk (food industry)
- Gases and mixtures of gases

Surface Tension Ring

Aluminium ring with a blade for determining the surface tension of liquids. Includes a hook and three threads for suspension from a dynamometer.

Diameter: 60 mm
Weight: 5 g approx.

9983-1000797

Additionally required:
9983-1002941 Laboratory Jack
9983-1003102 Dynamometer 0.1 N
9983-1002872 Beaker, 600 ml
Stand equipment



9983-1000797



9983-1003509

Falling Sphere Viscometer

Höppler-type falling sphere viscometer for simple but accurate measurement of dynamic viscosity of transparent Newtonian fluids. The sphere rolls and slides inside an inclined cylindrical tube filled with the fluid to be tested. The viscosity is measured in mPa s and is derived directly from the time the sphere takes to fall a specified distance through the fluid in the measuring tube. The tube can then be turned upside-down so that time the sphere takes to fall back can also be measured. The tube is situated inside a water bath, which can be filled with water at a specific temperature in order to measure how viscosity depends on temperature.

Includes:
Falling sphere viscometer with 6 spheres and 1 ball gauge
Thermometer 0 – 100° C
Cleaning set
Test certificate with accurate values for sphere constant *K* and density ρ for converting duration of fall to actual viscosity.

Technical data

Measuring range:	0.5 mPa s to $7*10^4$ mPa s (as per DIN 53015)
	>$7*10^4$ mPa s (for sphere fall times > 300 s)
Measurement precision	0.5 to 2% (depending on spheres used)
Spheres:	#1, #2: Borosilicate glass
	#3, #4: Ni-iron
	#5, #6: Steel
Diameter of spheres:	11.00 to 15.81 mm
Diameter of measuring tube:	15.95 mm
Fall times for spheres	30 to 450 s
Length of measured distance:	100 mm in both directions
Operating angle:	10° to vertical
Additional working angles	70°, 60°, 50° to horizontal
Volume when full:	40 ml
Permissible temperature range:	-60°C to +150°C
Dimensions:	180x220x330 mm
Weight:	3.1 kg

9983-1012827

Additionally required:
9983-1002811 Digital Stopwatch

Additionally recommended:
9983-1002622 Silicon Tubing (2x)

9983-1008654 Immersion/Circulation Thermostat (230 V, 50/60 Hz)
or
9983-1008653 Immersion/Circulation Thermostat (115 V, 50/60 Hz)

Communicating Tubes T

Four vertical glass tubes of different shapes linked by a horizontal glass tube demonstrate that liquid levels remain the same regardless of the shape of the vessel.

Height: approx. 195 mm

9983-1003509

Wedge Shaped Vessel

Wedge shaped vessel made of transparent acrylic for demonstrating the surface tension of liquids and capillary forces.

Length: 100 mm

9983-1000794



9983-1000794

NEW



9983-1012827

www.EngineeringBooksPDF.com

NEW



9983-1010126

Vacuum Chamber with Hand Pump

Inexpensive, transparent plastic vacuum chamber for basic experiments with low pressure. Hand pump integrated into base plate, bleed valve and manometer for measuring pressure down to 330 hPa.

Dimensions: 200 mm diam. x 250 mm

9983-1010126

Additionally required:
9983-1010125 Set of 100 Balloons



9983-1012856

9983-1003208

Magdeburg Plates

Equipment set for demonstrations and practical teaching of Guericke's historical experiment investigating the effect of atmospheric pressure. Includes nozzle for tubing, a simple hand pump and tubing with built-in directional valves. Two transparent acrylic plates with handles that can be held together with a coarse vacuum between them. Three sealing rings of various sizes are supplied for sealing the plates. This allows the dependency of the force on the contact area to be investigated.

Acrylic plates: approx. 13 mm x 105 mm diam.
Sealing rings: approx. 65 mm, 80 mm, 100 mm diam.

9983-1003496



9983-1003496

Magdeburg Hemispheres

To demonstrate Von Guericke's historical experiment on the effect of atmospheric air pressure. Two plastic hemispheres equipped with handles can be joined vacuum-tight using the insertable rubber sealing ring. One hemisphere is equipped with a stopcock and hose connection. Including air hose.

Vacuum connection: 8 mm
Diameter: 120 mm
Hose length: 110 mm

9983-1003208

Additionally required:
9983-1012856 Vacuum Hand Pump



9983-1010125

Set of 100 balloons

Set of 100 balloons for use in vacuum chamber with hand pump.

9983-1010125

www.EngineeringBooksPDF.com

Vacuum Bell Jar

Vacuum bell jar made of glass with grip knob and polished flange to be set on top of the vacuum experiment plate (9983-1003166).

Inner diameter: 190 mm
Total height: 220 mm

9983-1003167

9983-1003167



9983-1003166



Vacuum Experiment Plate

Experiment plate for the assembly of a vacuum chamber in conjunction with the vacuum bell jar (9983-1003167) for experiments in the coarse and fine vacuum range. Metal plate with sealing ring on a tripod, hose connection of the pump-side and ventilation cock. Includes two-pole current feed via 4-mm safety sockets and cable of approximately 1 m length with 4 mm safety plugs, plus a central bore with M12 thread for attaching experimental equipment.

Diameter: 250 mm
Height: 90 mm
Electrical limit specs.: max. 48 V, max. 12 A
Vacuum connection: 2 hose nozzles 12 mm and 8 mm diam.

9983-1003166

Additionally required:
9983-1003167 Vacuum Bell Jar
9983-1003317 Rotary-Vane Vacuum Pump, Two-Stage
9983-1002619 Vacuum Hose 8 mm

Vacuum Recipient

Inexpensive vacuum recipient made of transparent acrylic for experiments in coarse and fine vacuums. Comprises a base and vacuum cylinder with venting valve, manometer, inlet tap, entrance for contacts and rubber ring.

Volume: 9 l approx.
Leakage rate: < 0.5 mbars/h
Base plate: 320x320x10 mm approx.
Vacuum cylinder: 200 mm x 240 mm (diam.) approx.
Thickness of walls: 5 mm
Weight: 2.9 kg approx.

9983-1009943

Additionally required:
9983-1012830 Vacuum Tubing, 6 mm
9983-1003317 Rotary-Vane Vacuum Pump, Two-Stage

Electric Doorbell

Bell for demonstrating electro-magnetic operation of apparatus and verifying that sound waves do not propagate in a fine vacuum (< 1 hPa). Open acrylic housing with 4-mm safety sockets.

Power supply: 6 V AC
Dimensions: 100x95x50 mm³

9983-1003170

Additionally required:
Vacuum Chamber
Vacuum Pump
9983-1003316 Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (230 V, 50/60 Hz)
or
9983-1003315 Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (115 V, 50/60 Hz)

9983-1003170





9983-1003169

Baroscope

Beam balance on base with suspended polystyrene ball and adjustable counterweight for demonstrating buoyancy on a body due to atmospheric pressure. At a state of equilibrium a Baroscope is placed in a vacuum bell jar under atmospheric pressure. The air in the bell jar is then evacuated, the Styrofoam sphere falls on account of the reduction in lift.

Styrofoam sphere: 50 mm diam.
Base: 120x90 mm²
Height: 125 mm

9983-1003169

Additionally required:
Vacuum Chamber
Vacuum Pump



9983-1009943

...going one step further
www.EngineeringBooksPDF.com



Vacuum Hoses

Vacuum hoses made of natural rubber according to DIN 12865. Colour red.

	9983-1012831	9983-1012830	9983-1002619	9983-1002620
Length	1 m	1 m	1 m	1 m
Internal diameter	4 mm	6 mm	8 mm	10 mm
Wall strength	4 mm	4 mm	5 mm	5 mm
Temperature range	-30° up to + 85°	-30° up to + 85°	-30° up to + 85°	-30° up to + 85°



9983-1002619

9983-1002620

Water-Jet Pump

Pump for experiments in a coarse vacuum; equipped with an integrated non-return valve to prevent water rise; can be disassembled.

Material: Plastic
Suction capacity: approx. 4 l/min (dependent on water pressure)
Final total pressure: approx. 15 hPa (dependent on water temperature)
Pump-out time for a 5 l container: 6 to 10 minutes
Threaded joint: R 1/2" with inserts for R 3/8" and R 3/4"

9983-1003008



9983-1003008



9983-1000798

Piston Vacuum Pump

Robust two-stroke piston pump for vacuum experiments, for final vacuum pressures down to 400 hPa. Air is pumped out on both the upward and the downward stroke of the piston. Includes carrying rod with handles and heavy base plus vacuum hose diam. 5 mm.

Final pressure: 400 hPa
Tubing nozzle: 5 mm diam.
Dimensions: approx. 160x235x560 mm³
Weight: approx. 1.7 kg

9983-1000798

Vacuum Hand Pump

Simple mechanical air pump for filling and evacuating small containers; equipped with an ergonomic handle, a manometer with a pointer that rotates through a full 360°, a ventilation valve, two hoses (long and short) and six connecting adapters.

Final pressure: from -980 hPa to 4000 hPa
Tubing nozzle: 8.5 mm diam.
Hose: 850 mm x 6.5 mm internal diam.
65 mm x 4.5 mm internal diam.
Dimensions: approx. 180x60x260 mm³
Weight: approx. 0.3 kg

9983-1012856



9983-1012856

Rotary-Vane Vacuum Pump, One-Stage

High performance, compact, one-stage, oil-sealed rotary vane pump for vacuum experiments. With thermal overload protection, handle, air valve, manometer and hose nipple. Includes pump oil.

Suction capacity: 100 l/min
Final pressure: 0.03 hPa
Motor power: 245 W
Manometer: 0 – 1000 hPa
Hose nipple: 10 mm diam.
Dimensions: approx. 335x138x250 mm³
Weight: approx. 8 kg

9983-1012855

Rotary-Vane Vacuum Pump, Two-Stage

High performance, compact, two-stage, oil-sealed rotary vane pump for vacuum experiments. With thermal overload protection, handle, air valve, manometer and hose nipple. Includes pump oil.

Suction capacity: 100 l/min
Final pressure: 0.003 hPa
Motor power: 245 W
Manometer: 0 – 1000 hPa
Hose nipple: 10 mm diam.
Dimensions: approx. 335x138x250 mm³
Weight: approx. 11 kg

9983-1003317



9983-1012855



9983-1003317

www.EngineeringBooksPDF.com

2-Way Ball Valve DN 16 KF

Connection: DN 16 KF
Length: 100 mm

9983-1002923

Crosspiece DN 16 KF

Connection: DN 16 KF
Dimensions: 80x44 mm²

9983-1002924

T-Piece DN 16 KF

Connection: DN 16 KF
Dimensions: 50x44 mm²

9983-1002925



9983-1002924
9983-1002923
9983-1002925
9983-1002929

Adapter Flange DN 16 KF / Shaft 12 mm

Adapter flange for connecting a vacuum hose to ISO-KF systems.
Connection: DN 16 KF
Tubing nozzle: 12 mm
Length: 40 mm

9983-1002928

Adapter Flange DN 16 KF / NS 19/26

Adapter flange for connecting components with internally ground nozzles, e.g. gas discharge tube (9983-1002905, to ISO-KF systems.
Connection: DN 16 KF
Core: 19/26 NS
Length: 40 mm

9983-1002929

Dummy Flange DN 16 KF

Connection: DN 16 KF

9983-1002927



9983-1002928
9983-1002927
9983-1002926

Ventilation Valve DN 16 KF

Connection: DN 16 KF
Dimensions: 36 mm x 26 mm Ø

9983-1002926

Rotary-Vane Vacuum Pump, PK 4 D

Compact, two-stage rotary pump with high suction capacity. Automatic lubrication of the rotary valve and ball bearings using optimized oil pressure increases the final pressure levels achievable, stabilizes the pump temperature and prolongs the pump's working life. Includes direct drive with elastic coupling. Device exhibits good resistance to chemicals and a high degree of water vapour compatibility. A suitable mechanism prevents the oil from rising back to contaminate the recipient. Lightweight device that operates with low noise. High-quality parts make the device capable of continuous operation. The pump is complete and ready for connection with a full complement of oil, centring ring, locking ring, motor protection circuit breaker, mains switch and connection cable with mains plug

Connecting flange:	DN 16 KF
Suction performance (Pneurop):	77/92 l/min at 50/60 Hz
Final pressure (without partial gas ballast):	$2x10^{-4}$ hPa
Final pressure (with total gas ballast):	$1x10^{-2}$ hPa
Water vapour tolerance:	60 hPa
Motor output:	200 W
Oil capacity:	530 ml
Dimensions:	415x150x235 mm³ approx.
Weight:	17.5 kg approx.

Rotary-Vane Vacuum Pump PK 4 D (230 V, 50/60 Hz)

9983-1002919

Rotary Vane Vacuum Pump PK 4 D (115 V, 50/60 Hz)

9983-1002918



9983-1002919
9983-1002918



9983-1002924
9983-1002930
9983-1002931
9983-1002925

Tension Ring DN 10/16 KF

Tension ring for mechanically secure connection of ISO-KF components.
Connection: DN 16 KF

9983-1002930

KF External Centring Ring DN 10/16 KF

Rubber sealing ring for ISO-KF connections.

9983-1002931

Pirani Vacuum Gauge

An easily programmable desktop device for measurement and control in fine and coarse vacuums using a Pirani vacuum gauge. Includes a clearly arranged membrane keypad, measuring line (3m) and mains cable.

Vacuum connection:	DN 16 KF
Measuring range:	120 – 0.001 hPa
Measurement uncertainty:	< 20% of the display value
Display:	Digital LED display in mbar/torr
Digit height:	10 mm
Readout:	5 per s
Recorder output:	0 – 10 V
Threshold switch:	2x230 V, 2 A, independently adjustable
Switching accuracy/hysteresis:	±1 digit
Permissible overload:	2 bar absolute
Power consumption:	max. 15 W
Dimensions:	98x98x152 mm³ approx.
Weight:	1.2 kg approx.

Pirani Vacuum Gauge (230 V, 50/60 Hz)

9983-1012514

Pirani Vacuum Gauge (115 V, 50/60 Hz)

9983-1012510



9983-1012514
9983-1012510

www.EngineeringBooksPDF.com

Jet Nozzle (Flow Laminator)

Nozzle for emitting a near laminar air stream, e.g. for experiments with the set of drag and lift objects or experiments on recoil. Mounted on a stem. The very light air nozzle contains no moving parts and generates no spin. It spreads out the air stream from a connected fan. Air that comes out of the tubular nozzles near the plastic ring mixes with the secondary air to form an overall air stream of a large diameter. Includes a hose.

Air inlet:	33 mm
Air outlet:	120 mm
Dimensions:	255x150 mm²
Stand holder:	10 mm
Weight:	approx. 350 g

9983-1000758

Additionally required:
9983-1000606 Air Flow Generator (230 V, 50/60 Hz)
or
9983-1000605 Air Flow Generator (115 V, 50/60 Hz)
Stand Equipment



9983-1000758

Component Balance

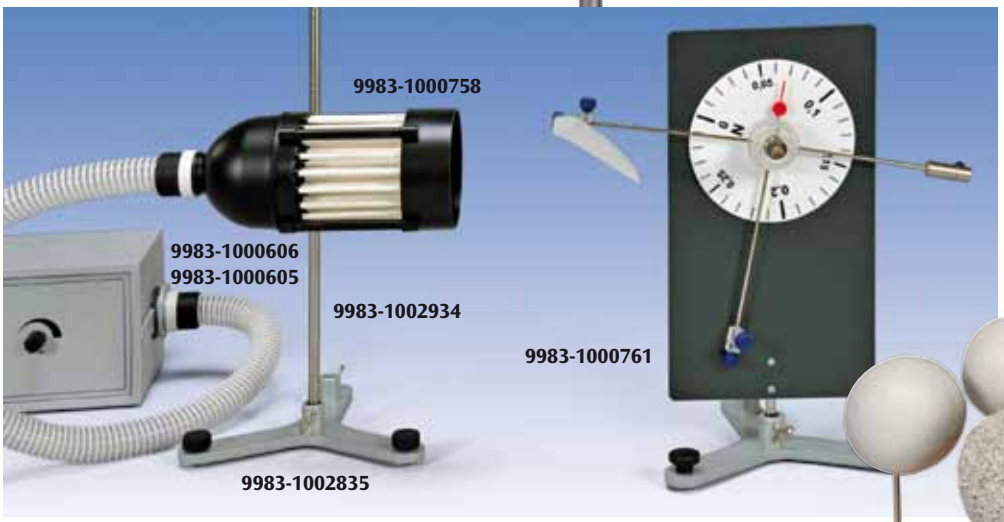
Scales for measuring components with holding mechanism for measuring air resistance and buoyancy of bodies from set 9983-1000760. On rod.

Measuring range:	0 – 0.3 N
Diameter of the scale:	170 mm
Dimensions:	approx. 350x220 mm²
Rod diameter:	10 mm
Weight:	approx. 0.9 kg

9983-1000761



9983-1000761



Air Flow Generator

Fan allowing continuous adjustment of air flow. Includes a hose.

Hose length:	approx. 1.5 m
Power consumption:	max. 1100 W
Dimensions:	300x180x170 mm³
Weight:	4.4 kg

Air Flow Generator (230 V, 50/60 Hz)

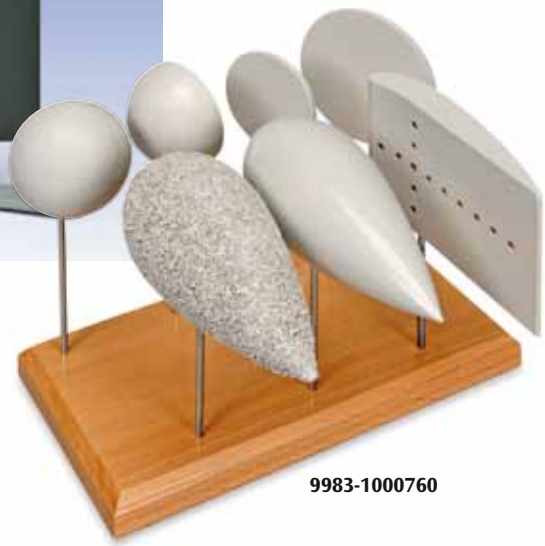
9983-1000606

Air Flow Generator (115 V, 50/60 Hz)

9983-1000605



9983-1000606
9983-1000605



9983-1000760

Set of bodies for air resistance and buoyancy experiments

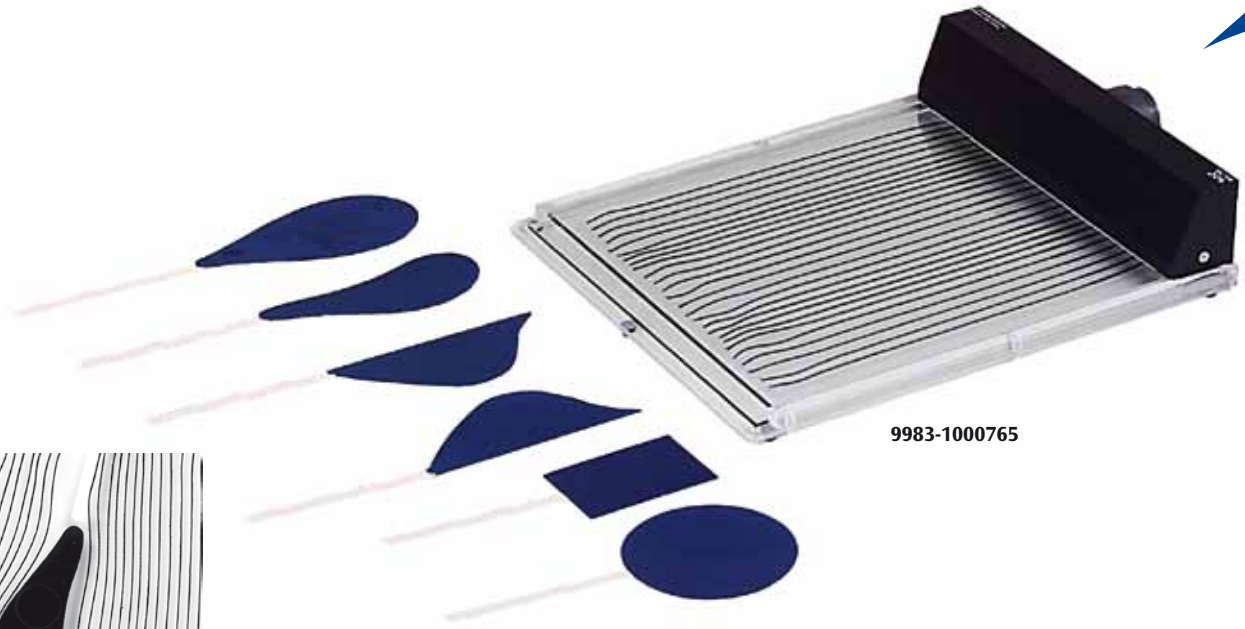
Set of 7 wooden models on stems for measuring buoyancy and fluid resistance of various bodies in laminar air flows. Including storage block.

Contents:
1 streamlined body, smooth, l = 120 mm
1 streamlined body, rough, l = 120 mm
1 ball, d = 50 mm
1 circular disc, d = 47 mm
1 circular disc, d = 68 mm
1 semi shere, d = 50 mm
1 plate, 150 mmx40 mm
1 wing profile, l = 150 mm

9983-1000760

Additionally required:
9983-1000758 Jet Nozzle (Flow Laminator)
9983-1000761 Component balance

www.EngineeringBooksPDF.com



9983-1000765



Example of an
air flow pattern

Air Flow Apparatus

Apparatus for demonstrating air flow patterns around bodies of different shapes. The air flow patterns can be projected on to a wide screen using an overhead projector. Two strings are fastened on one side at equal distances between two glass plates. The strings move according to the air currents between the two glass plates. Bodies of different shapes can be introduced in the air current. The inserted bodies can be moved to various positions in the air current from outside. Includes a hose.

Dimensions: approx. 385x310x75 mm³
Weight: approx. 3.2 kg

Contents:
1 Air flow apparatus
1 Circular body
1 Rectangular body
1 Streamlined body
1 Wing section
2 Bodies to demonstrate narrowing of flow
1 Hose

9983-1000765

Additionally required:
9983-1000606 Air Flow Generator (230 V, 50/60 Hz) or
9983-1000605 Air Flow Generator (115 V, 50/60 Hz)

Additionally recommended:
9983-1003264 Overhead Projector (230 V, 50/60 Hz) or
9983-1003263 Overhead Projector (115 V, 50/60 Hz)



9983-1006784

Laminar Flow Apparatus

For demonstrating and investigating the laminar flow properties of water. The emergence of currents in water, the flow of current in the case of straight laminar flow and the overflow of differently shaped bodies can be studied. The flow of current at a narrows can also be demonstrated clearly. A rectangular piece of velour paper is placed in the apparatus consisting of an upper and lower trough. Owing to capillary forces, water from the upper trough is drawn in by the paper. The water flows down into the velour paper. The flow of water in the upper level is marked with a dye at constant intervals. Owing to the low speed of flow of approx. 2 mm/s, the development of currents can be observed with the help of the dye. After the velour paper has been dried, a lasting current pattern remains, which can be copied and evaluated.

Dimensions: approx. 220x140x240 mm³
Weight: approx. 1 kg

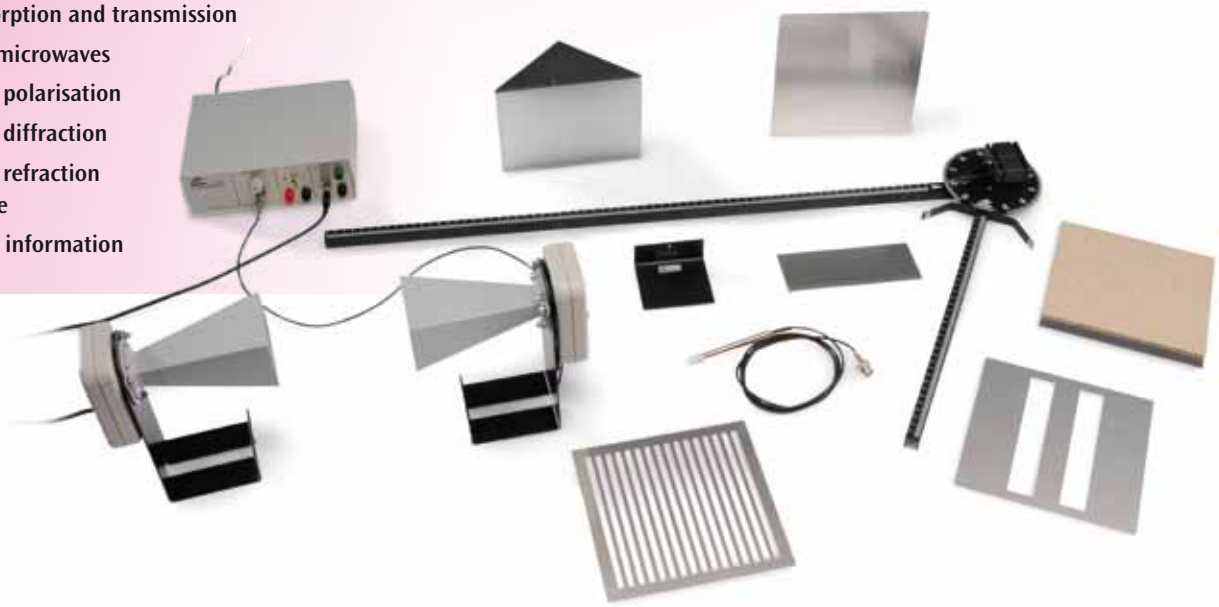
9983-1006784

Contents:
2 Acrylic glass basins
1 Mask
20 Sheets of velour paper with cut-outs
1 Mini-flask with dye
Swab for dye
Rubber gloves

...going one step further
www.EngineeringBooksPDF.com

Experiment Topics:

- Straight-line propagation of microwaves
- Reflection, absorption and transmission
- Shielding from microwaves
- Experiments on polarisation
- Experiments on diffraction
- Experiments on refraction and interference
- Transmission of information



Microwave Set

Equipment set for conducting wave optics experiments involving wavelengths in the cm range. A transmitter with a horn antenna radiates a narrow beam of linearly polarised electromagnetic waves with a wavelength of about 3 cm. The direction of polarisation can be altered by rotating the antenna around the axis of propagation. To detect the waves, a horn antenna receiver and a microwave sensor are provided. A control unit converts the intensity of the signal received into a proportionally large output voltage that can be measured using a voltmeter. It is also possible to switch on an acoustic signal with a volume that is proportional to the intensity of the signal.

Oscillator frequency:	9.4 GHz (9983-1009951) 10.5 GHz (9983-1009950)
Power of transmitter:	10 – 25 mW
Internal modulator frequency:	3 kHz approx.
Acoustic signal:	Switchable
External modulation:	100 Hz –20 kHz, 1 V max.
Output voltage:	10 V max.
Receiver with horn antenna:	Silicon diode with resonator
Microwave sensor:	Silicon diode with resonator
Dimensions of basic apparatus:	approx. 160x200x75 mm³

Contents:

1 Control unit
1 Transmitter with horn antenna
1 Receiver with horn antenna
1 Microwave probe
1 Microwave bench, 800 mm
1 Microwave bench, 400 mm with plate holder
1 Reflection plate 180x180 mm²
1 Polarisation grating, 180x180 mm²
1 Absorption plate, fibreboard, 180x180 mm²
1 Paraffin prism
1 Stand for prism
1 Plate with double slit
1 Cover plate for double slit

Microwave Set 9.4 GHz (230 V, 50/60 Hz)

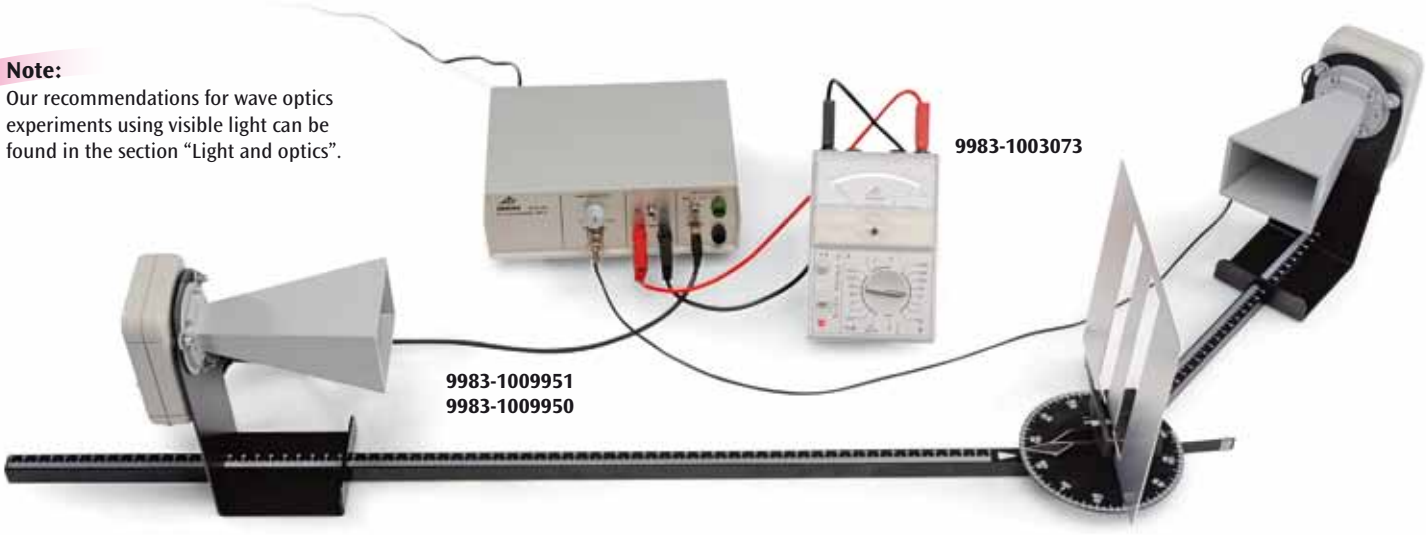
9983-1009951

Microwave Set 10,5 GHz (115 V, 50/60 Hz)

9983-1009950

Additionally recommended:
9983-1003073 Analogue Multimeter, AM50

Note:
Our recommendations for wave optics experiments using visible light can be found in the section “Light and optics”.



Refraction by a double slit

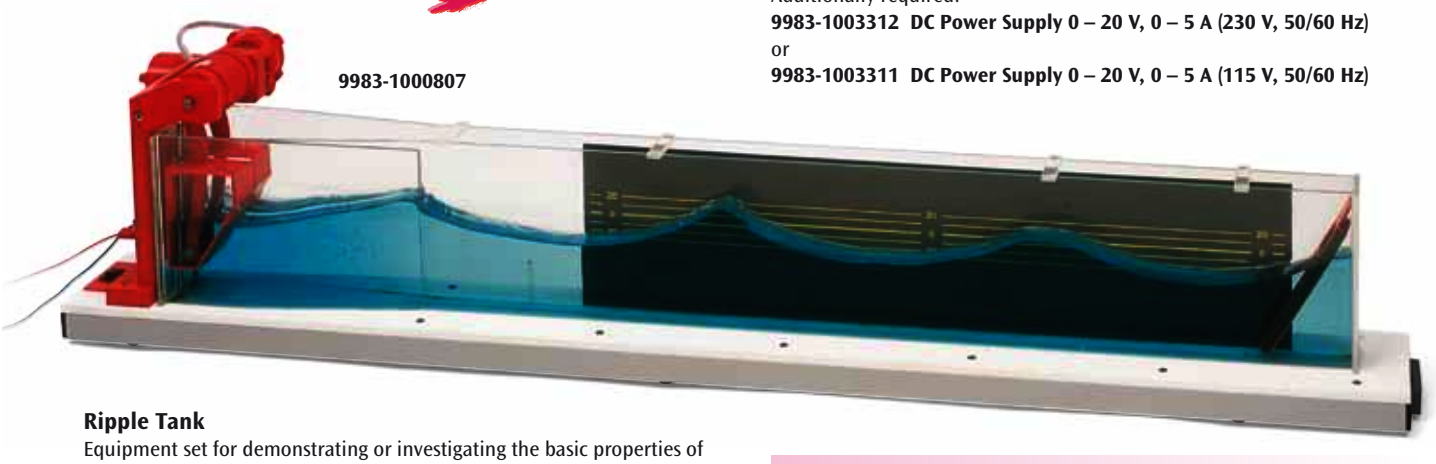
www.EngineeringBooksPDF.com

Experiment Topics:

- Excitement of periodic and non-periodic waveforms
- Deflection, phase and amplitude
- Frequency and wavelength
- Phase and group velocities
- In-phase and out-of phase superimposition of waves
- Reflection of a wave
- Standing waves

BEST SELLER

9983-1000807



Water Wave Channel

Wave channel for demonstrating or investigating the basic properties of waves using waves in water. A plexiglas duct is filled with water and a sinusoidal wave is generated that propagates with no reflection at the end thanks to an absorber mechanism. The frequency and thus the wavelength of the resulting movement can be varied continuously. In order to investigate reflection, the absorber at the end can be removed. Two exciting mechanisms are supplied that can be operated in or out of phase and the waves they generate can be viewed separately or superimposed. By applying a pulsed input to the exciters, non-periodic waves can be generated.

Supply voltage:	9 – 12 V DC
Power consumption:	40 W max.
Connectors:	4 mm safety sockets
Frequency range:	Continuously adjustable
Dimensions:	approx. 1500x150x290 mm³
Weight:	approx. 12.6 kg

9983-1000807

Additionally required:
9983-1003312 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Ripple Tank

Equipment set for demonstrating or investigating the basic properties of waves using waves in water. The ripple tank consists of a shallow basin with a glass bottom inside an aluminium frame. A halogen lamp operated via a stroboscope illuminates the tank from above. Underneath the tank is a diagonally aligned mirror that is used to project the waves onto a frosted glass screen. Waves in the water are produced via the oscillation of an electromagnetic vibrator, to which dippers for straight waves or up to three dippers for making concentric waves can be attached. A control unit sets the amplitude and frequency of the vibrations and the frequency of the stroboscope either synchronously or asynchronously. 4 mm safety sockets are provided for connecting a counter/timer in order to measure the frequency of the vibrations.

Frequency range:	Continuously adjustable
Supply voltage:	9 – 12 V DC
Connectors:	4 mm safety sockets
Lamp:	Halogen lamp 12 V/35 W, GY6.35
Dimensions of tank:	approx. 295x395x10 mm³
Dimensions of frame:	approx. 340x440x345 mm³

Contents:
1 Ripple tank with projection mirror; lamp and stroboscope
1 Control unit
1 Vibrator
1 Dipper for straight waves
3 Dippers for concentric circular waves
1 Holder for circular wave dippers
3 Bodies that can be laid in the tank to demonstrate reflection and diffraction (prism, bi-concave and bi-convex lenses)
1 Obstruction with a wide gap and four separate small gaps
2 Narrow covers
2 Wide covers
1 Drainage tube
1 Tube clamp

9983-1003198

Additionally required:
9983-1003312 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Experiment Topics:

- Generation of circular and straight waves
- Reflection
- Refraction
- Interference
- Diffraction
- Doppler effect

BEST SELLER

9983-1003198



Spare Halogen Lamp, 12 V, 35 W (not shown)
Spare halogen lamp for the ripple tank (9983-1003198).

9983-1003199

www.EngineeringBooksPDF.com

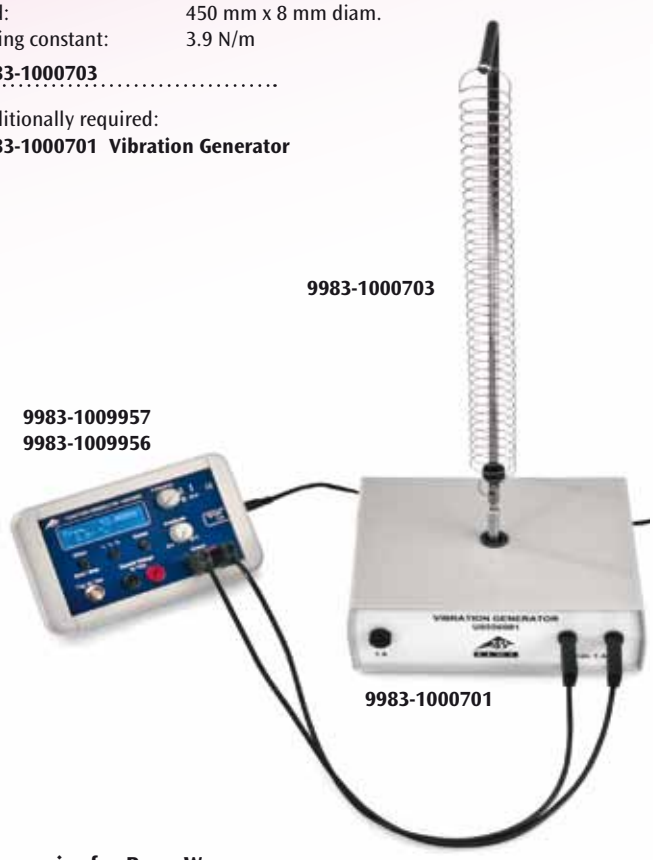
Accessories for Spring Oscillations

Accessories ideal for vibration generator 9983-1000701 for demonstrating standing longitudinal waves in a coil spring. Consisting of angled stand rod, coil spring and connector pin for attachment of the spring to the vibration generator.

Rod:	450 mm x 8 mm diam.
Spring constant:	3.9 N/m

9983-1000703

Additionally required:
9983-1000701 Vibration Generator



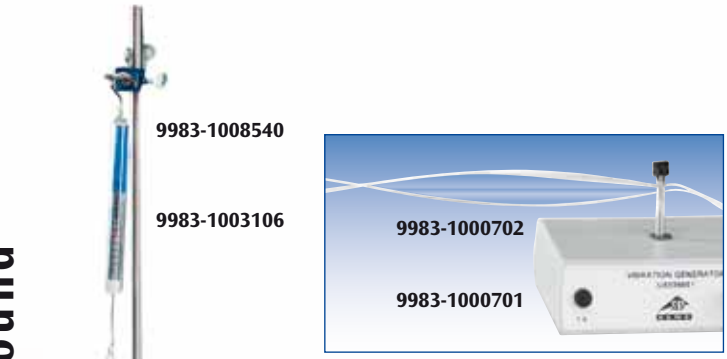
Accessories for Rope Waves

Accessories ideal for vibration generator (9983-1000701) for the investigation of standing transversal waves and their wavelengths as a function of the rope tension and the frequency. Consisting of a base plate with stand rod, holder for dynamometer, deflection device and rubber rope.

Rope:	1 m
Base plate:	approx. 180x180x25 mm³

9983-1008540

Additionally required:
9983-1000701 Vibration Generator
9983-1003106 Dynamometer 5 N



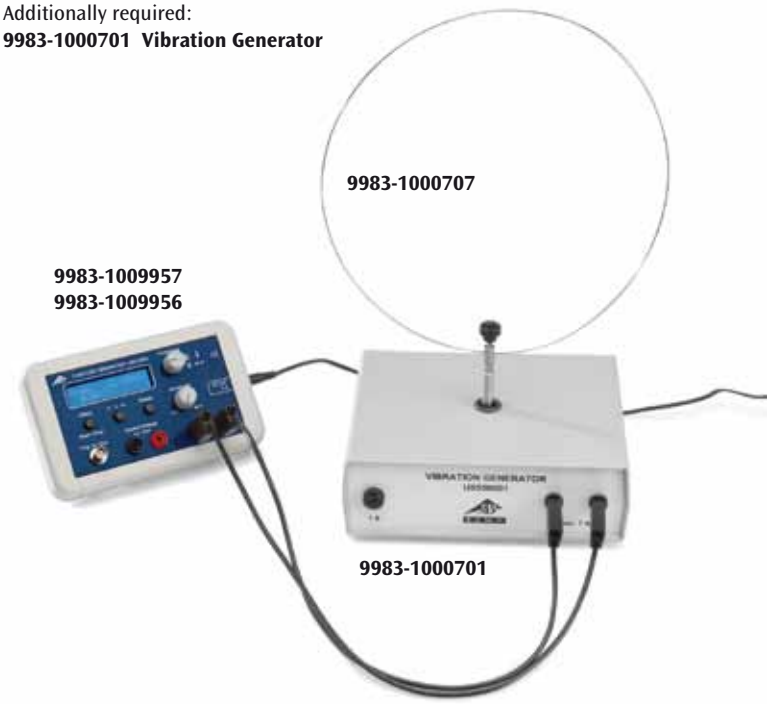
Resonance Wire, Ring Shaped

Accessories for vibration generator 9983-1000701 for demonstrating the vibration knots in determination of different frequencies. Wire ring with 4 mm plugs.

Diameter:	290 mm

9983-1000707

Additionally required:
9983-1000701 Vibration Generator



Vibration Generator

Tough vibration generator for exciting oscillations and waves mechanically, e.g. in coil springs, a rubber cord, a wire ring or a Chladni plate. In robust plastic housing including mounting pin with 4 mm socket for attaching accessories (Chladni plates, resonance wire, rubber band etc.). Including holder for stand rod (up to 8mm diam.) on the rear side of the apparatus for the demonstration of standing waves in a coil spring. The generator is equipped with overload protection.

Connection:	via 4 mm safety sockets
Impedance:	8 Ω
Frequency range:	0 up to 20 kHz
Overload protection:	1 A fuse
Dimensions:	approx. 200x160x70 mm³
Weight:	aprox. 1.4 kg

9983-1000701

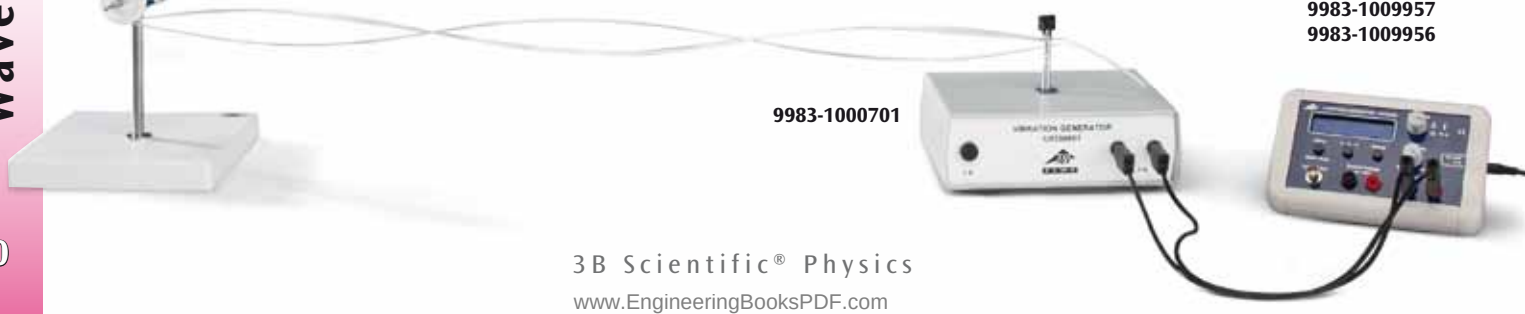
Additionally required:
9983-1009957 Function Generator FG 100 (230 V, 50/60 Hz)
or
9983-1009956 Function Generator FG 100 (115 V, 50/60 Hz)

Rubber Band

For demonstrating stationary waves and wave propagation e.g. Using the vibration generator (9983-1000701). Wound on a board, 25 m, 2 mm diam.

9983-1000702

Additionally required:
9983-1000701 Vibration Generator



www.EngineeringBooksPDF.com

Chladni's Plates

Inexpensive metal plates for generating acoustically excited figures in fine dry sand, as in the experiment by Chladni. To be used for instance in conjunction with vibration generator (9983-1000701). With 4 mm plugs.

Chladni Plate, circular, 240 mm diam.

9983-1000705

Chladni Plate, square, 180x180 mm²

9983-1000706

Additionally required:
9983-1000701 Vibration Generator



9983-1000706

9983-1000705



DC Motor 12 V

Compact experiment motor – can also be used as a tachogenerator, oscillation generator or for the excitation of rope waves. The motor has a coreless rotor and thus has a high starting torque at a lower moment of inertia. It is characterised by a very short starting time, smooth running and low running noise. On its axis, the motor has a threaded bush with a screw on retaining pulley. Thus, plates and levers too can be fixed on to the axis.

Nominal voltage/current:	12 V/260 mA DC
Run-up voltage/current:	0.5 V/45 mA DC
Power consumption:	3.6 W
Nominal speed	3900 rpm
Nominal rated torque:	0.5 Ncm
Direction of rotation:	reversible
Connection:	via 4-mm safety sockets
Dimensions in mm:	approx. 130x55 mm²
Weight:	approx. 200 g

9983-1001041



9983-1001041

Band Wave Device

Robust apparatus for demonstrating transverse standing waves on a rope and investigating how wavelength depends on the tension in the rope and on the frequency.

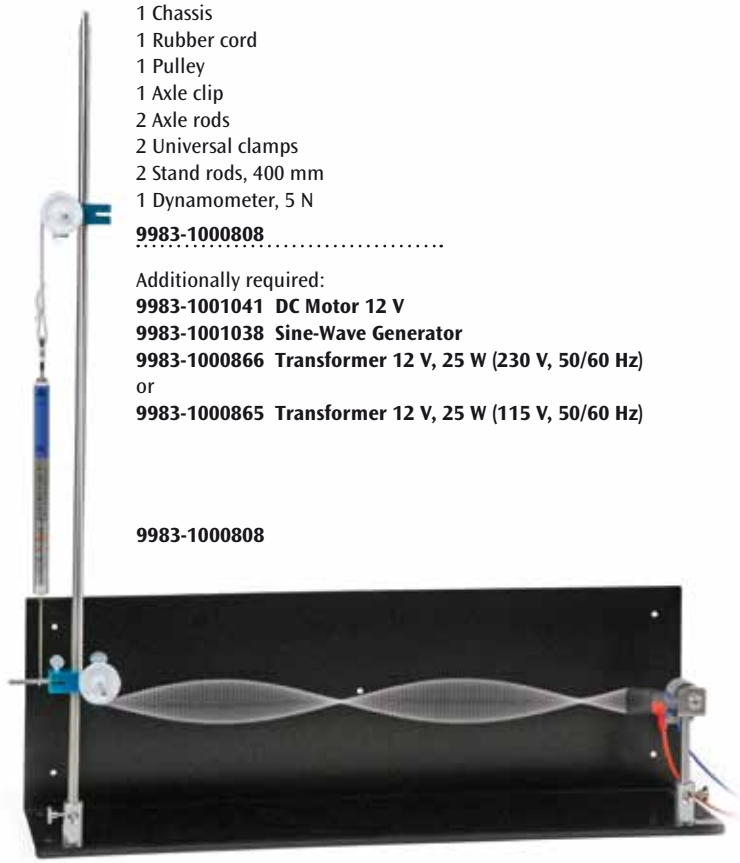
Dimensions:	700x150x230 mm³
Weight:	approx. 4.4 kg

Contents:
1 Chassis
1 Rubber cord
1 Pulley
1 Axle clip
2 Axle rods
2 Universal clamps
2 Stand rods, 400 mm
1 Dynamometer, 5 N

9983-1000808

Additionally required:
9983-1001041 DC Motor 12 V
9983-1001038 Sine-Wave Generator
9983-1000866 Transformer 12 V, 25 W (230 V, 50/60 Hz)
or
9983-1000865 Transformer 12 V, 25 W (115 V, 50/60 Hz)

9983-1000808



www.EngineeringBooksPDF.com



Helical Spring Snakey
Very long helical spring for demonstrating and investigating transverse and longitudinal waves.

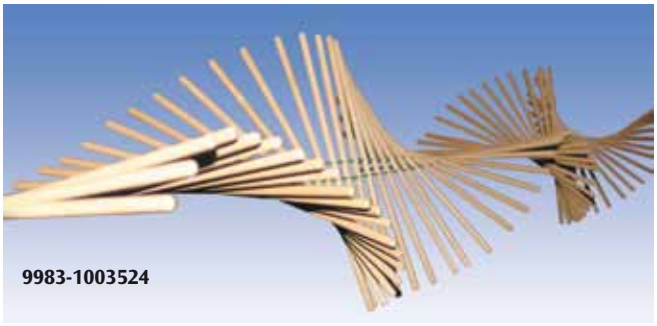
Length:	2 m up to 14 m
Total number of turns:	1300
Coil diameter:	25 mm
Weight:	1400 g

9983-1008687

Coil Spring Slinky
Long coil spring for demonstrating the propagation and reflection of longitudinal waves.

Length:	0.2 m up to 5 m
Total number of turns:	330
Coil diameter:	70 mm
Weight:	550 g

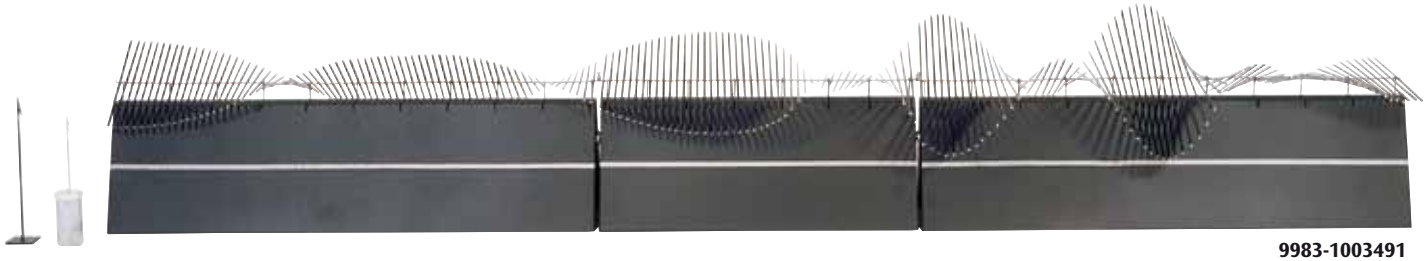
9983-1003516



Wave Machine, Manual
Demonstration equipment for displaying propagation, reflection, diffraction and superimposition of transverse waves. A chain of wooden double-ended pendulums joined together by a bifilar thread. Two handles allow the chain to be held by hand and excited. Pendulum weights are supplied for altering the moment of inertia.

Number of double pendulums:	79
Length:	3 m
Weight:	approx. 0.8 kg

9983-1003524



9983-1003491

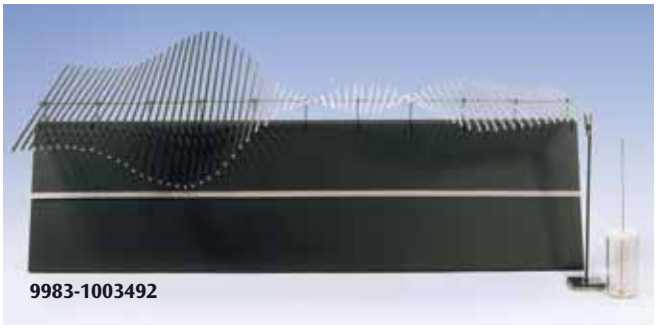
Experimental topics:

- Propagation of a moving wave
- Wavelength, frequency and phase velocity
- Reflection of waves at fixed or moving ends
- Standing waves and resonance in the case of fixed or moving ends
- Constructive and destructive reinforcement of waves
- Propagation and speed of communication for a disturbance of equilibrium.
- Reflection of a disturbance of equilibrium at fixed or moving ends
- Damping of moving waves
- Reflection at a transition **(experiment only possible with full set)**
- Coupling at a transition **(experiment only possible with full set)**

Demonstration Wave Machine, Complete Set
Supplement to the demonstration wave machine comprising a module with short pendulum bars, a transition module and two module couplers. If the two models with differing bar lengths and thus differing wave velocities are coupled together, then reflections can be observed at the point where they are joined together. This can be avoided by adding the transition module.

Length of bar module 1:	460 mm
Length of bar module 2:	230 mm
Length of bars for transition module:	230 – 460 mm
Total length:	2440 mm

9983-1003491

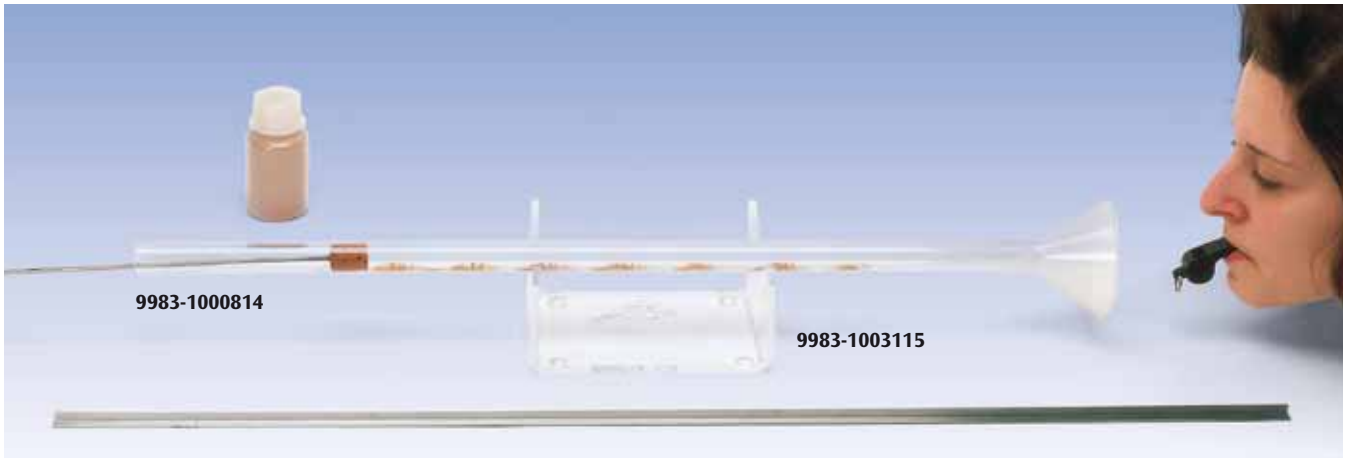


Demonstration Wave Machine, Single Module
Wave machine for conducting various demonstration experiments to show the behaviour and properties of transverse waves. The motion of the wave is demonstrated by a chain of 73 steel pendulum bars each soldered at their mid-point along a rod spring that can be subjected to torsion. The ends of the bars are painted on one side in fluorescent paint and on the other side with white paint. The machine is mounted on a foldable steel base. A damping mechanism is also supplied and a retaining clamp on a stem for demonstrating reflections at a fixed end.

Number of bars:	73
Length of bars:	460 mm
Total length:	920 mm

9983-1003492

www.EngineeringBooksPDF.com



Kundt's Tube

Glass tube for demonstrating standing sound waves and calculating wavelengths of sound using cork powder in a method devised by Kundt. Cork powder is spread evenly throughout the tube by means of a filler chute. Then a sound source, e.g. a whistle, a 1700 Hz tuning fork (9983-1002607) or a horn speaker (9983-1000811), is used to excite the powder into a regular pattern of nodes and antinodes. The effective length of the tube can be altered by means of a piston.

Length:	600 mm
External diameter:	20 mm
Internal diameter:	17 mm

Contents:
1 Glass tube with funnel
1 Plunger
1 Filler chute
1 Whistle
1 Bottle of cork powder

9983-1000814

Additionally recommended:
9983-1000964 Plexiglas Stands

9983-1000815



Cork Powder, 10 g Bottle

Fine cork powder for use in Kundt's glass tube (9983-1000814.

9983-1000815

Battery Box

Accessory for probe microphone (9983-1003116) to be used as a power supply and for connecting the microphone to a meter or oscilloscope. The equipment includes a battery compartment for one 9 V alkaline battery and a voltage regulator to output the requisite 5 V DC.

Output voltage:	5 V DC
Input channels:	two 6-pin DIN sockets (180°), 8-pin DIN socket (270°)
Outputs:	two 5-pin DIN sockets, two 4 mm safety sockets
Dimensions:	approx. 143x84x37 mm³

9983-1003117

Kundt's Tube with Scale

Transparent acrylic tube with scale and end plates for measuring standing acoustic waves and determining their wavelength in air or in other gases. With tubing nozzles for filling the tube with various gases, built-in speaker at one end, a bore and guide for accommodating moving piston or probe microphone (9983-1003116) at the other end. Includes retaining clips for mounting on stands and a connector lead for the speaker.

Tube nozzle:	7 mm diam.
Length:	1000 mm
Diameter:	70 mm

9983-1003115

Additionally required:
9983-1001045 Barrel Foot, 0.9 kg (2x)
9983-1003116 Probe Microphone
9983-1009957 Function Generator FG 100 (230 V, 50/60 Hz)
or
9983-1009956 Function Generator FG 100 (115 V, 50/60 Hz)

Probe Microphone

Probe microphone for measuring changes in sound pressure in a Kundt's tube with scale 9983-1003115. A miniature microphone is attached to one end of a long stainless steel rod.

Frequency range:	20 Hz – 20000 Hz
Dimensions:	approx. 740 mm x 8 mm diam.
Connector lead:	2 m
Connectors:	DIN plug suitable for battery box (9983-1003117).

9983-1003116

Additionally required:
9983-1003117 Battery Box







www.EngineeringBooksPDF.com



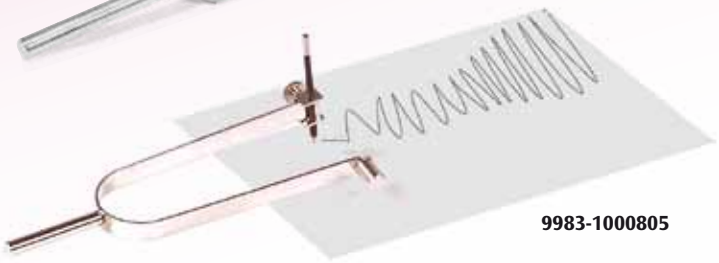
9983-1000700

Demonstration Tuning Fork

Large tuning fork for demonstrating the vibrating legs of the fork.

Length:	750 mm

9983-1000700



9983-1000805

21 Hz Tuning Fork with Plotter Pen

Tuning fork that allows for plotting oscillations on a sheet of paper. The oscillation is triggered by pushing the prongs of the fork together. The oscillation of the tuning fork is highly visible both with the naked eye or with the aid of a stroboscope. Includes a plotter pen with holder and a counterweight.

Natural frequency:	21 Hz
Length:	245 mm
Total weight:	approx. 170 g

9983-1000805



9983-1002606



9983-1002609

Recording Tuning Fork, c 128 Hz

For demonstrating and recording sound oscillations. For recording the oscillations on a sooted glass plate one of the two prongs is equipped with a metal tip. Complete with a glass plate.

Natural frequency:	128 Hz
Total length:	approx. 280 mm
Glass plate:	120x50 mm²

9983-1002606

Tuning Fork, 2000 Hz

Tuning fork with handle for demonstrating the Doppler Effect. The effect can be exhibited very impressively by moving the fork slowly toward and away from the audience.

Natural frequency:	2000 Hz
Length of the tuning fork:	220 mm

9983-1002609

Additionally recommended:
9983-1002610 Hard Striking Hammer



9983-1002607



9983-1002608

Light Metal Tuning Fork, 1700 Hz

Suitable as a source of intense, high-frequency sound, for example, for producing stationary sound waves in Kundt's tube.

Natural frequency:	1700 Hz
Length:	approx. 105 mm

9983-1002607



9983-1002613

Light Metal Tuning Fork, 1000 Hz

Suitable as a source of intense, high-frequency sound, for example, for producing stationary sound waves in Kundt's tube.

Natural frequency:	1000 Hz
Length:	approx. 115 mm

9983-1002608

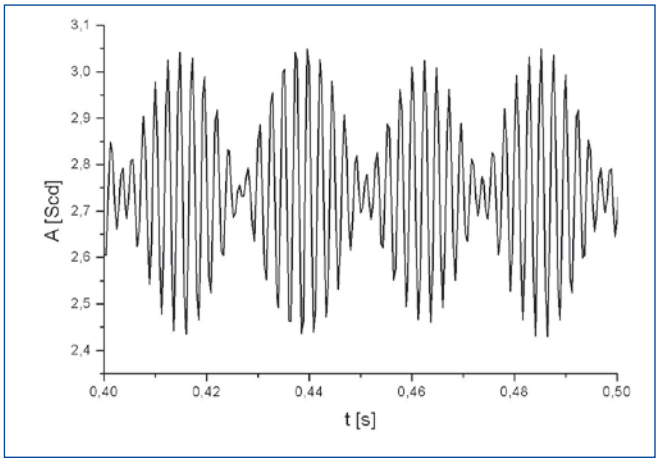
Tuning Fork, 440 Hz, on Resonance Box

Long-sustain tuning fork mounted on a resonant chamber made of clear grained fir wood. Removable, includes a soft striking hammer 9983-1002614.

Natural frequency:	440 Hz
Length of the tuning fork:	approx. 170 mm
Resonance box:	180x90x50 mm³

9983-1002613

www.EngineeringBooksPDF.com



Acoustic beats

BEST SELLER



9983-1002612

Pair of Tuning Forks, 440 Hz, on Resonance Boxes

Pair of Tuning Forks for experiments on beats; the tuning forks are identical with (9983-1002613). Complete with a soft striking hammer (9983-1002614) and a pair of tuning weights (9983-1002611).

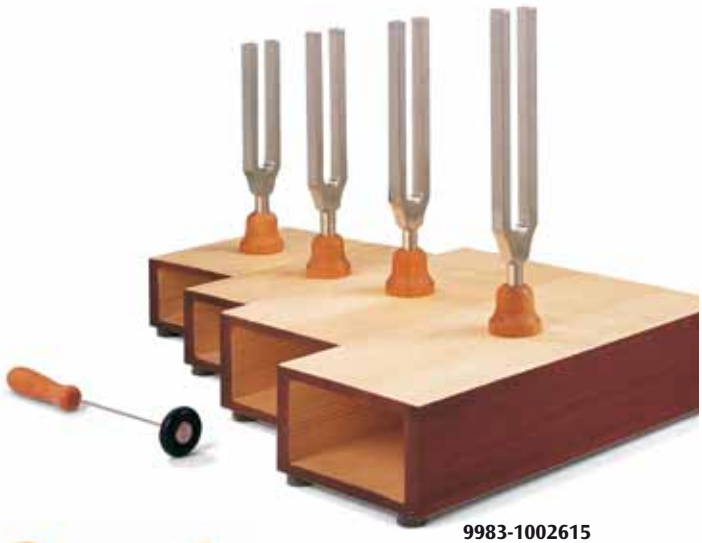
9983-1002612

Set of Tuning Forks, C-Major Chord, on Resonance Boxes

Set of four tuning forks for demonstrating C major chord. Supplied on a sound box made of clear grained pine for especially long sustain from which the tuning forks can be removed. Includes a soft striking hammer (9983-1002614).

Natural frequency:			Internal length:
c'	=	256 Hz	300 mm
e'	=	322 Hz	240 mm
g'	=	384 Hz	190 mm
c''	=	512 Hz	140 mm

9983-1002615



9983-1002615

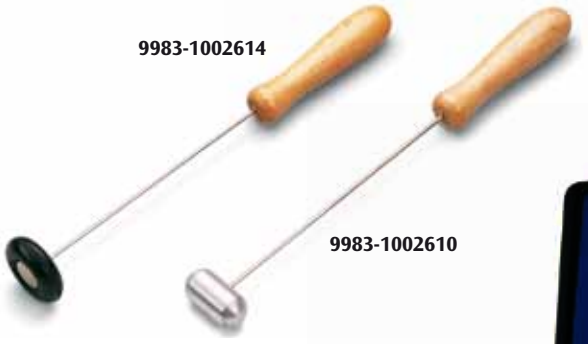
Set of Tuning Forks for the C-Major Scale

Set of 8 tuning forks in a storage case.
Frequencies:

c'	=	256 Hz
d'	=	288 Hz
e'	=	320 Hz
f'	=	341⅓ Hz
g'	=	384 Hz
a'	=	426⅔ Hz
h'	=	480 Hz
c''	=	512 Hz

9983-1002605

9983-1002614



9983-1002610



9983-1002605

Striking Hammer, Soft

Rubber beater particularly suited for striking low-frequency tuning forks, e.g. tuning forks on sound box (9983-1002612, 9983-1002613 and 9983-1002615).

9983-1002614

Striking Hammer, Hard

Aluminium beater particularly suited for striking high-frequency 2000 Hz tuning fork (9983-1002609).

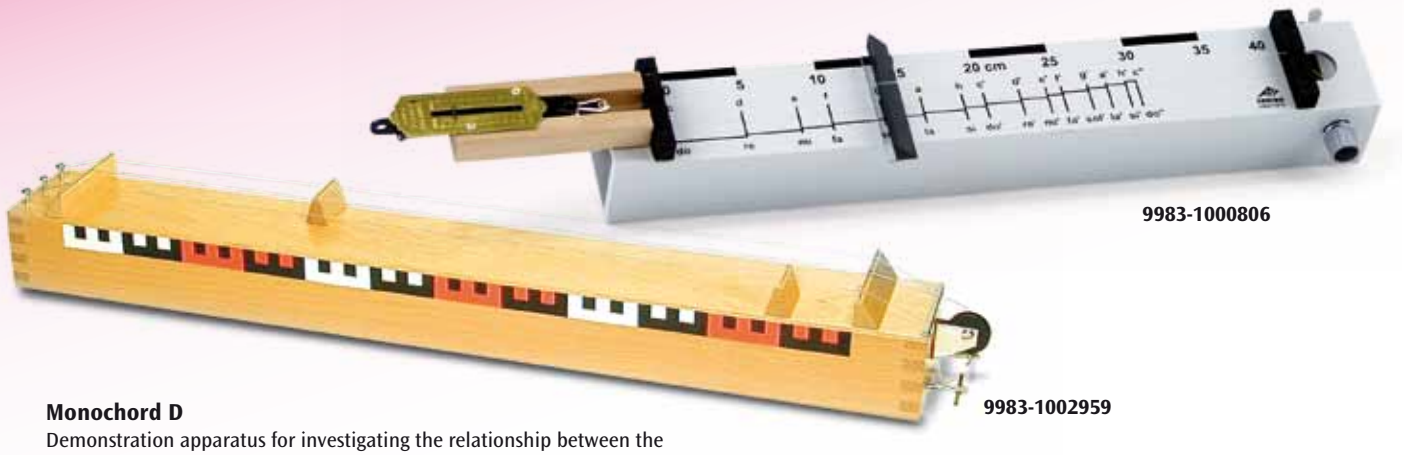
9983-1002610

Pair of Tuning Weights (not shown)

Two tuning weights for changing the frequency of tuning forks for beat experiments; intended for the 440-Hz tuning fork mounted on a resonance box (9983-1002613).

9983-1002611

www.EngineeringBooksPDF.com



9983-1000806

9983-1002959

Monochord D

Demonstration apparatus for investigating the relationship between the pitch of a sound and the length of the string making it. Also for investigating overtones formed by harmonic waves with intermediate nodes and the dependence of the pitch on string tension. Two steel strings and one nylon string are stretched over a sound box. The tension on two of the strings can be altered by tuning pegs while the other's tension can be changed by adding weights or using a dynamometer at the end of a cord passed over a pulley. The effective length of the strings can be altered by means of two moving bridges.

Scale length: 600 mm
Scale division: cm and dm
Dimensions of the resonance box: approx. 700x90x70 mm³

9983-1002959

Additionally recommended:
9983-1003375 Dynamometer 50 N

Monochord

A wooden box open at both ends, with a clamping mechanism for a string to demonstrate the relationship between pitch and string length and the dependence of pitch on string tension. Includes an indicator for the tensioning force, as well as a steel string (tuned to B) and a nylon string.

Dimensions: approx. 490x70x60 mm³

9983-1000806

Set of 3 Monochord Strings (not shown)

Two steel and one nylon string with eyelets, fitting the monochord D (9983-1002959).

9983-1002960

9983-1012893



9983-1009924

Lip Whistle

Lip whistle for experiments on pitch as a function of resonance space. Closed wooden whistle with a round cross-section and movable piston, chromatic range from g1 (392 Hz) to g2 (794 Hz).

Frequency range: approx. 400 Hz – 800 Hz
Resonance space: approx. 170 mm x 20 mm diam.
Length: approx. 250 mm

9983-1009924

Reed Pipe

Reed pipe with 8 valves, tuned to C major.

Length: 37 cm
Weight: approx. 90 g

9983-1012893

Helmholtz Resonator

Hollow glass bulb with a narrow tube leading out for demonstrating acoustic resonance. The fundamental oscillation is generated by blowing into the opening or tapping on the outside of the bulb. The elasticity and inertial mass of the air in the bulb cause the bulb to act as an acoustic resonator with a highly distinct resonant frequency. The frequency is dependent on the dimensions of the bulb and the tube. With a whole set of Helmholtz resonators it is possible to demonstrate how tones combine to form a tonal mixture.

Opening on the glass bulb: 14 mm diam.
Length of tube: 15 mm
Internal diameter of tube: 6 mm

Helmholtz Resonator, 70 mm diam.

9983-1003520

Helmholtz Resonator, 52 mm diam.

9983-1003521

Helmholtz Resonator, 40 mm diam.

9983-1003522

Helmholtz Resonator, 32 mm diam.

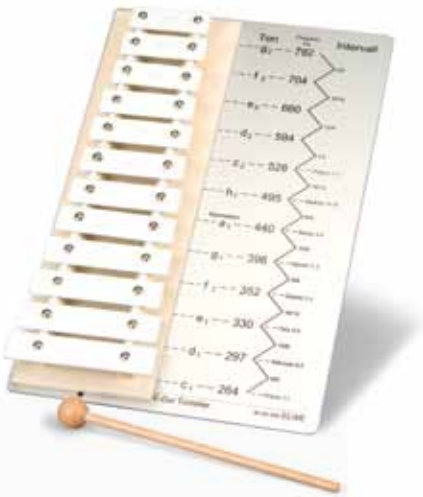
9983-1003523

Metallophone

Metallophone for demonstrating a C major scale from c1 to g2. Note labels, frequencies and frequency ratios are printed on the instrument. With striking hammer.

Dimensions: approx. 320x210 mm²
Weight: approx. 510 g

9983-1000804



9983-1000804



9983-1003520 9983-1003521 9983-1003522 9983-1003523

www.EngineeringBooksPDF.com

9983-1000811



9983-1001045

Horn Speaker

Speaker that approximates to being a point source for excitation of Kundt's tube 9983-1000814, for example. Without barrel foot.

Frequency range:	300 Hz – 10 kHz
Max. load capacity:	8 W (max. 10 W)
Impedance:	8 Ω
Shaft:	10 mm diam.
Weight:	approx. 470 g

9983-1000811

Additionally recommended:
9983-1001038 Sine Wave Generator
9983-1000866 Transformer (230 V, 50/60 Hz)
or
9983-1000865 Transformer (115 V, 50/60 Hz)

Wide-Band Loudspeaker

Ideal sound source for acoustics experiments in the frequency range 60 Hz to 23 kHz. Includes connecting lead with 4 mm safety plugs.

Frequency range:	60 Hz to 23 kHz (-10 dB)
Power capacity:	100 W (as per IEC 268-5)
Impedance:	4 Ω
Tweeter:	½" diam.
Woofer:	5½" diam.
Dimensions:	225x150x142 mm³
Weight:	1.8 kg

9983-1000812



9983-1000812

Additionally recommended:
9983-1001038 Sine-Wave Generator
9983-1000866 Transformer (230 V, 50/60 Hz)
or
9983-1000865 Transformer (115 V, 50/60 Hz)



Recording of ultrasonic standing waves



Ultrasound Transducer, 40 kHz, Equipment Kit

Equipment set for experiments on geometric and wave-mechanical acoustics. Based on the piezo-effect discovered by the Curie brothers, an AC voltage is applied to a piezo-electric body causing it to oscillate. Sound waves can also be used to excite the body and the oscillations can be converted into an electrical voltage signal.

Resonant frequency:	40 kHz approx.
Band width:	6 kHz approx.
Capacitance:	1900 pF
Connector:	BNC
Stand rod:	145 mm x 10 mm diam.
Dimensions:	40 mm x 20 mm diam.

Contents:
1 Ultrasonic transmitter, on stand rod
1 Ultrasonic receiver, on stand rod
1 Projection screen
1 Ruler, 1 m

9983-1009888

Equipment:
9983-1009888 Ultrasound Transducer, 40 kHz, Equipment Kit
9983-1001046 Barrel Foot, 0.5 kg (3x)
9983-1002727 Analogue Oscilloscope, 2x30 MHz
9983-1002752 T-Piece, BNC
9983-1009957 Function Generator FG100 (230 V, 50/60 Hz)
or
9983-1009956 Function Generator FG100 (115 V, 50/60 Hz)

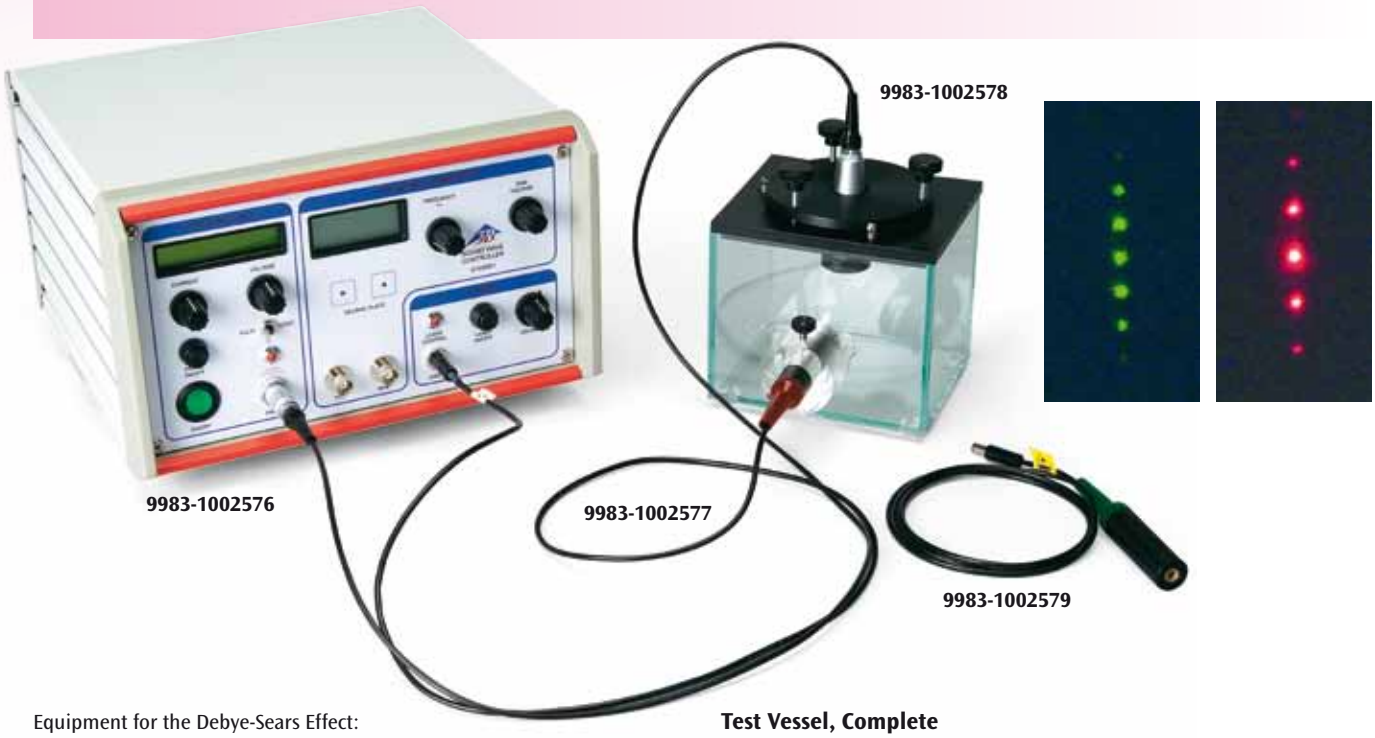


9983-1009888

www.EngineeringBooksPDF.com

Debye-Sears Effect

In 1932, Debye and Sears for the first time demonstrated the refraction of light as it passed through a liquid being subjected to high-frequency vibrations. In this process, the density maxima and minima of a stationary ultrasonic wave act like the elements of an optical diffraction grating. The grating constant here is equal to half the wavelength and therefore dependent on the frequency and speed of the ultrasonic waves transmitted through the medium (e.g. water, glycerin, oil).



Equipment for the Debye-Sears Effect:
9983-1002576 Ultrasonic CW Generator with Probe
9983-1002578 Test Vessel
9983-1002577 Laser Diode for the Debye-Sears Effect, red
9983-1002579 Laser Diode for the Debye-Sears Effect, green

Ultrasonic cw Generator with Probe

Ultrasonic generator for producing continuous, high-powered ultrasonic waves in a wide frequency range of up to 20 MHz. Includes a multi-frequency probe with waterproof cast sound transmitting surface. The transmitter frequency can be adjusted in digital increments of 1 Hz and is indicated on a display. The acoustic power can also be adjusted by regulating the transmitter voltage of the ultrasonic converter and can be turned on and off separately. The transmitting mode is shown by an indicator lamp. The transmitter voltage is shown on an LCD display. The transmitter output supplies a sinusoidal signal with a maximum amplitude of 40 V. The transmitter frequency can also be output as a TTL signal from a monitor terminal. There is also a suitable voltage output for controlling the red and green laser diodes in the Debye-Sears experiment. This, too, can be turned on and off separately and has its own indicator light. The apparatus automatically detects any laser probe that is connected and adjusts the control voltage accordingly.

Generator frequency:	≤ 20 MHz
Multi-frequency probe:	1 – 13 MHz
Frequency increment:	1 Hz
Signal amplitude:	2 – 40 V
Output:	Transmitter signal (sinusoidal), separately switchable with indicator light, TTL (0 – 5 V, square)
Connection:	Laser diode, adjustable, separately switchable with indicator light
Display:	Voltage/frequency
Power consumption:	approx. 100 VA
Mains voltage:	90 – 230 V, 50/60 Hz
Dimensions:	approx. 256x185x160 mm³

9983-1002576

Test Vessel, Complete

Test vessel made of glass, for conducting the Debye-Sears experiment or projecting ultrasonic waves with divergent light. Lid with probe adjustment via three adjustment screws can be used to produce a stationary wave. A laser fixture with a lens mounting aligned vertically to the sound axis. Includes a plano-convex lens on a square mounting for the projection.

Test vessel:	100x100x120 mm³
Testing volume:	approx. 1 litre
Laser fixture:	18 mm diam.
Lens:	Plano-convex, f = 100 mm, 16 mm diam.

9983-1002578

Laser Diode for Debye-Sears Effect, Red

Laser diode of protection classification II with 1 m connector lead and barrel connector for connecting ultrasonic cw generator (9983-1002576). Fits the laser holder of test vessel (9983-1002578). All lasers have been measured to determine their wavelength specifically and the results are logged.

Wavelength:	approx. 650 nm
Power:	< 1 mW
Supply voltage:	3 V DC
Current consumption:	max. 30 mA
Dimensions:	90 mm x 17 mm diam.

9983-1002577

Laser Diode for Debye-Sears Effect, Green

Laser diode of protection classification IIIa with 1 m connector lead and barrel connector for connecting ultrasonic cw generator (9983-1002576). Fits the laser holder of test vessel (9983-1002578). All lasers have been measured to determine their wavelength specifically and the results are logged.

Wavelength:	approx. 532 nm
Power:	< 5 mW
Supply voltage:	3 V DC
Current consumption:	max. 250 mA
Dimensions:	90 mm x 17 mm diam.

9983-1002579

www.EngineeringBooksPDF.com

Ultrasonic Echoscope

Operational device for conducting ultrasonic experiments in reflection mode (pulse echo principle) or in through-transmission mode with 1 MHz (9983-1002581), 2 MHz (9983-1002582) and 4 MHz (9983-1002583) ultrasonic probes. With the built-in transmission and receiving unit, time gain control (TGC), integrated analogue-digital converter and microprocessor for connection to the measuring and evaluating computer via the USB interface. Connection of the ultrasonic ultrasonic probes via robust snap-in sockets with automatic frequency recognition. Compensation on intensity losses of the transmitted ultrasonic pulse in the test bodies or test liquids using time gain control (TGC) with adjustable threshold value, starting value and location or time-dependent amplification factor. The most important function signals (trigger, TGC, AF signal (amplitude signal), RF signal) are available via BNC sockets on the front of the device. Includes measurement and evaluation software for Windows operating systems. Screen display of the receiver signal (echogram) and the simultaneous TGC signal, whereby the AF and RF signals can be recorded individually or both simultaneously in the echogram as a function of time or penetration depth. Display of all currently set system parameters (transmission power, frequency, gain etc.), Fast Fourier Analysis, depiction of 2-dimensional ultrasonic images (B-image) and the time characteristic of time motion reflection layers (Time-Motion Methods). Ultrasonic transducer not included.

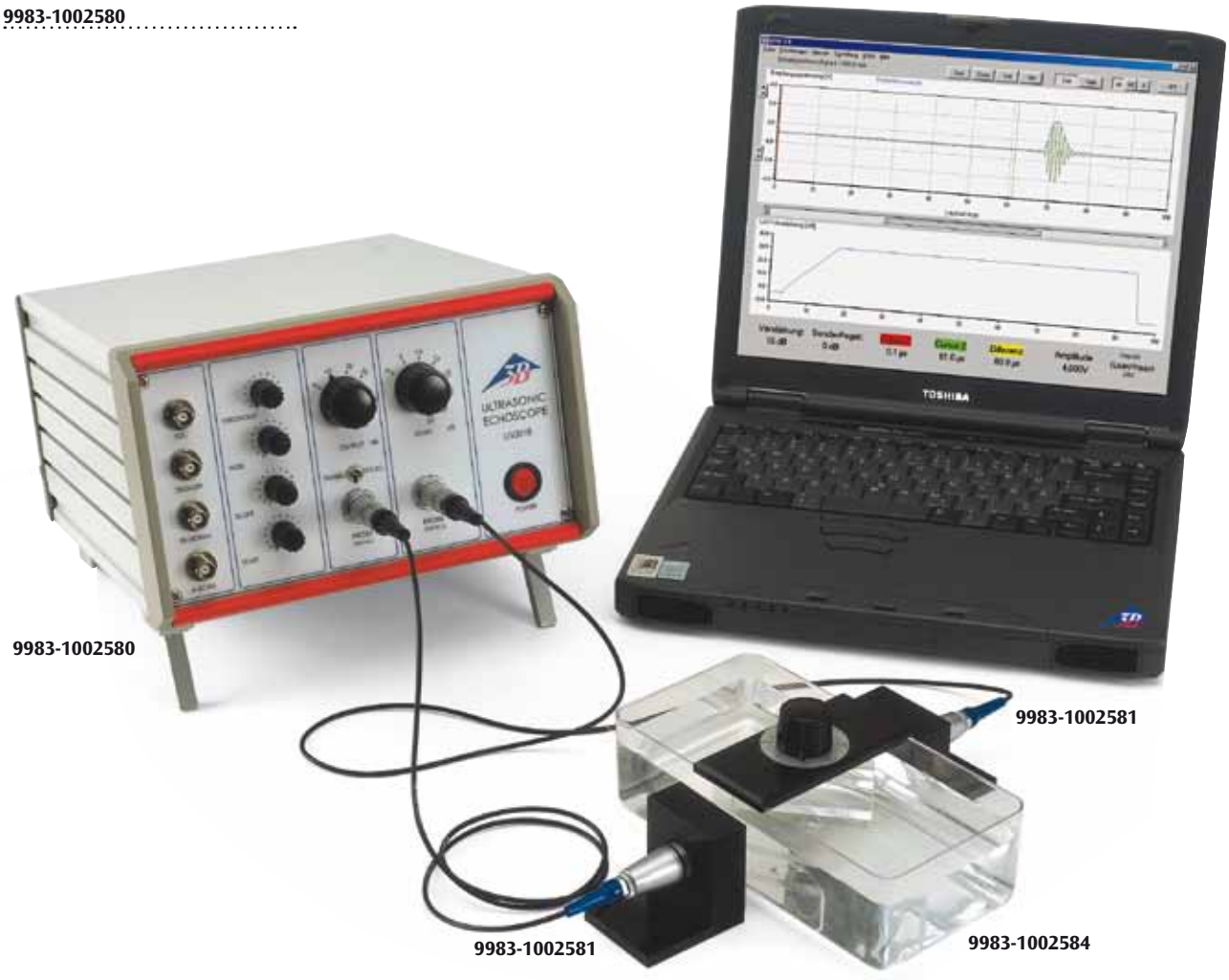
Frequency range:	1 – 5 MHz
Transmission signal:	Dirac pulse (< 1 µs, 10 V to 300 V)
Transmission power:	0 – 30 dB, in 10 dB steps
Gain:	0 – 35 dB, in 5 dB steps
TGC:	Continuously adjustable threshold value, start value, rise time and gain time, Maximum gain of 30 dB
Connections:	TGC signal, trigger, low-frequency signal, high-frequency signal via a BNC socket in each case transmitter and receiver via a snap in socket
PC connection:	USB
Scanning rate:	10 MHz per channel
Power consumption:	approx. 20 VA
Mains voltage:	90 – 230 V, 50/60 Hz
Dimensions:	approx. 256x257x156 mm³

9983-1002580

Experiment Topics:

- Propagation of longitudinal and transverse ultrasonic waves in solid bodies
- Determining velocity of longitudinal and transverse ultrasonic waves in solid bodies
- Determination of shear modulus, modulus of elasticity and Poisson number
- Attenuation of sound in solid bodies and liquids
- Frequency dependence of sound attenuation
- Time-dependent gain
- Frequency dependence of resolution
- Recording brightness images
- Recording ultrasonic echoes from moving boundaries (time-motion mode)
- Measurement of anomalies

Equipment:
9983-1002580 Ultrasonic Echoscope
9983-1002584 Equipment Set “Ultrasound in Solids”
9983-1002581 Ultrasonic Probe 1 MHz (2x)



9983-1002580
9983-1002581
9983-1002581
9983-1002584

www.EngineeringBooksPDF.com



Ultrasonic Probe, 1 MHz

Ultrasonic probe for tests involving large penetration depths or high acoustic power at low depth resolutions. It includes a 16-mm piezo-ceramic disc in a die-cast metal case and a 1-m long cable with a frequency-coded snap-in plug. The equipment is adapted to sound in water/acrylic glass.

Dimensions: 65 mm x 27 mm diam.

9983-1002581

Ultrasonic Probe, 2 MHz

Ultrasonic probe for investigations at medium penetration levels and depth resolution. It includes a 16-mm piezo-ceramic disc in a die-cast metal case, adapted to sound in water/acrylic glass, a 1 m long cable with a frequency-coded snap-in plug.

Dimensions: 65 mm x 27 mm diam.

9983-1002582

Ultrasonic Probe, 4 MHz

Ultrasonic probe for investigations with small penetration depths and maximum depth resolution. It includes a 16-mm piezo-ceramic disc in a die-cast metal case and a 1 m long cable with a frequency-coded snap-in plug. The equipment is adapted to sound in water/acrylic glass.

Dimensions: 65 mm x 27 mm diam.

9983-1002583

Pair of Reflection Blocks with Delay Line

These polished polyacrylate blocks are used to investigate multiple echoes and measure frequency-dependent attenuation. A 4 MHz probe (9983-1002583) is especially suitable for such measurements. An echo pattern comprising at least 3 echoes is recorded, and the spectra of the individual echoes analysed. The result of the analysis is a shift in the average frequency toward lower frequencies, due to a stronger attenuation of the signal's high-frequency components.

Dimensions: 80x40x10 mm³

9983-1002587

Equipment Set "Ultrasound in Solids"

Equipment kit for the investigation of the propagation of longitudinal and transversal waves (shear waves) as well as for the determination of elastic constants (shear modulus, elasticity modulus and Poisson's ratio) in solid bodies. Further for the determination of ultrasonic attenuation in liquids by means of time dependent amplitude measurement with sliding reflector (9983-1002585). Consisting of acoustic basin, polyacrylic test plate in holder with protractor scale and two probe holders to accommodate and precisely position two 1 MHz (9983-1002581), 2 MHz (9983-1002582) or 4 MHz (9983-1002583) ultrasonic probes on the acoustic basin.

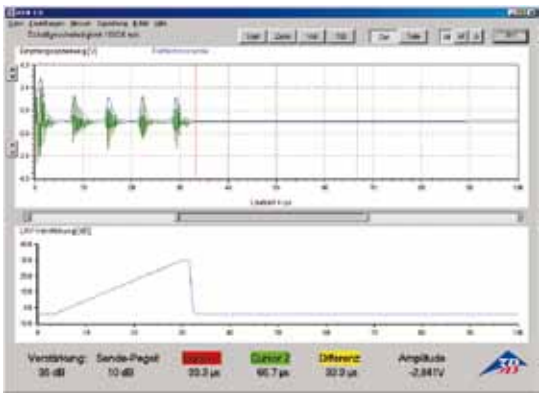
Sound trough: 200x100x60 mm³
Test plate: 104x75x50mm³
Protractor scale: 360°, 5° divisions
Polyacrylate block: 70x45x10 mm³

9983-1002584

Additionally recommended:
9983-1002585 Aluminum Test Block with Protractor Scale
9983-1002586 Polyoxymethylene Test Block with Protractor Scale



9983-1002587



Multiple reflections from a mirror plate

Aluminum Test Block with Protractor Scale

This accessory to equipment set 9983-1002584 for longitudinal and transverse waves is used to examine the propagation of transverse waves in metals and ascertain the elastic constants of aluminum, such as its shear modulus, modulus of elasticity and Poisson ratio. The test block's very high reflectivity with high reflection coefficient in water provides sizeable signal amplitudes for measurements of attenuation in liquids (e.g. water, cooking oil or glycerine).

Protractor scale: 360°, 5° divisions
Aluminum block: 70x45x10 mm³
Dimensions: 104x75x50 mm³

9983-1002585

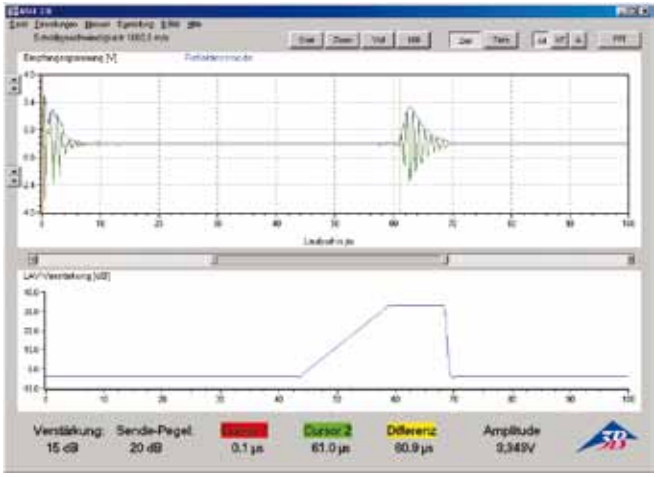
Polyoxymethylene Test Block with Protractor Scale

This accessory to equipment set 9983-1002584 for longitudinal and transverse waves is used to examine the propagation of transverse waves in plastic and ascertain the elastic constants of polyoxymethylene (POM) such as its shear modulus, modulus of elasticity and Poisson ratio.

Protractor scale: 360°, 5° divisions
POM block: 70x45x10 mm³
Dimensions: 104x75x50 mm³

9983-1002586

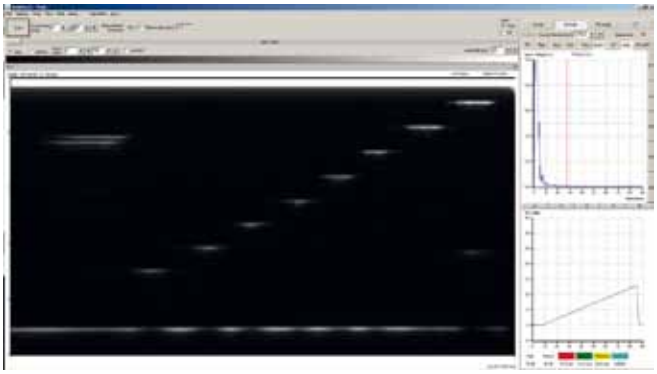
www.EngineeringBooksPDF.com



Pulse echo signal from a hole



9983-1002589



B-image: acrylic body with drilled holes

Acrylic Body with Drilled Holes
Polished polyacrylic block with bores of various diameters and varying distance from the surface to determine the speed of sound and the attenuation of ultrasonic signals in polyacrylate, to localize defects, investigate aberrations resulting from acoustic shadows and ground returns, analyze frequency-dependent resolving power and display manual B-images.
Dimensions: 150x80x40 mm³

9983-1002589

Additionally required:
9983-1002580 Ultrasonic Echoscope
9983-1002581 Ultrasonic Probe 1 MHz
9983-1002583 Ultrasonic Probe 4 MHz
9983-1008575 Ultrasonic Coupling Gel

Heart Model
This double vessel with a rubber membrane and pressure regulator is used to demonstrate movement of the cardiac wall by means of the time-motion technique. In the experiment the membrane vessel produces images similar to the cardiac wall of a beating heart during echocardiography in medical diagnostics.
Dimensions: 160x70 mm²

9983-1002590

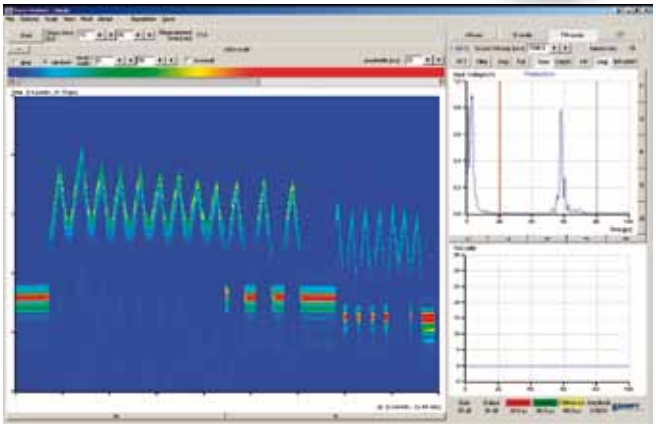
Additionally required:
9983-1002580 Ultrasonic Echoscope
9983-1002583 Ultrasonic Probe 4 MHz
9983-1008575 Ultrasonic Coupling Gel



9983-1002590



9983-1002588



Time motion scan

Set of 3 Cylinders
These polished polyacrylate cylinders are used to ascertain the speed of sound and the attenuation of ultrasonic waves in transparent acrylic. Measurements can be performed in reflection mode or through-transmission mode.
Length : 40 mm, 80 mm and 120 mm
Diameter: 40 mm

9983-1002588

www.EngineeringBooksPDF.com

Model Eye for Ultrasonic Biometry

Model of the human eye, enlarged to a scale of 3 to 1, including the cornea, the lens and glass bodies for demonstrating the fundamentals of ultrasonic biometry. The biometric ratios in the human eye (distance between cornea and lens, thickness of lens, distance between lens and retina) are very well suited to demonstrating measurement using a pulse-echo method with ultrasound. With the help of an ultrasonic echoscope (9983-1002580) and a 2-MHz ultrasonic probe (9983-1002582), typical echoes and the speed of sound can be measured. This allows the geometry of individual objects in the eye to be calculated. A lesion close to the back of the eye becomes apparent due to the diffuse nature of its echo.

Diameter: 80 mm

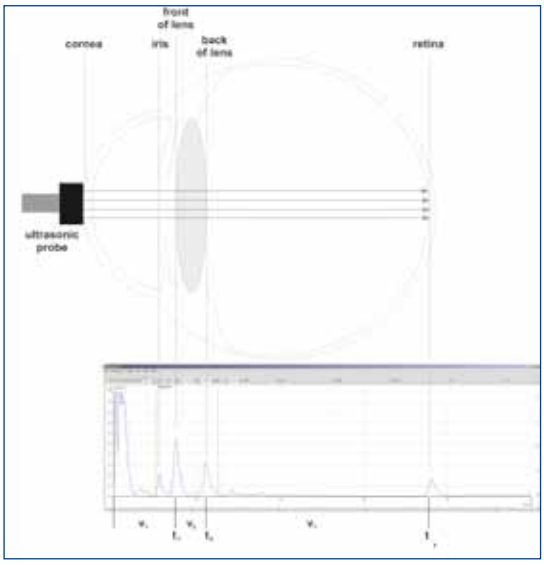
9983-1012869

Additionally required:
9983-1002580 Ultrasonic Echoscope
9983-1002582 Ultrasonic Probe 2 MHz
9983-1008575 Ultrasonic Coupling Gel

Recommended for comparison:
9983-1000259 6-Piece, 3:1 Scale Model of the Human Eye



9983-1012869



A-mode image and schematic diagram of the human eye

Single Breast Model with Benign Tumor

Model of a woman's breast made of 3B SKIN*like*™ silicone with simulated benign tumor for the demonstration of ultrasonic B-image mode.

9983-1000345

Additionally required:
9983-1002580 Ultrasonic Echoscope
9983-1002581 Ultrasonic Probe 1 MHz
9983-1008575 Ultrasonic Coupling Gel



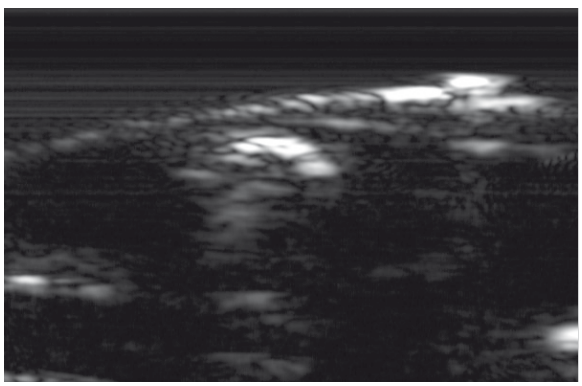
9983-1000345

Ultrasonic Coupling Gel (not shown)

To secure the ultrasonic probes to solid test objects.

Contents: 250 ml

9983-1008575



B-image: breast model

Doppler Phantom Fluid

Phantom fluid with excellent scattering characteristics for ultrasonic waves in the frequency range from 1 – 6 MHz and viscosity calibrated for ultrasonic Doppler experiments. In plastic bottle.

Contents: 1 l
Ultrasonic scattering: 1 – 6 MHz
Colour: blue
Diameter of glass microspheres: 30 – 50 µm

9983-1002574



9983-1002574

www.EngineeringBooksPDF.com

Equipment:
9983-1002571 Ultrasonic Doppler Apparatus
9983-1002582 Ultrasonic Probe 2 MHz
9983-1002572 Set of Doppler Prisms and Flow Tubes
9983-1002573 Riser Tubes for Pressure Measurement
9983-1002574 Doppler Phantom Fluid
9983-1002575 Centrifugal Pump
9983-1008575 Ultrasonic Coupling Gel

Experiment Topics:

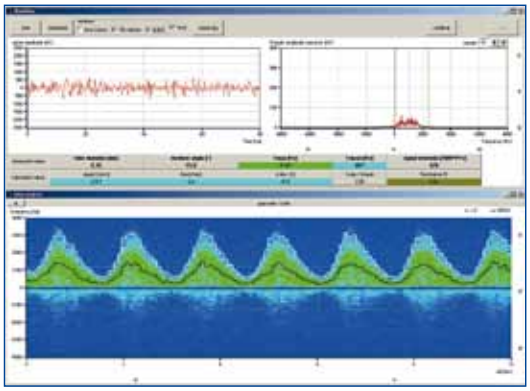
- Investigation of flowing liquids using ultrasonic waves
- Experiments on the Doppler principle
- Measurement of flow velocities
- Demonstration of laminar and turbulent flow
- Experiments on the continuity equation, Bernoulli's equation (static and dynamic pressure) and the Hagen-Poiseuille law (resistance to flow)

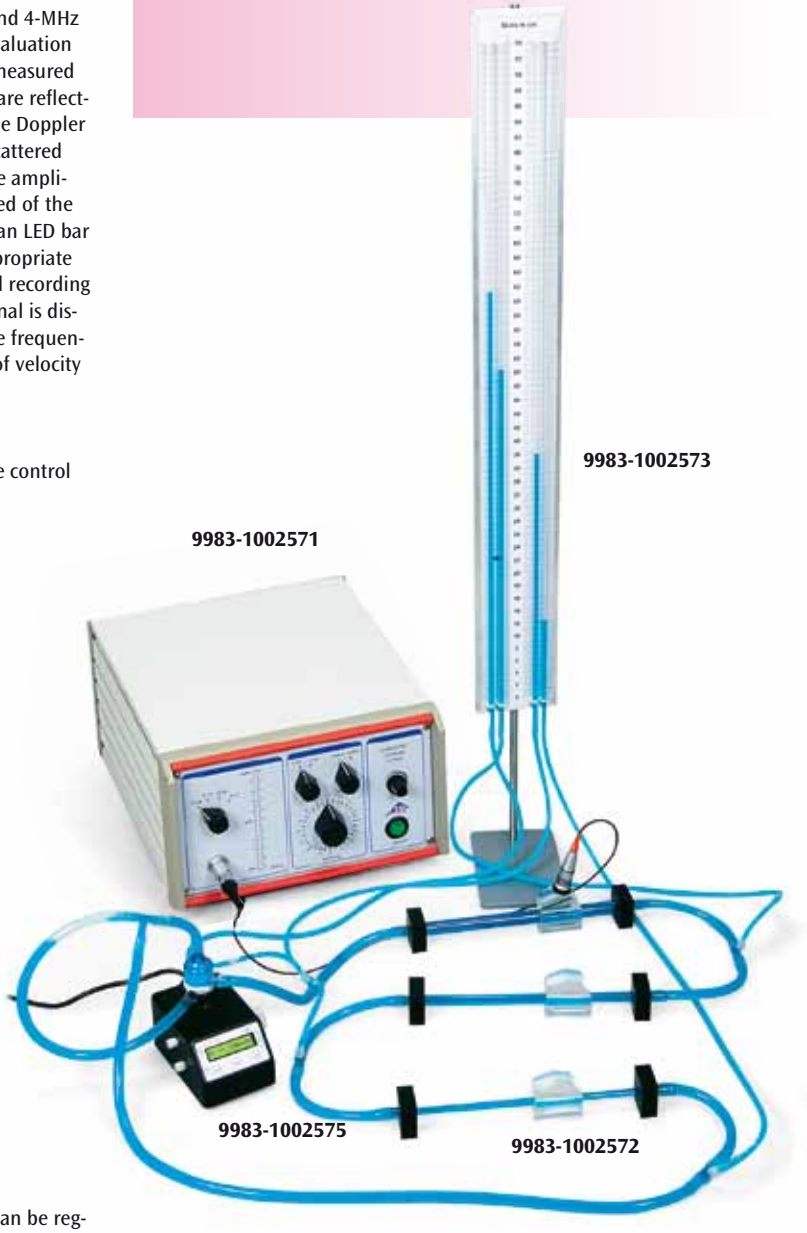
Ultrasonic Doppler Apparatus

Ultrasonic device for carrying out experiments on the Doppler principle, on fluid mechanics and on Doppler sonography in the diagnosis of vascular problems using 1-MHz (9983-1002581), 2-MHz (9983-1002582) and 4-MHz (9983-1002583) ultrasonic probes. Includes measurement and evaluation software for Windows operating systems in order to display the measured signals and colour-coded Doppler spectra. If the radiated waves are reflected or scattered from moving particles or bubbles in fluid flow, the Doppler shift in frequency can be detected. The equipment detects the scattered waves and generates an audio signal at a volume that reflects the amplitude of the reflected signal and a frequency that reflects the speed of the scattering. At the same time, the amplitude is also displayed on an LED bar display. Sensitivity and volume can be adjusted by means of appropriate controls. The controller can also pass on data to a PC for detailed recording and evaluation. During measurement the current LF Doppler signal is displayed. Evaluation is by means of a Fourier transformation in the frequency domain and the result can be interpreted as the distribution of velocity within the flow.

Frequency:	1 MHz, 2 MHz and 4 MHz
Gain:	10 – 40 dB
Display:	LED bar display and acoustic signal with volume control
PC connector:	USB
Mains voltage:	90 – 230 V, 50/60 Hz
Dimensions:	approx. 256x185x160 mm³

9983-1002571





Centrifugal Pump

Pump for transporting liquids at a constant flow velocity which can be regulated continuously to any value and intended for the investigation of flow phenomena with laminar flow profiles. The pump has ⅜" plug-in connectors for insertion into a flow circuit (9983-1002572) or an arm simulator (9983-1012880). The display can be switched to show either speed or flow. The display of the flow can be calibrated to match the flow pressure. For Doppler sonographic experiments using a so-called arm phantom to simulate a real arm, the pump can be set to provide a pulsing flow (to simulate a heart beat) with a variable pulse frequency. This allows ultrasonic signals to be obtained which are typical for vascular diagnosis.

Connectors:	2x ⅜"
Max. flow:	6 l/min
Display:	LCD
Mains voltage:	90 – 230 V, 50/60 HZ

9983-1002575



9983-1002575

www.EngineeringBooksPDF.com

Set of Doppler Prisms and Flow Tubes

Equipment set including plastic tubes and hoses of various diameters for investigating flow phenomena using ultrasonic waves. Includes Doppler prisms for connecting an ultrasonic probe to the tubes or hoses at three different angles.

Contents:
1 Doppler prism ¼"
1 Doppler prism ⅜"
1 Doppler prism ½"
1 Flow tube ¼", 300 mm
1 Flow tube ⅜", 300 mm
1 Flow tube ½", 300 mm
1 Hose ¼", 1000 mm
1 Hose ⅜", 3000 mm
1 Hose ½", 1000 mm
Various hose connectors, T-pieces and accessories

9983-1002572



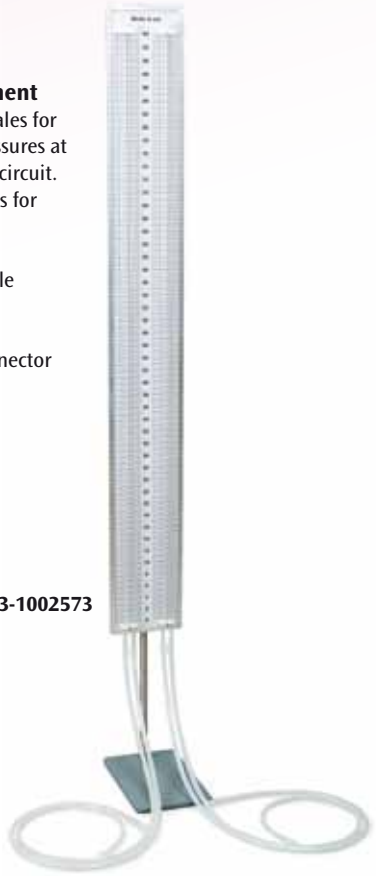
9983-1002572

Riser Tubes for Pressure Measurement

Set of four riser tubes with millimetre scales for measuring the relationship between pressures at up to four measuring locations in a flow circuit. Includes tubing and Luer-Lock connectors for attachment to a flow circuit and stand.

Length:	1000 mm
Connectors:	Luer Lock, male
Length of tubing:	1200 mm
Tubing connector:	⅜" female Luer Lock connector

9983-1002573



9983-1002573

Arm Phantom Set

Model of a human arm for simulating Doppler sonographic examinations of blood vessels. Includes an ultrasonic Doppler probe and so-called phantom fluid for simulating blood. The model features a variety of tubing (simulating blood vessels), including one tube which simulates a blood vessel stricture or stenosis. Using the ultrasonic Doppler apparatus (9983-1002571) and a centrifugal pump (9983-1002575), it is possible to simulate typical examinations used in vascular diagnosis. Doppler spectra are measured for the flow through arteries and veins with both a pulsing flow (like a heart beat) and continuous flow, allowing sounds typical of Doppler sonography to be heard. One particularly interesting feature is the possibility of observing the change in the spectra and the Doppler sound due a stenosis (stricture) in the elbow. In addition, it is possible to calculate the flow index and resistance index from the curves measured with a pulsing flow.

Probe frequency:	2 MHz
Probe dimensions:	200 mm x 15 mm diam.
Length of lead:	1 m

Experiment Topics:

- Doppler sonographic examinations of the human arm
- Measurement of the flow velocity of blood
- Recording of Doppler spectra and pulse curves
- Diagnosis of stenosis (vascular stricture) in an arm



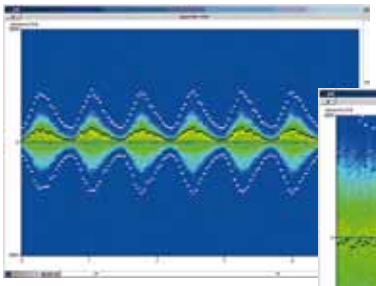
9983-1012880

Includes:
Model arm with stenosis
Silicone tubing
⅜" connectors
Ultrasonic Doppler probe
Phantom fluid to simulate blood, 250 ml
Funnel
Rubber stoppers

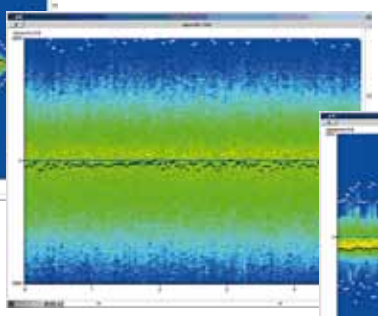
9983-1012880

Equipment:

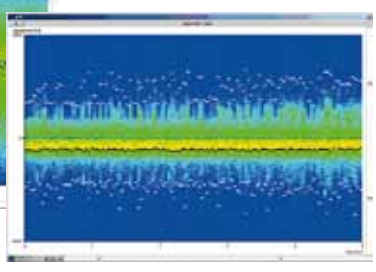
9983-1002571	**Ultrasonic Doppler Apparatus**
9983-1002575	**Centrifugal Pump**
9983-1012880	**Arm Phantom Set**
9983-1008575	**Ultrasonic Coupling Gel**



Doppler spectrum of arterial blood flow



Doppler spectrum of a stenosis (stricture)



Doppler spectrum of blood flow in veins

www.EngineeringBooksPDF.com

Ultrasonic Waves in a Space Saving Table Top Experiment

Experiment Topics:

- Tracing of oscillations over time from a fixed point on the wave
- Investigation of phase shifts between signals using a fixed and a moving microphone
- Recording of points on the wave front on a plane and determination of wavelength
- Relationship between wavelength and frequency and determining the speed of propagation of a wave
- Recording of circular wave fronts from a point source
- Recording of linear wave fronts after reflection from a concave semi-circular mirror
- Diffraction by a double slit
- Interference between two beams of ultrasonic waves
- Michelson interferometer using ultrasonic waves
- Absorption and reflection of ultrasonic waves
- Interference by a Lloyd mirror
- Interference between ultrasonic waves of not quite equal frequency
- Doppler effect (determination of differential frequency)

SW Ultrasonics Set
Equipment package for demonstrating the basic properties of waves using 40-kHz ultrasonic waves as an example in a space-saving, table-top experiment. Two rod-shaped microphone probes are used to record and analyse oscillations with the help of a standard oscilloscope. An ultrasonic pen can be used to record wave fronts in the plane of the table as lines of equal phase (isophases).

Contents:
1 Operating unit US
2 Ultrasonic transmitters 40 kHz
2 Microphone probes
1 Ultrasonic pen
1 Concave semi-circular mirror
2 Ultrasonic blocks/mirrors
1 Set for double slit
1 Ultrasonic semi-silvered mirror
1 Ultrasonic absorber
2 BNC cables
1 Cable, BNC/4-mm safety sockets
1 Plug-in power supply 12 V AC, 700 mA

SW Ultrasonics Set (230 V, 50/60 Hz)
9983-1012845

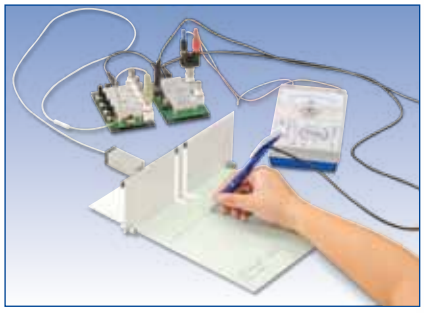
SW Ultrasonics Set (115 V, 50/60 Hz)
9983-1012846

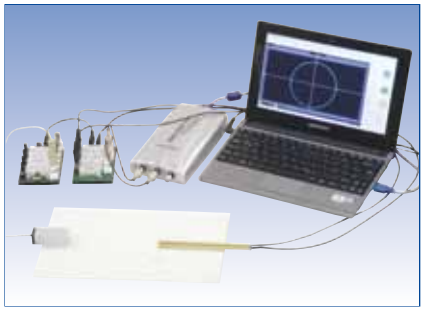
Additionally recommended:
9983-1012879 USB Oscilloscope 2x40 MHz
or
9983-1008695 Analogue Oscilloscope 2x20 MHz

9983-1006810 Multimeter Escola 10

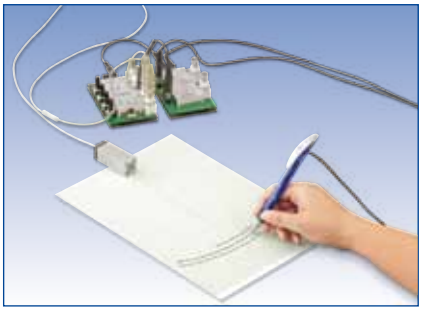


9983-1012845
9983-1012846

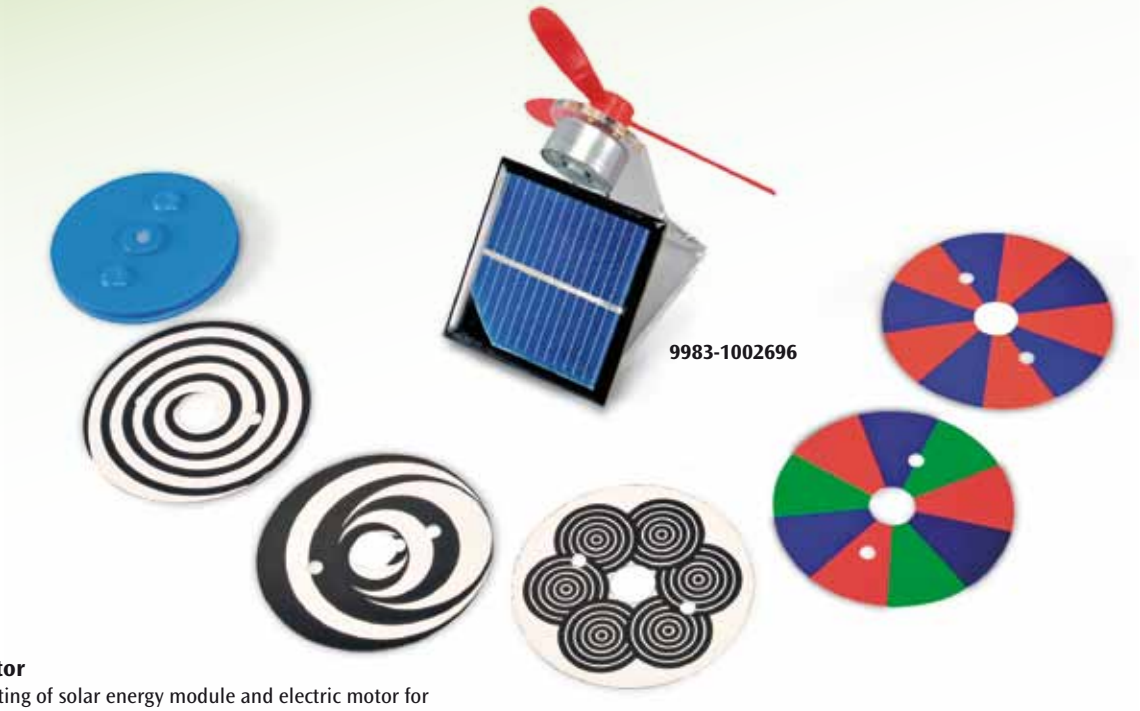








www.EngineeringBooksPDF.com



9983-1002696

Solar Electric Motor

Compact unit consisting of solar energy module and electric motor for demonstrating the conversion of light energy into electrical energy. Mounted on angled transparent acrylic base. A propeller is attached to the electric motor to make its rotation clearly visible. As an alternative to that, rotating discs are provided for demonstrating the phenomena of optical illusions or colour mixing effects.

No-load voltage for solar module: 0.5 V
Short-circuit current for solar module: 350 mA
Starting current for electric motor: 20 mA

9983-1002696

Halogen Lamp – 500 W

Strong light source for experiments, e.g. for use with solar energy basic kit (9983-1000839). With handle.

Halogen Lamp 500 W (230 V, 50/60 Hz)

9983-1000894

Halogen Lamp 500 W (115 V, 50/60 Hz)

9983-1000893

Additionally required:
9983-1002835 Stand Base

Spare Bulbs for Halogen Lamp – 500 W (230 V, 50/60 Hz)

9983-1003536

Spare Bulbs for Halogen Lamp – 500 W (115 V, 50/60 Hz)

9983-1003535

Solar Energy Basic Kit

Set of equipment including four test bodies with different surface coating, heat insulators and covers for experiments on the utilisation of solar energy. Four series of measurements that can be completed in approximately 25 minutes elucidate the temperature characteristics and peaks of the test bodies when exposed to sunlight. The kit comes in a robust storage case.

Storage capacity: approx. 365x310x70 mm³
Weight: approx. 1 kg

Contents:
4 Solar measuring bodies, each of a different colour
2 Insulating housings
2 Mounts for the measuring bodies
1 Transparent acrylic plate
4 Thermometers, -10 – +110° C

9983-1000839

Additionally required:
9983-1000894 Halogen Lamp, 500 W (230 V, 50/60 Hz)
or
9983-1000893 Halogen Lamp, 500 W (115 V, 50/60 Hz)



9983-1000894



9983-1000839

www.EngineeringBooksPDF.com



9983-1000840



9983-1000824

Bolometer

Designed to measure heat radiation from the sun, this device consists of an aluminium tube with a blackened front enclosed in a cardboard tube blackened on the inside. Includes a borehole for a thermometer.

Aluminium tube:	30 mm x 40 mm diam. approx.
Cardboard tube:	195 mm x 50 mm diam. approx.
Weight:	350 g approx.

9983-1000840 .....

Additionally required:
9983-1003527 Thermometer, +10 – +30° C
9983-1002833 Universal Clamp
Stand Equipment

Moll-Type Thermopile

Sensitive probe for measuring heat radiated by a black body or Leslie's cube, as well as for detecting visible light and ultra-violet radiation. Comprises a metal housing with a polished, conical reflector and a black surface 15 mm in diameter with 17 linked thermocouples. With two 4 mm connectors mounted on a stem.

Sensitivity:	approx. 0.28 mV/µW
Internal resistance:	approx. 1 Ω
Setting duration:	40 s (95 %)
Tripod:	156 mm x 10 mm diam.
Dimensions:	94 mm x 40 mm diam.
Weight:	approx. 200 g

9983-1000824 .....

Greenhouse Effect Kit

A set of equipment permitting quick and easy experiments to demonstrate the effect of greenhouse gases on the absorption of infra-red radiation. Solar radiation received by the earth is simulated here by means of short-wave infrared radiation that is attenuated by absorption in water and visible light from a reflector lamp. Infra-red radiation emitted by the earth is simulated by heating a black metal disc. Both types of radiation are made to pass through air or butane gas in a metal tube and subsequently registered with a thermopile. Comparison of the obtained values reveals that long-wave infra-red radiation is absorbed to a high degree by butane gas. Consequently butane gas released into the atmosphere causes it to heat up, i.e. butane gas is a greenhouse gas.

Contents:
1 Base plate
1 Lamp holder with reflector lamp
1 Cuvette on stem
1 Black metal disc
1 Metal tube, simple
1 Metal tube, with taps
2 Mounting stems
1 Silicone hose
1 Storage case

Greenhouse Effect Kit (230 V, 50/60 Hz)

9983-1000837 .....

Greenhouse Effect Kit (115 V, 50/60 Hz)

9983-1009764 .....

Additionally required:
9983-1000824 Thermopile
9983-1006810 Multimeter ESCOLA10
Butane (lighter gas)



9983-1000824

9983-1000837
9983-1009764

www.EngineeringBooksPDF.com

Tomorrow's Energy Carriers

Fuel cells, electrolysers, solar hydrogen technology – significant contributors to a sustainable energy supply in the future: preservation of the environment and resources while maintaining today's standard of living. Now you can demonstrate the mode of operation of this fascinating technology to your students. Pure water is broken down by means of electrolysis into hydrogen and oxygen for the purpose of energy storage with the help of regenerative energy. During reconversion of the gases in a fuel cell, electricity, heat and water are formed. The resolute use of membrane technology in the training and demonstration systems does away with the use of corrosive liquids and only distilled water is required.

Fuel Cells Car

Fascinating working model of a hydrogen-fuel cell car. Designed for graphic demonstration of the practical use of hydrogen technology and a pioneering drive system.

Special features:

- Robust design guarantees long working life
- Simple to operate
- Only distilled water and no corrosive fluids required
- Acrylic glass construction permits good visibility and thus better understanding of how fuel cells actually work

Fuel cells are essential components of a sustainable energy supply of the future which will ensure that modern living standards are maintained while also preserving our environment and natural resources. To store energy for regeneration, pure water is broken down into its components, hydrogen and oxygen, by means of electrolysis. Current, heat and water are produced when the gases are recombined in the fuel cell. The power is used to drive a vehicle at a speed of approx. 20 cm/s. The hydrogen fuel cell's efficiency is about twice as high as that of a combustion engine. After being filled up with distilled water and connected to the mains via the plug-in power supply (alternatively the solar module or battery box) the vehicle is ready to drive after just two minutes.

Power:	1 W (during electrolysis), 500 mW (fuel cell operation)
Gas storage cell:	30 cm^3 H_2, 30 cm^3 O_2
Charging time:	approx. 2 min (with plug-in power supply)
Driving time:	approx. 8 min
Speed:	approx. 20 cm/s
Plug-in power unit:	100 V up to 240 V, 50/60 Hz
Solar module:	2 V, 0.6 A
Battery box:	4,5 V, 0,8 A
Dimensions:	approx. 100x115x260 mm^3
Weight:	approx. 1.3 kg

9983-1002692

Fuel Cell Demonstration System

Model showing the function of a hydrogen solar cell consisting of:

- Solar module
- PEM electrolyser
- Hydrogen and oxygen accumulators
- PEM fuel cell
- Fan

Conveniently arranged on a baseplate.

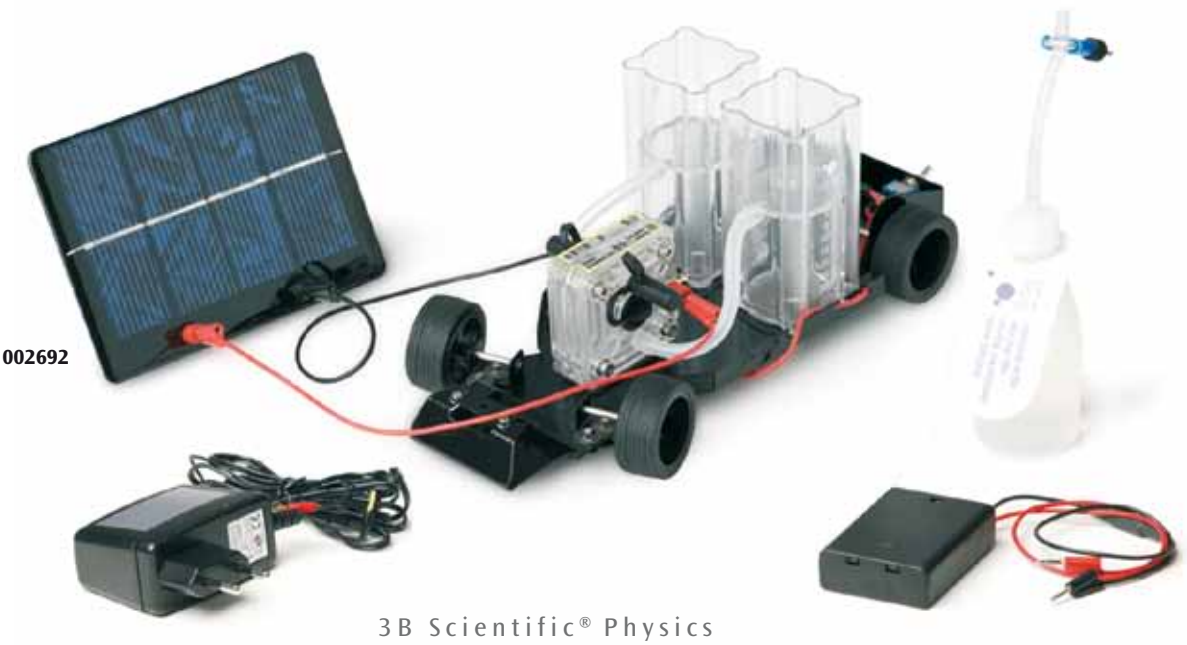
Solar module:	2.0 V / 350 mA
Electrolyser:	1 W
Fan output:	10 mW
Dimensions:	approx. 100x300x150 mm^3
Weight:	approx. 600 g

9983-1002689



9983-1002689

For your Safety:
Exclusive use of distilled water. No corrosive electrolytes such as potassium hydroxide (KOH).



9983-1002692

www.EngineeringBooksPDF.com

H-Racer

Global prize winning fuel-cell racing car, reflecting in miniature the dreams of all those developing the vehicles of the future, i.e. an electric racer powered by fuel cells. The only thing needed to operate the vehicle is water, which is electrolysed by solar energy at a hydrogen fuelling station in order to generate hydrogen. Some parts of this kit need to be assembled by customers themselves.

Includes:
1 Car with fuel cell
1 Hydrogen station with solar cell and battery box for 2 1.5-V AA batteries
1 Remote control unit
Connecting tubes and accessories

9983-1008699

Additionally required:
2 Batteries, 1.5V AA
Distilled water
Cross-head screwdriver



Hydrogen Car

Self-contained car with reversible fuel cell. Current to electrolyse water, in order to make hydrogen and oxygen for the fuel cell, can be provided either by the supplied solar cell or by a battery. Since the tanks are transparent, it is possible to watch the conversion process. Some parts of this kit need to be assembled by customers themselves.

Includes:
1 Car with fuel cell
1 Oxygen tank, transparent
1 Hydrogen tank, transparent
1 Solar cell
1 Battery box for 2 1.5-V AA batteries
Connecting tubes and accessories

9983-1008700

Additionally required:
2 Batteries, 1.5V AA
Distilled water



"Solar Hydrogen" Kit

Inexpensive set for demonstrating solar fuel-cell technology, consisting of a solar-powered fuel cell, gas reservoirs, solar module and a motor with propeller. Includes a battery box as an alternative power supply to the fuel cell. Batteries not included. Some components must be assembled by the user.

Contents:
1 Fuel cell
1 Solar cell
1 Motor with propeller
1 Gas reservoir for hydrogen
1 Gas reservoir for oxygen
2 Experiment leads, 2 mm
1 Battery box for 2 batteries, 1.5 V AA
Connecting tubes and accessories

Technical data for fuel cell:

Dimensions:	54x54x17 mm³ approx.
Weight:	70 g approx.
Electrolytic operation:	
Voltage:	1.8 V – 2.6 V
Current:	0.7 A (over 2 V)
Hydrogen production:	7 ml/min
Oxygen production:	3.5 ml/min
Fuel cell operation:	
Output voltage:	0.6 V DC
Output current:	360 mA
Power:	210 mW



Technical data for solar cell:

Dimensions:	125x155x8 mm³ approx.
Max. output voltage:	2.2 V DC
Max. output current:	1.1 mA

9983-1008702

Additionally required:
2 Batteries, 1.5 V, AA
Distilled water

www.EngineeringBooksPDF.com

9983-1010233



9983-1002877



Hygrometer F

Hygrometer in a metallic box with indication of the relative humidity.

Measuring range:	20 to 100% relative humidity
Diameter of the dial:	98 mm

9983-1010233

Precision Hair Hygrometer

Hygrometer for measuring the relative air humidity, consisting of a round plastic housing with a human hair as the measuring element. The specially treated hair exhibits an almost inertia free response to changes in humidity. Wall mountable.

Measuring range:	0% – 100% relative humidity
Temperature range:	- 35° C – + 65° C
Reading accuracy:	± 5%
Diameter:	100 mm

9983-1002877

9983-1002795



9983-1003011



Digital Hygro-Thermometer

Digital measuring device for displaying exterior and interior temperature and humidity. With min/max function and acoustic signal if exterior temperature drops to or below zero, switchable between °C and °F, on/ off button, eyelet for hanging up and fold-out stand.

Measuring range:	
Temperature (interior):	0° C – 50° C / 32° F – 122° F
Temperature (exterior):	-50° C – 70° C / -58° F – 158° F
Humidity:	20% – 99%
Divisions:	0.1° C/F, 1%
Accuracy (temp.):	±1° C / ±2° F
Accuracy (humidity):	±3%
Exterior temperature sensor:	Cable length 3 m

9983-1003011

9983-1002878



Infrared Temperature and Humidity Gauge

Digital measuring device for contact-free temperature measurement from large distances, e.g. of hot or moving objects or inaccessible points of measurement, and for simultaneous humidity display. With laser diode as detection aid, integrated in the measuring probe, illuminated LCD display, max and data-hold function, switchable between °C and °F, automatic switch-off. Includes pouch and battery.

Measuring range, temperature:	-50° C – +500° C; -58° F – +932° F
Divisions:	0.1° C/F
Accuracy:	±2% of measured value ±2° C / 4° F
Measuring range, humidity:	5% – 95%
Divisions:	0.1%
Accuracy:	±3.5%
LCD dual-function display:	3½-digit, 21 mm with backlighting
Voltage supply:	9 V battery
Dimensions:	approx. 90x170x45 mm³
Mass:	approx. 360 g

9983-1002795

9983-1002627



Demonstration Aneroid Barometer

Barometer for measuring air pressure and demonstrating how an aneroid barometer operates. The measurement system consists of two flat, highly-evacuated metal cans which deform in response to changes in the air pressure. This deformation is indicated by a pointer. The pointer mechanism and metal cans are situated behind a glass cover for easy observation. By pumping the attached rubber ball the action caused by the air pressure changes can be demonstrated.

Measuring ranges:	955 mbar up to 1070 mbar, scale division 1 mbar 715 mmHg up to 800 mmHg, scale division 1 mmHg
Scale diameter:	120 mm
Housing diameter:	130 mm
Weight:	650 g

9983-1002627

Maximum-Minimum Thermometer

Reading of maximum, minimum and instantaneous temperature. In plastic housing with reset button and hanging strap. Mercury filling.

Measuring range:	- 38° C – 50° C
Divisions:	1° C
Dimensions:	approx. 230x85 mm²

9983-1002878

www.EngineeringBooksPDF.com

Digital Pocket Anemometer

Waterproof anemometer for measuring wind speed. Indication of wind chill temperature based on the combination of air temperature and wind speed. Indication of mean and maximum speeds. Wind curves on the Beaufort scale. Supplied with closeable cover.

Wind speed:	0,2 … 30 m/s
Accuracy:	±5% of mean wind speed
Units:	km/h, m/h, m/s or knots
Temperature:	-30° to +59°C
Battery:	3.0 V (CR2032)
Dimensions:	137x50x18 mm³

9983-1010250



9983-1010250

Aneroid Barometer F

Aneroid Barometer in a metallic box with altitude adjustment screw at the rear. Graduations in mm of mercury and hPa.

Diameter of the dial: 98 mm

9983-1010232



9983-1010232

Wireless Weather Station

Weather station with wireless detection of external temperatures from up to three sensors situated at distances of up to 25 m. Display of internal temperature and humidity. Features switchable °C/°F display, min/max function, weather forecasting, trend displays for air pressure and radio-controlled clock with date function. Supplied with one external temperature sensor, two 1.5-V AA batteries and two 1.5-V AAA batteries. Silver/grey housing. Can be suspended or set up on a surface.

External temperatures:	-30°C … +70°C
Internal temperatures:	0°C … +60°C
Humidity:	1 … 99%

9983-1010248



9983-1010248

NEW

Noise: the World's no. 1 Pollutant

Noise

- Damages hearing
- Makes it more difficult to hear genuinely important signals
- Impedes both physical and mental work
- Disturbs and adversely affects well being
- Disturbs relaxation and sleep
- Can cause chronic stress, physical ailments and illness



9983-1012741

Noise Level Indicator SPL

Handy and easy-to-use noise level meter with digital display in decibels (dB) and an arbitrarily adjustable trigger threshold for use as a traffic-light style noise indicator with a happy green face and a sad red face. Can be mounted on a wall or set up on a table top. Its well-conceived compact design makes it easy to transport. Automatically switches to electricity-saving stand-by mode when noise is low for a long period. The brightness of the display can also be adjusted. Includes a stand base, USB/miniUSB cable, USB power supply and transport case.

Display:	100 mm diam, with LED
Measuring range:	40 dB to 130 dB
Resolution:	1dB
Thresholds for colour display:	Adjustable to any level in steps of 1 dB
Power supply:	5 V DC via miniUSB socket
Power consumption:	150 mA (normal operating mode) <1 mA (stand-by)
USB power supply:	100 – 240 V, 50/60 Hz
Dimensions:	130x145x12 mm³
Weight:	400 g approx.

9983-1012741





www.EngineeringBooksPDF.com



Thermometer Clip
Stainless steel clip for holding thermometers in beakers.

9983-1003528



9983-1003527

9983-1002881



9983-1002880
9983-1002879



9983-1003384
9983-1003385
9983-1003386
9983-1003387

9983-1003525



9983-1003526

9983-1003013



9983-1003014



9983-1000551



9983-1000550

Temperature Sensor, Pt100
Temperature sensor for the measurement of temperatures in organic liquids, solutions of salts, acids, and bases. The stem and tip of the temperature sensor are of stainless steel. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-50°C – 150°C
Resolution:	0.1° C
Accuracy:	0.1% of measured value plus 0.25°C
Sensor cable:	1 m, with silicone insulation
Sensor type:	Pt100 thermocouple

9983-1000550



9983-1002804

9983-1002805

Temperature Sensor, TC – K
Temperature sensor for the measurement of extremely low and extremely high temperatures, for example in liquid nitrogen or liquid oxygen, or inside a flame. With room temperature compensation. The immersible NiCr-Ni sensors (9983-1002804 and 9983-1002805) can also be connected to the sensor box. Can be used in conjunction with a 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-270°C to 400°C
Accuracy:	0.2% plus 3°C (-270°C – 0°C) 0.1% plus 2°C (0°C – 400°C)
Resolution:	1°C
Sensor type:	NiCr-Ni (type K)
Sensor length:	60 cm approx.

9983-1000551

Digital Quick-Response Pocket Thermometer
For instantaneous measurements on surfaces, in liquids, soft plastic media, air/gases, very small objects. For connection to a K-type NiCr-Ni measurement sensor. Sensor not included in scope of supply.

Measuring range:	-65° C – 1150° C / -85° F – 1999° F in 2 ranges
Division:	0.1° C / 1° C/F
Accuracy in lowest range:	0,05% of measured value ±0,2% FS
Display:	3½-digit LCD display, 13 mm in height
Dimensions:	106x67x30 mm³
Mass:	approx. 135 g

9983-1002803

Additionally required:
9983-1002804 K-Type NiCr-Ni Immersion Sensor, -65° C to 550° C
or
9983-1002805 K-Type NiCr-Ni Immersion Sensor, -200° C to 1150° C

www.EngineeringBooksPDF.com

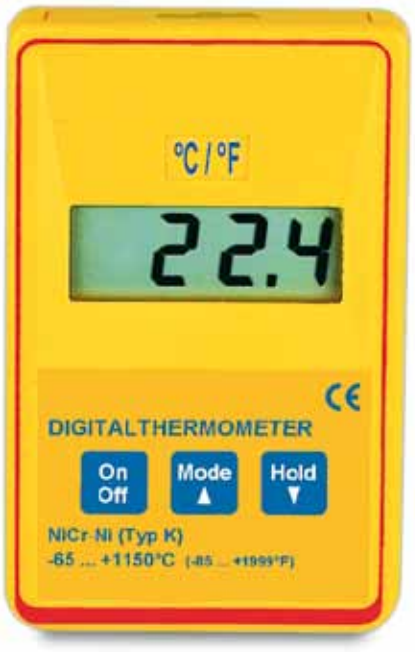
Art. No.	Scale division	Measuring range	Scale division	Dimensions	Remarks
9983-1003527	**Thermometer**	+10° – 30°C	0.2°C	140 mm x 6 mm diam.	Tube type, white coated capillary, red alcohol filling.
9983-1002881	**Pocket Thermometer**	-10° – 110° C	1° C	165 mm x 10 mm diam.	Tube type, scale on white background, special red filling, in yellow plastic protective case with clip.
9983-1002879	**Tube Thermometer, graduated**	-10° – 110° C	1° C	260 mm x 6 mm diam.	Glass thermometer with eyelet, scale on white background, special red filling, in transparent square plastic case.
9983-1002880	**Tube Thermometer, not graduated**	–	–	260 mm x 6 mm diam.	For demonstrating function and mode of operation of thermometers. Like 9983-1002879 but without scale.
9983-1003384	**Thermometer**	-20° – 110° C	1° C	295 mm x 6.3 mm diam.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
9983-1003385	**Thermometer**	-10° – 150° C	1° C	295 mm x 6.3 mm diam.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
9983-1003386	**Thermometer**	20° – 110° C / 0° – 230° F	1° C/F	295 mm x 6.3 mm diam.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
9983-1003387	**Thermometer**	-20° – 150° C / 0° – 300° F	1° C/F	295 mm x 6.3 mm diam.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
9983-1003525	**Thermometer**	-10° – 200° C	1° C	300 mm x 6 mm diam.	Rod-shaped general-purpose thermometer, white-coated capillary, red indicator liquid, total immersion depth.
9983-1003526	**Rod Thermometer**	-10° – 100° C	1° C	350 mm x 8 mm diam., Length of rod: 150 mm	Rod thermometer with internal scale made of frosted glass, prismatic capillary tube and red liquid.
9983-1003013	**Stable Tube Type Thermometer**	-1° – 101° C	0.2° C	460 mm x 7 mm diam.	Stable tube type thermometer with biodegradable special blue filling, scale on yellow background, with eyelet.
9983-1003014	**Demonstration Thermometer**	-10° – 110° C	1° C	650 mm x 30 mm diam.	Extra-large tube type thermometer with biodegradable special blue filling, easy-to-read scale on yellow background.

K-Type NiCr-Ni Immersion Sensor, -65° C to 550° C
Temperature measurement sensor with stainless steel (V4A)-tube, spring-mounted (rigid) and silicone cable.
Measuring range: -65° C – 550° C
Response time: approx. 3 s
Tube: 130 mm x 1.5 mm diam.

9983-1002804

K-Type NiCr-Ni Immersion Sensor, -200° C to 1150° C
Sheath thermocouple with stainless steel (Inconel) tube, flexible and silicone cable.
Measuring range: -200° C – 1150° C
Response time: approx. 3 s
Tube: 150 mm x 1.5 mm diam.

9983-1002805



9983-1002803

www.EngineeringBooksPDF.com

NEW



9983-1010219



9983-1003334

Insertion Thermometer

For measuring the temperature in air, liquids and soft materials. Temperature sensor made of stainless steel with protective case, switchable between °C and °F, On/Off switch and automatic switch-off.

Measuring range:	-50° C – 150° C / – 58° F – 302° F
Division:	0.1° C/F
Accuracy:	±1° C / ±2° F
Temperature sensor:	130 mm x 4 mm diam.
Mass:	29 g

9983-1003334

Insertion Thermometer F

Waterproof digital thermometer with a 125 mm long sensor to measure the temperature of liquid, pulverulent and soft substances. With memory function, min/max function, reversible °C/°F. Plastic casing, clip and LR 44 button battery included.

Measuring range:	-40 – +200°C
Accuracy:	±0.8 degree (from 0 – 100°C), ±1 degree (from -20 – 0°C), ±1.5 degree (others)
Measurement interval:	1 s
Dimensions:	205x20x17 mm³
Mass:	56 g

9983-1010219

Digital Thermometer, Min/Max

Insertion thermometer with Hold and Min/Max function in robust plastic housing and temperature sensor made of stainless steel. Switchable between °C and °F, On/Off switch, hanging strap and folding angled support.

Measuring range:	-50° C – 200° C / -58° F – 392° F
Division:	0.1° C/F
Dimensions:	95x65x20 mm³
Cable length:	1400 mm
Measurement probe:	120 mm

9983-1003010



9983-1003010

Digital Pocket Thermometer

Temperature sensor made of stainless steel with protective case, watertight, switchable between °C and °F, Min/Max/Hold function, automatic switch-off.

Measuring range:	-40° C – 200° C / -40° F – 392° F
Division:	0.1° C/F
Accuracy:	±1° C / ±2° F
Dimensions:	150x20x18 mm³
Mass:	20 g

9983-1003335



9983-1003335

www.EngineeringBooksPDF.com

Infrared Thermometer

Surface thermometer for contactless temperature measurement from a safe distance, e.g. in inaccessible places, hot or moving objects. With laser diode for laser sighting, illuminated LCD display, range overflow display, measured value storage function, selection between Celsius and Fahrenheit, automatic switch off. Includes bag and battery.

	9983-1002791	9983-1008630
Designation	Infrared Thermometer, 800° C	Infrared Thermometer, 380° C
Measuring range	-50° C – +800° C -58° F – +1472° F	-50° C – 380° C -58° F – 716° F
Division	0.1° C/F	1° C/F
Accuracy	±1% of measured value ±1° C / 1.8° F	2% of measured value +2° C / 4° F
Response time	150 ms	< 1 s
Optical resolution	20:1	12:1
Max. temperature display	yes	–
Alarm function	high/low	–
Voltage supply	9 V battery	9 V battery
Dimensions	146x43x104 mm³	160x82x45 mm³
Mass	approx. 170 g	approx. 180 g



9983-1002799



9983-1002791 9983-1008630

Digital Thermometer Type K/IR

Digital two channel thermometer with two K- type inputs and additional external infrared sensor. Can also be used for measurements at low temperatures. With automatic shut off, maximum value storage and data hold function. Includes case, 2 K-type thermocouple sensors, infrared temperature sensor, 9 V battery and instruction manual.

Measurement inputs:	2x K-type, external IR input
Measuring functions:	T1, T2, T3, T1-T2, T1-T3, T2-T3
Measuring range:	-200 – 1372°C (type K), -30 – 550°C (IR)
Measurement error:	±0.5% + 2°C (type K), ±2.5% +2°C (IR)
Resolution:	0.1°C
Unit of measurement:	°C or K
Emission factor:	0.95 fixed
Digital display:	3¾ digit LCD
Background lighting:	blue
Operating voltage:	9 V battery
Dimensions:	75x200x50 mm³ approx.
Mass:	280 g approx.

9983-1002799

	9983-1002793	9983-1002794
Designation	Digital Thermometer, 1 Channel	Digital Thermometer, 2 Channels
Measuring range	-50° C – +1300° C -58° F – +2000° F 223 K – 2000 K	-50° C – +1300° C -58° F – +2000° F
Division	0.1° C/F, 1 K	0.1°C/F
Accuracy	±0.5% +1° C / +2° F ±1% +2 K	±0.5% +1° C / +2° F
Display	3½-digit illuminated LCD	3½-digit illuminated LCD
Digit size	21 mm	21 mm
Voltage supply	9 V battery	9 V battery
Dimensions	approx. 90x170x45 mm³	approx. 90x170x45 mm³
Mass	approx. 350 g	approx. 350 g

Digital Thermometer

Versatile digital thermometer for type-K temperature sensors with single or dual input (9983-1002794) for measuring instantaneous or differential temperature (T1 – T2 9983-1002794). With storage of maxima and Data-Hold function. Includes type-K temperature sensor (9983-1002794 2x), battery, holster and carrying bag.



9983-1002793 / 9983-1002794

www.EngineeringBooksPDF.com

Heat Equivalent Apparatus

Apparatus for determining the specific heat capacity of aluminum and for confirming the energy conservation law. The robust heat equivalent apparatus consists of a shaft with ball bearings at both ends, an integrated counter for measuring the number of revolutions performed and an attached table clamp for securing the device. The aluminum calorimeter body heats up as a result of frictional work or electrical energy from the integrated heating element. An NTC thermistor, acting as a temperature sensor and located in an aluminum case, determines the temperature. The calculation can be performed easily using the temperature calibration table printed on the apparatus.

Length:	230 mm
Span of the table clamp:	10 – 65 mm span
Cord length:	approx. 1.80 m
Calorimeter body:	50 mmx48 mm diam.
Electric heater power:	10 V, 1 A
Heating element connection:	via 2 mm sockets
Weight calorimeter:	250 g
Total mass :	approx. 1200 g

Contents:
1 Basic unit
1 Aluminum calorimeter
1 Temperature sensor
1 Pair of adapter cables with 4 mm safety plugs / 2 mm plugs
1 Friction belt
1 Bucket, 5 l
1 Counterweight

9983-1002658

Additionally required for temperature measurement:
9983-1002781 Digital Multimeter

Additionally recommended:
9983-1003312 DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)
9983-1002659 Copper Calorimeter



See physics experiments catalogue

Immersion Heater, 12 V

Sheathed heater suitable for the metal block calorimeters (from 9983-1003253).

Operating voltage:	max. 12 V
Power:	max. 50 W (nominal)
Tubing:	150 mm long
Heated section:	70 mm
Electrical connection:	4 mm sockets

9983-1003258

Additionally required:
9983-1003312 DC Power Supply Unit 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply Unit 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



Copper Calorimeter

Calorimeter body for the heat equivalent device for determining the specific heat capacity of copper. With borehole for holding temperature sensor and with integrated heating element.

Electric heater power:	10 V, 1 A
Heating element connection:	via 2 mm sockets
Dimensions:	50 mm x 48 mm diam.
Mass:	750 g

9983-1002659


9983-1002659

Additionally required
9983-1002658 Heat Equivalent Apparatus

Set of 4 Calorimeter Cylinders

Four cylindrical metal calorimeter blocks, each of mass 1 kg, for determining the specific thermal capacities of aluminium, brass, copper and steel. Each calorimeter cylinder has two holes for inserting a heating element (9983-1003258) and a thermometer or temperature sensor.

Hole for heating element:	12.5 mm diam.
Hole for thermometer:	8 mm diam.

9983-1003253

Additionally required:
9983-1003258 Immersion Heater, 12V
Thermometer or Temperature Sensor

Art. No.	Material	Height	Diameter	Specific heat J/(kg*K)
9983-1003254	Aluminium	84 mm	75 mm	896
9983-1003255	Brass	84 mm	44 mm	377
9983-1003256	Copper	85 mm	43 mm	385
9983-1003257	Steel	92 mm	44 mm	452

www.EngineeringBooksPDF.com





9983-1000822



9983-1003526

9983-1000823



9983-1000821



Calorimeter with Heating Coil, 150 ml

For determining the specific heat capacity of solids and liquids and for measuring the electric heat equivalent. Two mutually insulated aluminum beakers, lid with rubber stopper with boreholes for thermometer and stirrer, with heating coil.

Capacity of insulated container:	150 ml
Connection sockets:	4 mm
Electric heater:	6 V/2 A max.

9983-1000822

Additionally required:
9983-1002879 Tube Thermometer, -10 ... +110°C

Additionally recommended:
9983-1000832 Aluminium Shot, 100 g
9983-1000833 Copper Shot, 200 g
9983-1000834 Glass Shot, 100 g

9983-1003312 DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Calorimeter, 200 ml

For determining temperatures of mixtures, specific heat capacities, conversion energies of substances and heat of fusion of ice. Designed for simple experiments for students. Plastic container with styrofoam inlay.

Capacity of insulated container:	approx. 200 ml
Weight:	approx. 80 g

9983-1000823

Additionally required:
9983-1003526 Tube Thermometer, -10 – +100° C

Additionally recommended:
9983-1000832 Aluminium Shot, 100 g
9983-1000833 Copper Shot, 200 g
9983-1000834 Glass Shot, 100 g

9983-1000834 9983-1000832 9983-1000833







Calorimeter with Heating Coil, 1,200 ml

Calorimeter for determining specific heat capacities, conversion energies of materials, mixing temperatures as well as measurement of electrical equivalents of heat. Consists of a double-walled, heat-insulating plastic container with an insulating vessel inside made of reflecting glass, with heating coil and stirrer. Also includes a lid with an opening for a thermometer and two 4 mm plugs for connecting the power supply for the heating coil. The calorimeter is equipped with a heating filament, electrically insulated to avoid decomposition of filament and terminals due to electrolytic processes.

Max. heater voltage:	25 V
Max. heating power:	approx. 160 W
Contents of insulated container:	approx. 1200 ml
Dimensions:	approx. 240 mm x 120 mm diam.
Weight:	approx. 0.8 kg

9983-1000821

Additionally required:
9983-1003526 Tube Thermometer, -10 – +100° C

Additionally recommended:
9983-1000832 Aluminium Shot, 100 g
9983-1000833 Copper Shot, 200 g
9983-1000834 Glass Shot, 100 g

9983-1003312 DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Graduated Cylinder, 100 ml

Duran glass, tall form with spout, hexagonal base.

Scale:	100 ml
Divisions:	1 ml

9983-1002870

Pellets

Granules for filling calorimeters.

Aluminium Shot, 100 g

9983-1000832

Copper Shot, 200 g

9983-1000833

Glass Shot, 100 g

9983-1000834

9983-1002870



www.EngineeringBooksPDF.com



9983-1000829

Tyndall's Bar Breaker

U-shaped clamping set up with a metal rib and fastening screw for demonstrating the linear expansion of metals on heating, as well as the tremendous forces which can be exerted in the process. The set includes 10 cast-iron bolts for breaking in the course of the experiment.

Diameter for bolt hole:	approx. 11 mm
Length of clamping fixture:	approx. 285 mm
Weight:	approx. 1400 g

9983-1000829

Ball and Ring

Brass ball and brass ring with plastic handles for demonstrating the thermal expansion of solid bodies. After heating in a burner flame, the ball no longer fits through the cold ring.

Length:	approx. 250 mm

9983-1003382



9983-1003382



9983-1000828



Ice Bomb

Clamping set up for demonstrating volumetric expansion of water on freezing, as well as the tremendous forces which can be exerted in the process. Comprises a steel cylinder with a clamping rib and plastic lid. The set includes 10 cast-iron bolts for breaking in the course of the experiment.

Diameter for bolt hole:	approx. 11 mm
Dimensions:	approx. 40x30x75 mm³
Weight:	approx. 620 g

9983-1000828

Cast Iron Bolts, Set of 10 Bolts

Spare bolts to be used with Tyndall's bar breaker (9983-1000829) or the ice bomb (9983-1000828).

9983-1000827



9983-1000827

Ball with Ring

An arrangement for demonstrating the expansion of solids on heating. After heating in a burner flame, the ball no longer fits through the bore in the bracket. Steel ball with chain and handle.

Dimensions of the bracket in mm:	approx. 40x50x40 mm²
Diameter of ball:	approx. 22 mm
Length of handle with shaft:	approx. 225 mm
Weight:	approx. 175 g

9983-1000831



9983-1000831

www.EngineeringBooksPDF.com

Linear Expansion Apparatus with Three Pointers

Apparatus for measuring the linear expansion of different kinds of solids simultaneously. The set includes three sample tubes (brass, aluminium and glass) which are heated by passing steam through them. Linear expansion is indicated on a mirror scale by three differently coloured pointers mounted on rollers. Includes silicone tubing.

Dimensions of the tubes:	700 mm x 6 mm diam.
Dimensions:	approx. 830x80x70 mm³
Weight:	approx. 1.2 kg

9983-1000830

Additionally required:
9983-1001049 Steam Generator (230 V, 50/60 Hz)
or
9983-1006769 Steam Generator (115 V, 50/60 Hz)

Steam Generator

Device for generation of steam, e.g. in experiments on thermal expansion. Aluminum vessel with cork lid and retainer on an adjustable hot plate with a thermal circuit breaker.

Hotplate:	90 mm diam.
Power consumption:	550 W
Vessel volume:	250 ml
Dimensions:	170 mm x 180 mm diam.
Hose connection:	6 mm diam.
Total mass:	approx. 1 kg

Steam Generator (230 V, 50/60 Hz)

9983-1001049

Steam Generator (115 V, 50/60 Hz)

9983-1006769



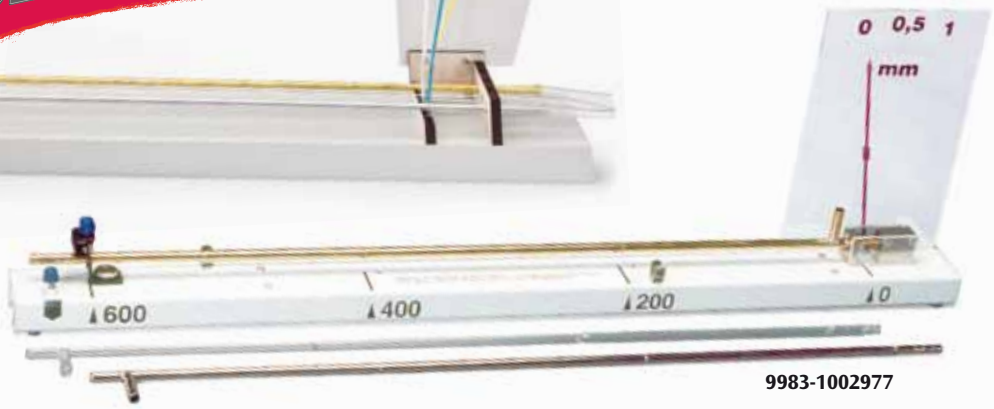
9983-1001049
9983-1006769

BEST SELLER

9983-1000830



9983-1012862



9983-1002977

Gauge with Adapter

Analogue gauge for measuring minimal changes in length plus an adapter for fitting a gauge dial as an enhancement to the extension apparatus D (9983-1002977).

9983-1012862

Linear Expansion Apparatus S

A device for measuring the linear expansion of solids as a function of length and material. Includes three sample tubes (iron, copper and glass) which are heated by passing water vapour through them. Consists of a base strip with a clamping spring, pointer, scale and hose nipple.

Pointer ratio:	1:50
Tube length:	approx. 630 mm
Dimensions:	530x60x240 mm³
Weight:	0.6 kg

9983-1002978

Additionally required:
9983-1001049 Steam Generator (230 V, 50/60 Hz)
or
9983-1006769 Steam Generator (115 V, 50/60 Hz)
9983-1002622 Silicone Tubing, 1 m

Linear Expansion Apparatus D

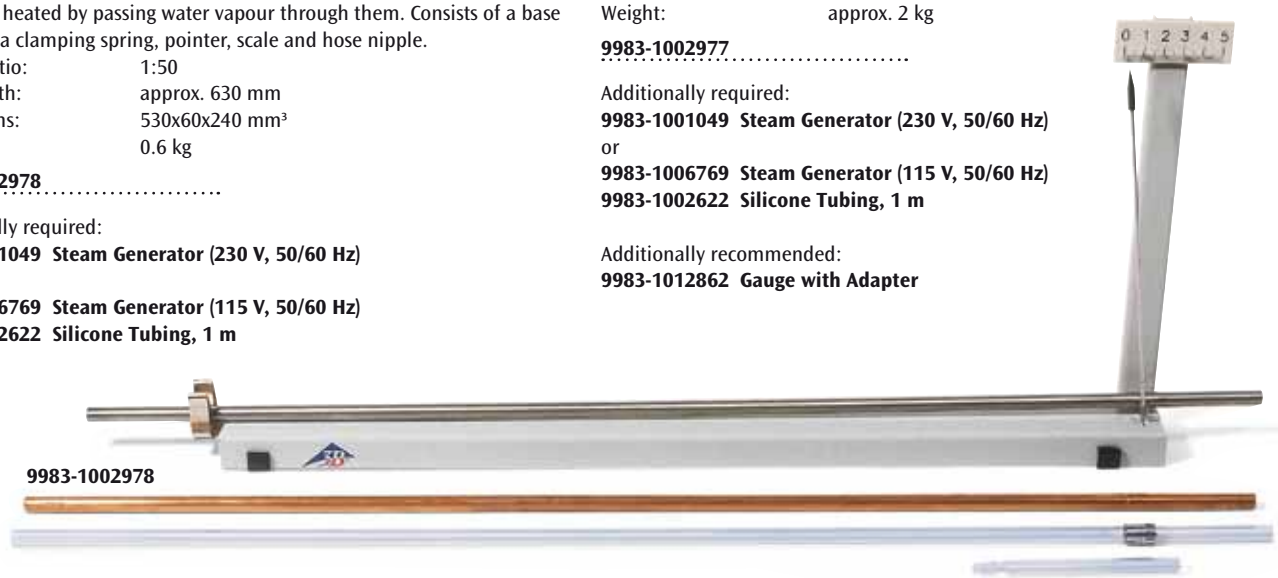
A device for measuring the linear expansion of solids as a function of length and material. Includes three sample tubes (steel, brass and glass) which are heated by passing water vapour through them. Consists of a base strip with a fixed bearing, pilot bearing, pointer and projectable scale.

Scale dimensions:	140x200 mm²
Measuring range:	1 mm
Reading accuracy:	0.05 mm
Tube length:	approx. 650 mm
Dimensions:	approx. 730x50x200 mm³
Weight:	approx. 2 kg

9983-1002977

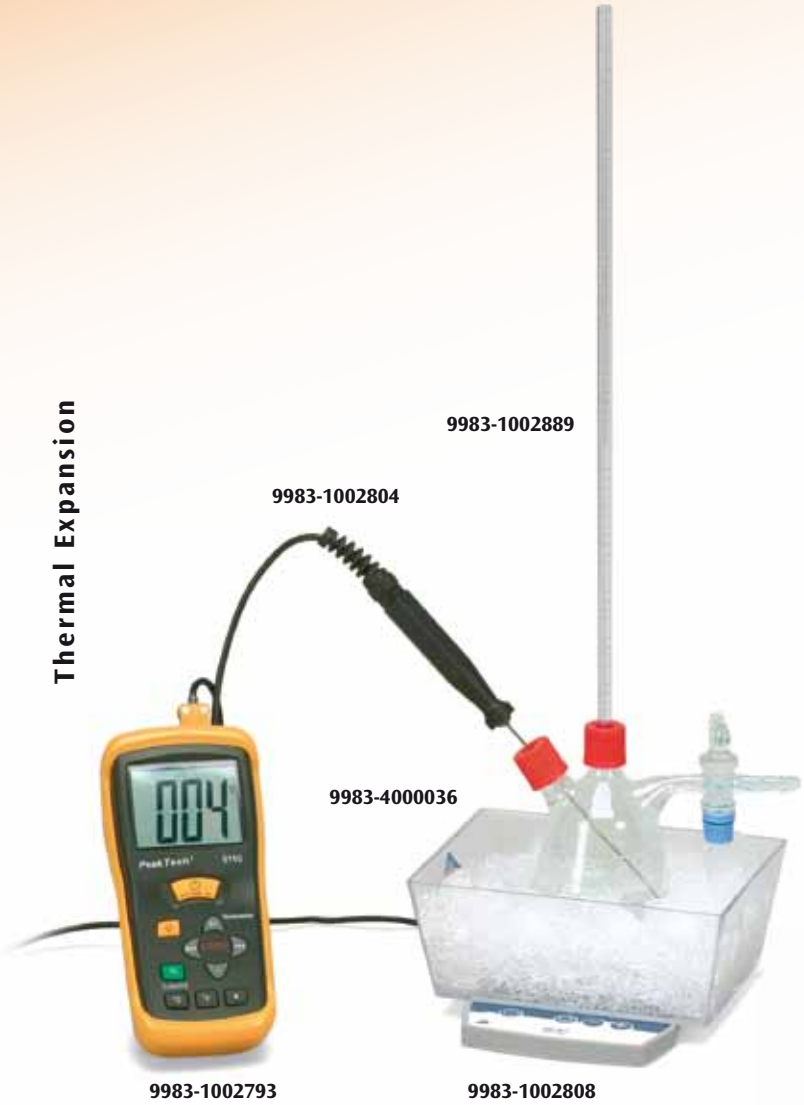
Additionally required:
9983-1001049 Steam Generator (230 V, 50/60 Hz)
or
9983-1006769 Steam Generator (115 V, 50/60 Hz)
9983-1002622 Silicone Tubing, 1 m

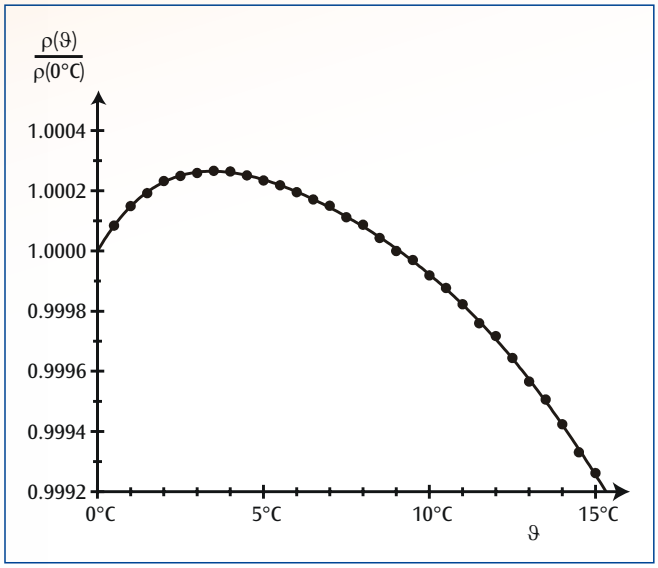
Additionally recommended:
9983-1012862 Gauge with Adapter



9983-1002978

www.EngineeringBooksPDF.com





Determining the maximum density of water

Gas Expansion Apparatus
Glass vessel with ground-glass sealing joints for demonstrating the expansion of air when heated. The U-tube is filled with water at room temperature and the water levels are marked. Even the heat from a hand is enough to cause the air in the flask to expand so that the water levels in the U-tube change visibly.
Height: approx. 230 mm

9983-1003511

Device for Demonstrating the Anomaly of Water
Apparatus for demonstrating the thermal anomaly of water, measuring its thermal expansion and determining its maximum density. Comprises a Duran glass vessel with an inlet tube and two GL screw connections for mounting the riser tube with a mm scale and a temperature sensor or thermometer. Includes stirring rod.
Volume: 250 ml
Riser tube: 400 mm
Capillary: 1.5 mm diam.
Hose nipple: 8 mm
Overall height: approx. 500 mm

9983-1002889

Additionally required:
9983-4000036 Plastic Trough
9983-1002808 Magnetic Stirrer
9983-1003013 Tube Thermometer
or
9983-1002793 Digital Thermometer
and
9983-1002804 K-Type NiCr-Ni Immersion Sensor, -65°C – 550°C



9983-1003511

www.EngineeringBooksPDF.com

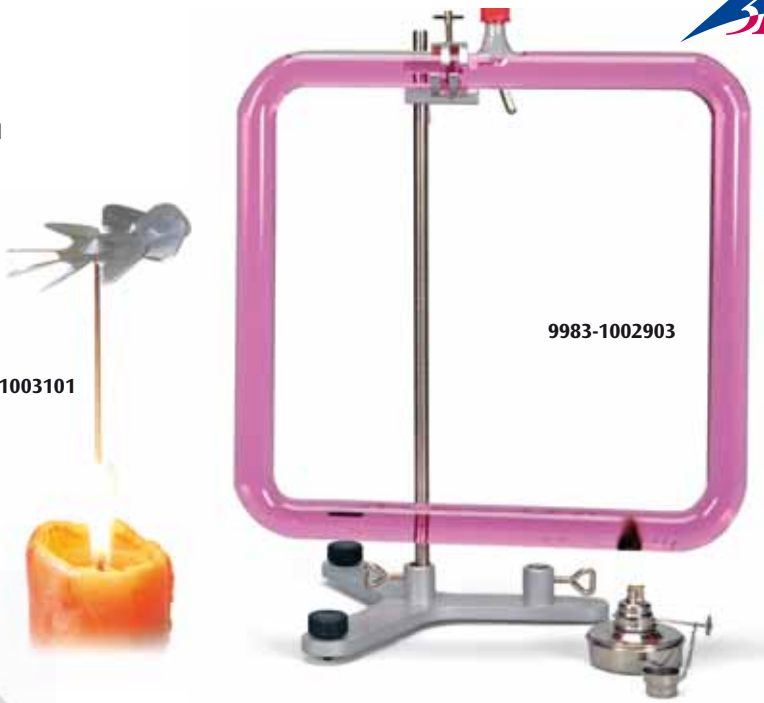
Heat-Flow Device

Stable glass flask with rectangular bends for demonstrating the flow of heat in a liquid that is heated non-uniformly. With GL18 screw fitting and side-limbs for filling with water, and a small quantity of potassium permanganate for colouring.

Dimensions: 420x420 mm²
Tube diameter: 30 mm

9983-1002903

Additionally required:
9983-1002836 Tripod Stand, 185 mm
9983-1002934 Stainless Steel Rod, 470 mm
9983-1002830 Universal Clamp
9983-1002833 Universal Jaw Clamp
9983-1003565 Spirit Lamp
Potassium permanganate for use as a colouring agent



Vane Wheel

Device for demonstrating air and heat flows generated by a burning candle, water vapor or other heat sources. Made of aluminum and mountable on a long needle.

9983-1003101

Additionally required:
Long needle



Heat-Flow Device S

Stable glass flask on a stand for demonstrating the flow of heat in a non-uniformly heated liquid. With filling hole for filling with water and a small quantity of potassium permanganate crystals for colouring.

Glass flask: 300x150 mm²
Tube diameter: 14 mm
Height: 250 mm

9983-1003512

Additionally required:
9983-1003565 Spirit Lamp
Potassium permanganate for use as a colouring agent

Heat Conductivity Device

A device with five metal bars for comparing the thermal conductivity of aluminium, brass, steel, zinc and copper – by melting wax balls at the rod ends. The five rods extend in a star-shaped configuration from a brass hub. Each rod has a notch for holding wax.

Length: 340 mm

9983-1003383



Thermal Conductivity Equipment Kit

Kit for the qualitative investigation of the heat conductivity of aluminum (extremely high thermal conductivity) and expanded polystyrene (very low thermal conductivity). Even at room temperature the varying material temperatures are evident to the touch. In the experiment ice cubes are placed on the plates. The ice cube on the seemingly colder aluminum plate melts much more quickly (in 1–2 minutes), while there seems to be no melting at all of the ice cube on the seemingly warmer plastic plate. Two rubber rings which prevent the ice cubes from slipping off the plates complete the experiment kit.

Plate dimensions: approx. 95x95x13 mm³

9983-1003497



www.EngineeringBooksPDF.com



9983-1000704

9983-1009957
9983-1009956

9983-1000701

Accessories for Kinetic Gas Theory

Accessories for vibrator (9983-1000701) for simulating particle motion in an ideal gas. Differently coloured spheres (gas model) are set in motion by mechanical vibrations.

Contents:
1 Plexiglas cylinder, length 300 mm
1 Circular disc
1 Set of spheres of different colours

9983-1000704

Additionally required:
9983-1000701 Vibration Generator
9983-1009957 Function Generator FG 100 (230 V, 50/60 Hz)
or
9983-1009956 Function Generator FG 100 (115 V, 50/60 Hz)

Crookes Radiometer

Device for demonstrating the conversion of radiation energy into kinetic energy. Rotary-vane wheel mounted on a metal tip and equipped with four plates, each coloured black on one side; housed in an evacuated glass bulb.

Height:	210 mm
Ball diameter:	80 mm

9983-1002882



9983-1002882

Moll Type Thermopile

Sensitive probe for measuring heat radiated by a black body or Leslie's cube, as well as for detecting visible light and ultraviolet radiation. Comprises a metal housing with a polished, conical reflector and a black surface 15 mm in diameter with 17 linked thermocouples. With two 4 mm connectors mounted on a stem.

Sensitivity:	approx. 0.14 µV/µWW
Internal resistance:	approx. 1 Ω
Setting duration:	40 s for 95% of the measured value
Rod:	156 mm x 10 mm diam.
Dimensions:	94 mm x 40 mm diam.
Weight:	approx. 200 g

9983-1000824

Additionally required:
9983-1006810 Multimeter ESCOLA 10
9983-1001046 Stand base
2 Experiment leads



9983-1000824

Leslie's Cube

A hollow aluminium cube for investigating heat radiation from a hot body as a function of its temperature and surface. With a removable lid for pouring in hot water and 2 openings for inserting a thermometer or thermal sensor and a stirrer. One side each is polished, matt, black and white.

Dimensions:	100x100x100 mm³
Weight:	approx. 360 g

9983-1000835

Additionally required:
9983-1000824 Moll Type Thermopile

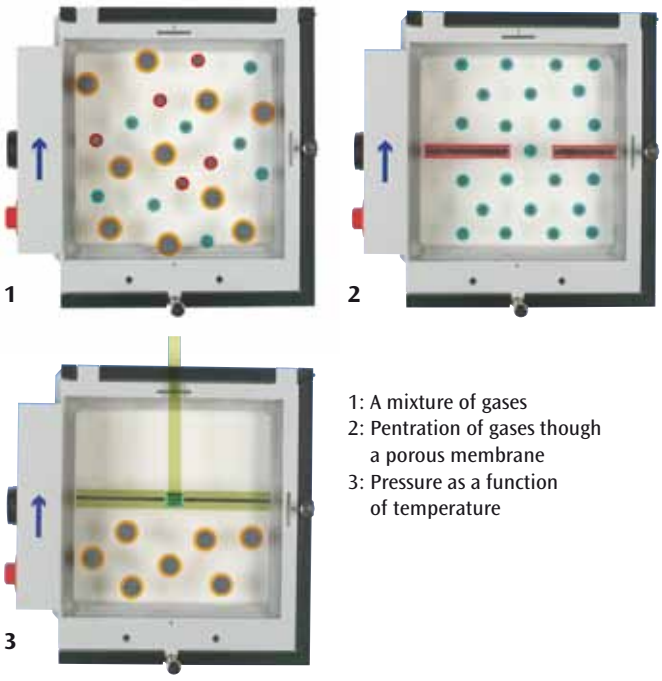


9983-1000835

www.EngineeringBooksPDF.com

Experiment Topics:

- Thermal motion of atoms and molecules in various states of aggregation
- Electrical conduction processes
- Models of atomic physics
- Mechanical motion



1: A mixture of gases
2: Pentration of gases though a porous membrane
3: Pressure as a function of temperature

Air-Cushion Plate

An ideal device for demonstrating a series of experimental models intended to study the motion of atomic particles:

a) Objects hovering on the air cushion experience near-zero friction and are used to simulate particle motion. The set contains five different transparent, coloured plastic or aluminium elements with round ceramic magnets fitted to them to ensure elastic collisions.

b) Magnetic barriers can be used to modify the plastic-bordered experimentation surface. This allows elastic collisions between the hovering bodies and the borders.

c) A lattice model with a fixture is available for emulating crystal lattices in experiments on electrical conductivity in semiconductors, for instance. Comprises a height-adjustable plexiglass plate from which 25 ceramic magnets are freely suspended.

d) Two rod-shaped metal electrodes can be positioned in parallel with the experimentation surface in order to generate an electrical field. The effect of electrical fields on charged particles can also be simulated by inclining the experimentation surface.

The equipment system is characterized by a clear and simple design, minimum preparatory adjustment requirements, clear visibility of all experiments through overhead projection, simple operation and high reliability. The device consists of a robust frame with a pressure chamber whose cover plate is furnished with 1089 fine perforations and serves as an experimentation surface. Air is supplied to the pressure chamber by a blower via a hose, causing the coloured bodies to hover. An additional air stream from an impulse valve makes it possible to alter the motion of the hovering bodies. The air-cushion table is equipped with two adjustment screws. With two adjustable screws for horizontal alignment.
Dimensions: 350x350x75 mm³

Additionally required:
9983-1000606 Air Flow Generator (230 V, 50/60 Hz)
or
9983-1000605 Air Flow Generator (115 V, 50/60 Hz)

Contents:
Air-cushion plate
Magnetic hovering bodies:
Red, 16 mm diam. (30x)
Green, 16 mm diam. (25x)
Aluminum, 21 mm diam. (5x)
Orange, 28 mm diam. (25x)
Blue, 48 mm diam. (1x)
Magnetic barriers:
253 mm (2x)
233 mm (1x)
233 mm with a recess (1x)
233 mm with an opening, flat, with 4 magnets (1x)
Magnetic piston
Lattice model
Fixture for lattice model
Pair of electrodes
Plexiglass plate
Manipulation rod
Tweezers
Experiment manual
Wooden storage box
Tube

9983-1002981

Kinetic gas theory made visible

9983-1002981



...going one step further
www.EngineeringBooksPDF.com

Qualitative Observations

- Liquid and gaseous states
- Dynamic compression and expansion
- Critical opalescence
- Formation of the transition point at various temperatures

Quantitative Measurements

- Display of the critical point and temperature
- Recording of isotherms in p-V (Clapeyron) diagrams
- Recording of isotherms in pV-p (Amegat) diagrams
- Pressure curves for a saturated vapour
- Differences between real gases and ideal gases



9983-1002670

Critical temperature:	318.6 K (45.5°C)
Critical pressure:	3.76 MPa (37.6 bars)
Critical volume:	197.4 cm^3/mol
Critical density:	0.74 g/mol
Temperature range:	10 – 60°C
Maximum pressure:	6.0 MPa (60 bars)
Maximum volume:	15.7 cm^3
Manometer diameter:	160 mm
Bore for temperature sensor:	6 mm diam.
Temperature control connections:	7 mm diam.
Reducing valve connection:	1/8" diam.
Standard gas connection:	3.5 mm diam.
Dimensions:	380x200x400 mm^3
Weight:	7 kg approx.

Contents:

1 Critical point apparatus filled with hydraulic (castor) oil but without test gas (SF_6). Includes built-in safeguarded connection nozzle for MINICAN® gas canisters
1 Oil filling device
1 Angled 1.3-mm hexagonal spanner (for grub screw on rotary scale)
1 Plastic hose, 3 mm internal diameter
1 1/8" pipe screw connection (SW 11)
1 Grease gun

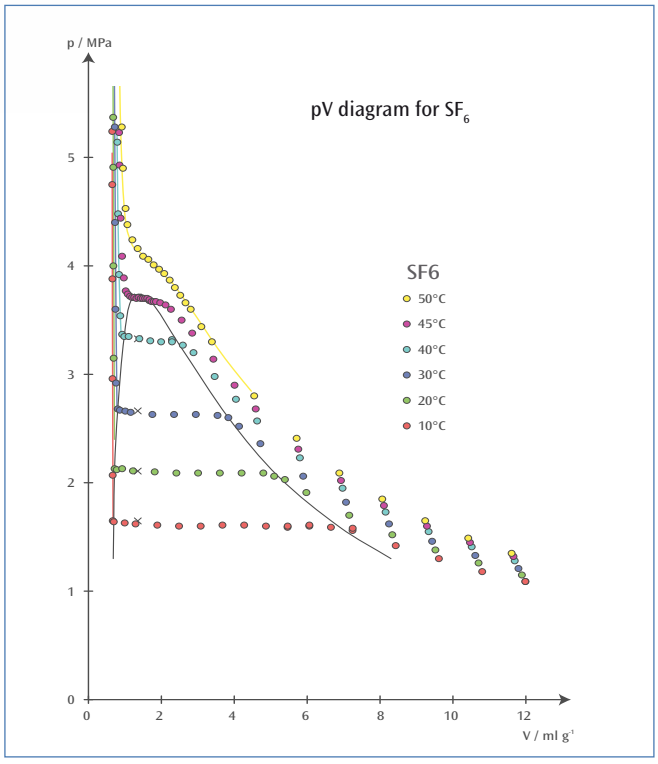
9983-1002670

Additionally required:

9983-1008654 Immersion/Circulation Thermostat (230 V, 50/60 Hz)
or
9983-1008653 Immersion/Circulation Thermostat (115 V, 50/60 Hz)
9983-1002622 Silicone Tubing, 1 m (2x)
9983-1002803 Digital Quick-Response Pocket Thermometer
9983-1002804 Immersion Sensor, NiCr-Ni, type K, -65°C – 550°C
Sulphur hexafluoride SF_6

Critical Point Apparatus

A high-precision apparatus for studying the compression and liquefaction of a gas, determining the critical point and recording isotherms in p-V (Clapeyron) diagrams. The test gas is sulphur hexafluoride (SF_6), which has a critical temperature of 318.6 K (45.5°C) and a critical pressure of 3.76 MPa (37.6 bars), allowing for a simple experiment set-up. The apparatus includes a transparent measuring cell that is highly resistant to leakage and compression. The volume inside the cell is changed via a finely adjustable handwheel, the change being indicated by a combination of a fixed and a rotary scale to an accuracy of 1/1000 of the maximum volume. The pressure is generated by a hydraulic system containing castor oil of medically approved quality. The measuring cell and hydraulic system are separated by a cap seal which rolls in as the volume increases. This design means the pressure gradient between the measuring cell and oil chamber is negligible. A manometer measures gas pressure instead of oil pressure without taking up any dead space inside the measuring cell. During transitions from the gaseous to the liquid phases and vice versa, it is therefore possible to observe the formation of the first drops of liquid and disappearance of the last gas bubbles. The measuring cell is enclosed in a transparent water chamber. A circulation thermostat allows the temperature to be maintained at a highly constant value, which can be monitored by means of a thermometer. Practical indications of the volume, pressure and temperature permit easy recording of p-V or pV-p diagrams providing qualitatively correct results. Pressure and temperature-dependent volumetric corrections also provide quantitatively accurate results comparing favourably with standard reference values.



www.EngineeringBooksPDF.com



9983-1002804

9983-1002803

9983-1002670

9983-1008654
9983-1008653

Note:
In accordance with good laboratory practice, it is advisable to obtain gas via a fixed pipeline if the critical-point apparatus is used frequently. In case of occasional usage, it is more expedient to obtain the test gas from MINICAN® canisters. A MINICAN® gas connection is designed similarly to thevalve on a common spray can, i.e. it is opened simply by fitting the MINICAN® on the gas connection nozzle.

Additionally required in case of degassing hydraulic oil:
9983-1002671 Castor Oil
High-Power Vacuum Pump

Set of Seals (not shown)
Set of spare seals for critical point apparatus (9983-1002670). Includes a rubber cap seal, round rubber seal of diameter 60 mm, square rubber seal 78x78 mm², a sealing ring of diameter 30/20 mm, four copper sealing discs and a threaded bush made of POM (Polyoxymethylene.

9983-1002672 .....

Castor Oil (not shown)
250 ml of DAB approved castor oil for filling critical point apparatus (9983-1002670).

9983-1002671 .....

Immersion/Circulation Thermostat
Immersion circulation thermostat for setting the temperature of a bath or external apparatus with non-flammable liquids at temperatures up to 95°C. The fully electronic continuous regulator and the powerful circulating pump ensure that the water in the bath is optimally stirred so that the temperature remains highly constant. The user-friendly menu and simple three-button operation guarantee that the equipment is easy to use. A single-row LED display indicates the desired temperature and the actual temperature. Excess temperature protection is set to a fixed value of 95°C and features both audible and visual alarms to enhance operating safety. Also included is the possibility of connecting a water cooler or heat exchanger to provide cooling by means of tap water.

Operating-temperature range:	25°C – 85°C
Temperature constancy:	±0.05°C
Heating power:	1.5 kW
Pump pressure:	max. 0.2 bar
Delivery rate:	max. 15 l/min
Bath volume:	max. 5.5 l
Bath area / depth:	approx. 145x161x150 mm³

Immersion / Circulation Thermostat (230 V, 50/60 Hz)

9983-1008654 .....

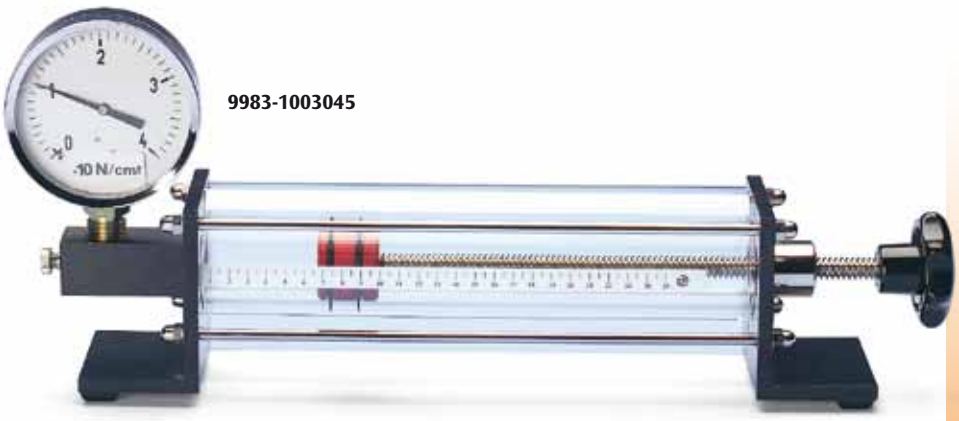
Immersion / Circulation Thermostat (115 V, 50/60 Hz)

9983-1008653 .....

Boyle-Mariotte Apparatus
Device for experiment based determinations of the dependence between the volume and pressure of a gas at constant temperature (Boyle's law). Consists of a plexiglass cylinder with graduations for volume measurement, piston, manometer and air inlet/outlet valves. Turning the handle moves the piston via a thread in the plexiglass cylinder. This allows a generation of overpressures and underpressures. For safety reasons, the power cylinder is enclosed in another plexiglass cylinder.

Length:	300 mm
Internal diameter:	40 mm
Piston:	30 mm x 40 mm diam.
Piston seal:	2 O-rings
Manometer diameter:	100 mm
Pressure range:	0 N/cm² – 40 N/cm²

9983-1003045 .....



9983-1003045

www.EngineeringBooksPDF.com



9983-1012870

NEW

Jolly's Bulb and Gauge

Palm-sized, hollow metallic ball with a manometer connected to it for demonstrating change of pressure in a closed volume of air when heated or cooled. Immersing the ball in a water bath at a specific temperature allows the relationship between pressure and temperature of the enclosed air to be investigated in order to demonstrate the behaviour of an ideal gas.

Hollow ball: 60 mm diam.
Manometer: 840 …1240 hPa

9983-1012870



9983-1003569

9983-1003236

Pneumatic Lighter

Device for demonstrating the ignition of diesel. By swiftly pressing down the piston, the compressed air in the transparent tube is heated so strongly that a piece of paper placed at the bottom of the tube very clearly ignites. Similarly, a cotton-wool pad soaked in ether also catches fire.

Length of
compression tube: approx. 150 mm

9983-1003569

Spare Glass Tube (not shown)

Spare glass tube for pneumatic lighter (9983-1003569).

9983-1003570

Oscillation Tube

For determining adiabatic exponent c_p/c_v of air by Rüchardt's method, used in conjunction with Mariotte flask (9983-1002894). Precision glass tube with precisely fitting aluminum cylinder. If the glass tube is placed vertically on a glass flask of 10 l volume and the aluminum cylinder is allowed to slide into the glass tube, it can be made to undergo harmonic oscillations on the air cushion resulting from the enclosed volume of air. c_p/c_v can then be calculated from the period.

Dimensions: 600x16 mm diam.$_{internal}$
Aluminum cylinder: 15.2 g

9983-1002895

Additionally required:
9983-1002894 Mariotte Flask
9983-1002811 Digital Stopwatch

Additionally recommended:
9983-1012856 Vacuum Hand Pump



9983-1002895

Mariotte Flask

Duran glass flask with discharge opening at base and two rubber stoppers with boreholes.

Volume: 10 l

9983-1002894

Additionally recommended:
9983-1002895 Oscillation Tube

9983-1002894

Boyle-Mariotte Apparatus S

This apparatus is ideally suited to demonstrating Boyle's Law to groups of students. Coloured oil is gradually pumped from a reservoir into a tube containing air. Whilst the volume of air is read from a scale clearly visible behind the tube, pressure is measured by a Bourdon gauge. The glass tube is extra strong and additionally protected by a plastic safety screen. The Bourdon gauge is fitted with a transparent plastic back to allow students to see its working parts. The apparatus is supplied complete with red oil.

Hose nipple: 10 mm diam.
Dimensions: approx. 350x200x760 mm³

9983-1003236

Additionally required:
9983-1012856 Vacuum Hand Pump

www.EngineeringBooksPDF.com

Experiment Topics:

- Recording and evaluating a pV diagram
- Operation of a Stirling engine as a heat pump or refrigerator
- Operation of a Stirling engine as a classical heat-engine

BEST SELLER



9983-1002594

Stirling-Engine G

Transparent Stirling engine for quantitative investigations of the Stirling cycle. as a heat engine, heat pump and refrigerating machine. The displacement cylinder and displacement piston are made of heat resistant glass; the power cylinder, flywheel and gearbox cover are made of acrylic glass. This allows very clear observation of the individual sequences of motion at all times. The crankshafts have ball bearings and are made of hardened steel. The connecting rods are made of wear resistant plastic. Includes spirit burner with adjustable wick for use as a heat source. The glass of the displacement cylinder is also equipped with recessed temperature measurement sockets before and behind the displacement piston, to allow measurements of temperature differences during operation as a heat pump or refrigerating machine. The large flywheel made of acrylic glass has imprinted markings to allow measurement of revolutions per unit of time using a light barrier. For recording pV-diagrams, it is possible to measure the pressure in the power cylinder via a hose connection; the string included in the scope of delivery can be fastened to the power piston to measure the stroke in order to determine the volume. The integrated engine generator unit with a two stage belt pulley allows a conversion of the produced mechanical energy into electrical energy. Equipped with a switchover option for operating an integrated lamp or external loads, or feeding electrical energy for operation as a heat pump or refrigerating machine, in accordance with the direction of rotation of the Stirling engine.

Power of the Stirling engine:	1.5 W
Idling speed:	1000 rpm
Flywheel:	140 mm diam.
Power cylinder:	25 mm diam.
Stroke of the power piston:	24 mm
Gas volume:	32 cm³ – 44 cm³
Motor generator unit:	max. 12 V DC
Belt pulley:	two stage (30 mm diam., 19 mm diam.)
Dimensions:	300x220x160 mm³
Weight:	1.6 kg

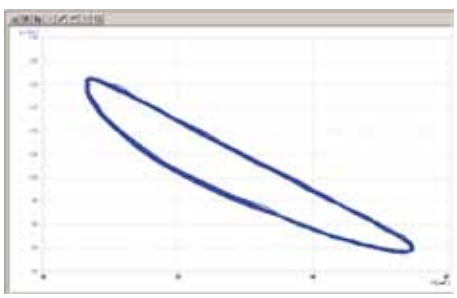
9983-1002594

Additionally recomended:
9983-1000548 Relative Pressure Sensor ±1000 hPa
9983-1000568 Displacement Sensor
9983-1008500 Sensor Holder for Stirling Engine G
9983-1000544 3B NET*lab*™
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)

Sensor Holder for Stirling Engine G

Holder for a relative pressure sensor (9983-1000548) and a displacement sensor (9983-1000568) for use with the G-series Stirling engine (9983-1002594).

9983-1008500



Pressure-volume diagram of Stirling engine G

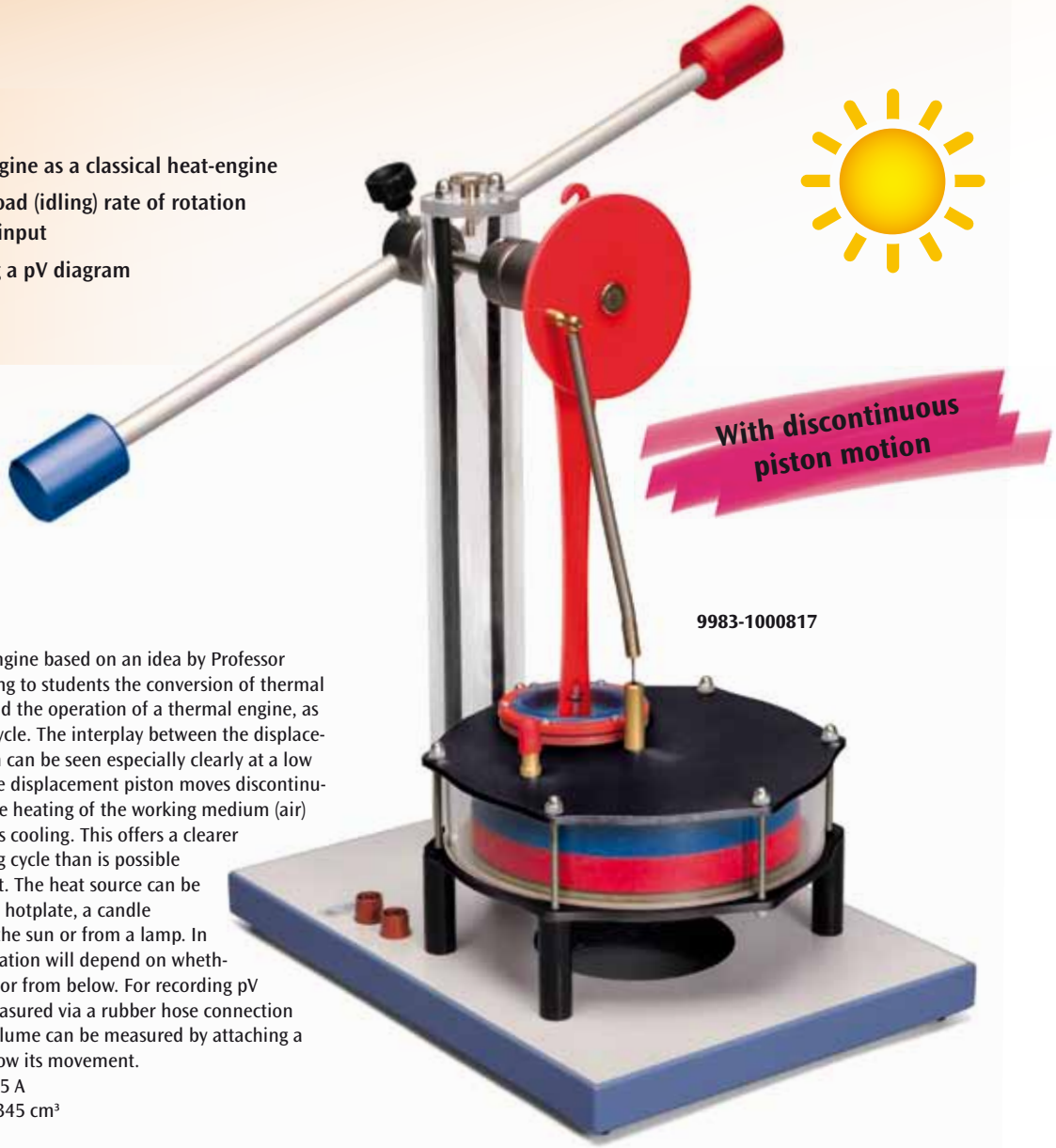


Set-up for recording a pressure-volume graph

www.EngineeringBooksPDF.com

Experiment Topics:

- Operation of a Stirling engine as a classical heat-engine
- Measurement of the no-load (idling) rate of rotation as a function of the heat input
- Recording and evaluating a pV diagram



9983-1000817

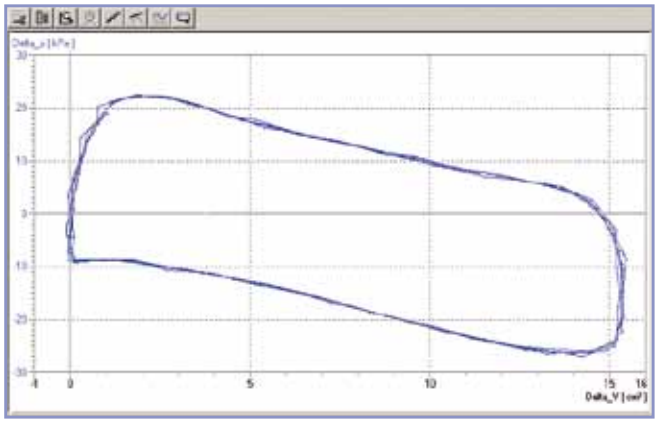
Stirling Engine D

A functional model of a Stirling engine based on an idea by Professor Wilcke optimised for demonstrating to students the conversion of thermal energy into mechanical energy and the operation of a thermal engine, as well as investigating the Stirling cycle. The interplay between the displacement piston and the power piston can be seen especially clearly at a low rate of rotation. In this version the displacement piston moves discontinuously, with a dwell time during the heating of the working medium (air) and a second dwell time during its cooling. This offers a clearer demonstration of the ideal Stirling cycle than is possible with continuous piston movement. The heat source can be provided by an integrated electric hotplate, a candle flame, or focused radiation from the sun or from a lamp. In the latter case the direction of rotation will depend on whether the heat is applied from above or from below. For recording pV diagrams, the pressure can be measured via a rubber hose connection on the power cylinder, and the volume can be measured by attaching a thread to the power piston to follow its movement.

Heater voltage:	8 – 12 V, 1.5 A
Gas volume:	330 cm³ – 345 cm³
Flywheel rod:	400 mm
Dimensions without flywheel rod:	260x185x330 mm³
Weight:	2.2 kg

9983-1000817

Additionally recomended:
9983-1000547 Relative Pressure Sensor ±100 hPa
9983-1000568 Displacement Sensor
9983-1008516 Supplementary Set for Stirling Engine D
9983-1000544 3B NET*lab*™
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)



Pressure-volume diagram of Stirling engine D



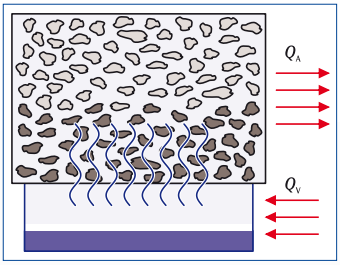
9983-1008516

Supplementary Set for Stirling Engine D

Set of equipment for adding a displacement sensor (9983-1000568) and a relative pressure sensor (9983-1000547) to the D-series Stirling engine (9983-1000817). The set consists of the following components:
1 Base plate to accommodate the pressure sensor
1 Knurled screw for fastening the base plate to a stand rod
1 Stem with magnetic base for displacement sensor
1 Silicone tubing for connecting ±100-hPa relative pressure sensor (9983-1000547)
1 Set of threads with suction pad
2 Weights with hook, 20 g each

9983-1008516

www.EngineeringBooksPDF.com





9983-1002826

Adsorption Cooler Ice-Quick

Demonstration instrument for illustrating the principle of adsorption cooling. Consists of an evacuable cartridge filled with zeolite and a high quality hand-operated vacuum pump interconnected via rubber tubing, plus a plastic beaker. By means of the Ice-Quick it is possible to freeze a small quantity of water in a very short time. This is done by placing the cartridge on the plastic beaker containing some water then pumping the air out of the system. After a few strokes of the pump the water begins to boil at the ambient temperature. The zeolite adsorbs the water vapour by binding it into its crystal structure, and is thereby heated. Thus, heat is extracted from the boiling water; after a short time it is cooled sufficiently to freeze, with ice formation beginning at the surface. The process can be repeated several times, allowing pauses in between for the zeolite to cool, until the zeolite becomes saturated with water. The contents of the cartridge can be regenerated by heating at about 250°C for a short time in an oven. After cooling, the sequence can be repeated until the zeolite again becomes saturated.

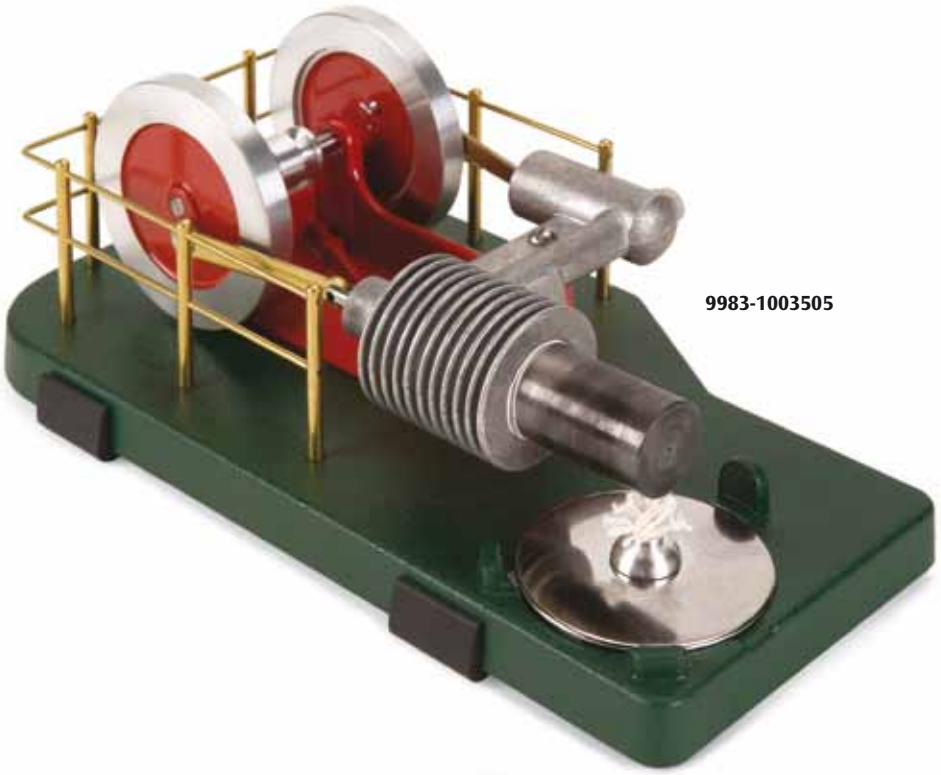
9983-1002826

Stirling Engine S

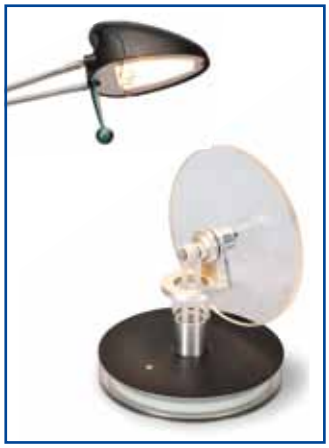
This affordable Stirling engine comes complete with built-in alcohol burner. Red flywheels and chassis mounted on a green base, this all-metal engine runs silently at speeds in excess of 1,000 rpm. The engine demonstrates the principle of the Stirling cycle and the functioning of a classical heat engine. It comes completely assembled and ready to run, accompanied by the book “Stirling Cycle Engines” which explains the principles of operation.

Rotation speed:	1000 rpm
Base plate:	180x110 mm²
Weight:	1.15 kg

9983-1003505



9983-1003505





Low Temperature Stirling Engine, Assembly Kit (not shown)

9983-1002599

Low Temperature Stirling Engine

A compact, transparent Stirling engine for demonstrating the operation and fundamental design of such engines. A temperature difference of approximately 5° C between the base and top plates is sufficient to set the motor in motion. This difference can be generated just by the warmth of a human hand or by cooling through contact with a cold object from a refrigerator. The top plate’s matt, black coat also enables the device to be operated as a solar-powered engine. In this case the direction of rotation will depend on whether the heat is applied from above or from below. The power cylinder is made of precision glass, while the displacement cylinder and flywheel are made of acrylic glass; this allows a clear observation of the movements of the power piston, displacement mechanism and crankshaft drive. The crankshaft and connecting rod have miniature precision ball bearings.

Rotation speed:	80 rpm at $\Delta T = 10°C$
Flywheel:	110 mm diam.
Dimensions:	138 mm x 110 mm diam.

9983-1002598

www.EngineeringBooksPDF.com

Heat Pump D

Demonstration model for showing how refrigerators and electrical compression heat pumps work. Consisting of compressor with drive motor, vaporizer, expansion valve and condenser. May be used as an air water or water water heat pump. Includes wattmeter, so that one can record the operation time, the mains voltage, instantaneous power input and electrical work, and two thermometers for measuring the temperatures in the two reservoirs. The components are connected in a closed system by copper pipes and mounted on a base board, and the clear layout makes it possible to directly relate the sequence of changes of state to the cyclic operation of the heat pump. Evaporator and condenser are constructed as copper tubing spirals and each of them is submerged in water filled containers serving as heat reservoirs for determining the heat absorbed or emitted. Two large manometers display the pressure ratios of the coolant in both heat exchangers. Two observation windows are provided for observing the state of aggregation of the refrigerant after the evaporator and after the condenser. A protective overpressure switch disconnects the compressor motor from the circuit when overpressure reaches 15 bars.

Compressor power:	120 W
Coolant:	R 134A, free of fluorochlorohydrocarbons
Temperature reservoirs:	2000 ml each
Manometer:	160 mm diam.
Dimensions:	560x300x630 mm³
Weight:	21 kg

Heat Pump D (230 V, 50 Hz)

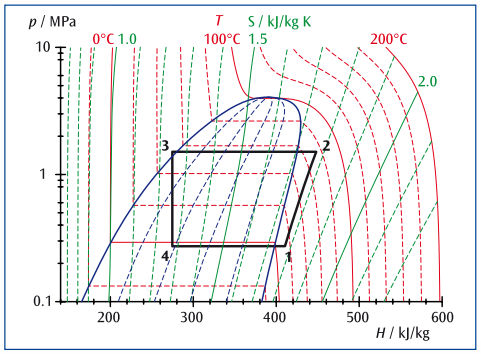
9983-1000820

Heat Pump D (115 V, 60 Hz)

9983-1000819

Experiment Topics:

- Determining the power output as a function of the temperature difference
- Analysing the cyclic process by means of a Mollier diagram



Pressure-enthalpy diagram of heat pump



Particularly clear layout!

9983-1000820
9983-1000819

NEW



9983-1009922

Temperature Sensor, Pt100 with Measurement Terminal

Temperature sensor for the measurement of temperatures on the copper tubing of a heat pump (9983-1000820 resp. 9983-1000819). Temperature sensor shaft made of rust-proof stainless steel. Tip with matching copper terminal. Can be used in conjunction with 3B NET*log*™ unit (9983-1000540 resp. 9983-1000539) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-50°C – 150°C
Resolution:	0.1° C
Accuracy:	0.1% of measured value plus 0.25°C
Sensor cable:	1 m, with silicone insulation
Sensor type:	Pt100 thermocouple

9983-1009922

www.EngineeringBooksPDF.com



9983-1002597

Steam Engine G
Transparent steam engine for demonstrating how an oscillating steam engine operates. In this engine the cylinder moves around a centre axis. This motion causes the inlet port and outlet port of the steam conduit to open and close. The base plate and flywheel are made of acrylic glass, while the boiler and working cylinder are made of heat proof quartz glass, making all of the moveable parts and actions very clearly visible. With a ball bearing supported crankshaft made of brass and a safety valve built into the boiler to prevent excessive pressure. Includes spirit burner with adjustable wick for use as heat source.

Rotation speed:	800 rpm
Mech. Power:	1 W
Boiler volume:	50 ml
Run time per load:	20 – 25 min
Max. operating pressure:	0.5 bars
Dimensions:	260x170x110 mm³

9983-1002597

Dry Fuel for Steam Engine B (not shown)
20 Esbit fuel tablets for heating water in steam engine B (9983-1012801).

9983-1012886

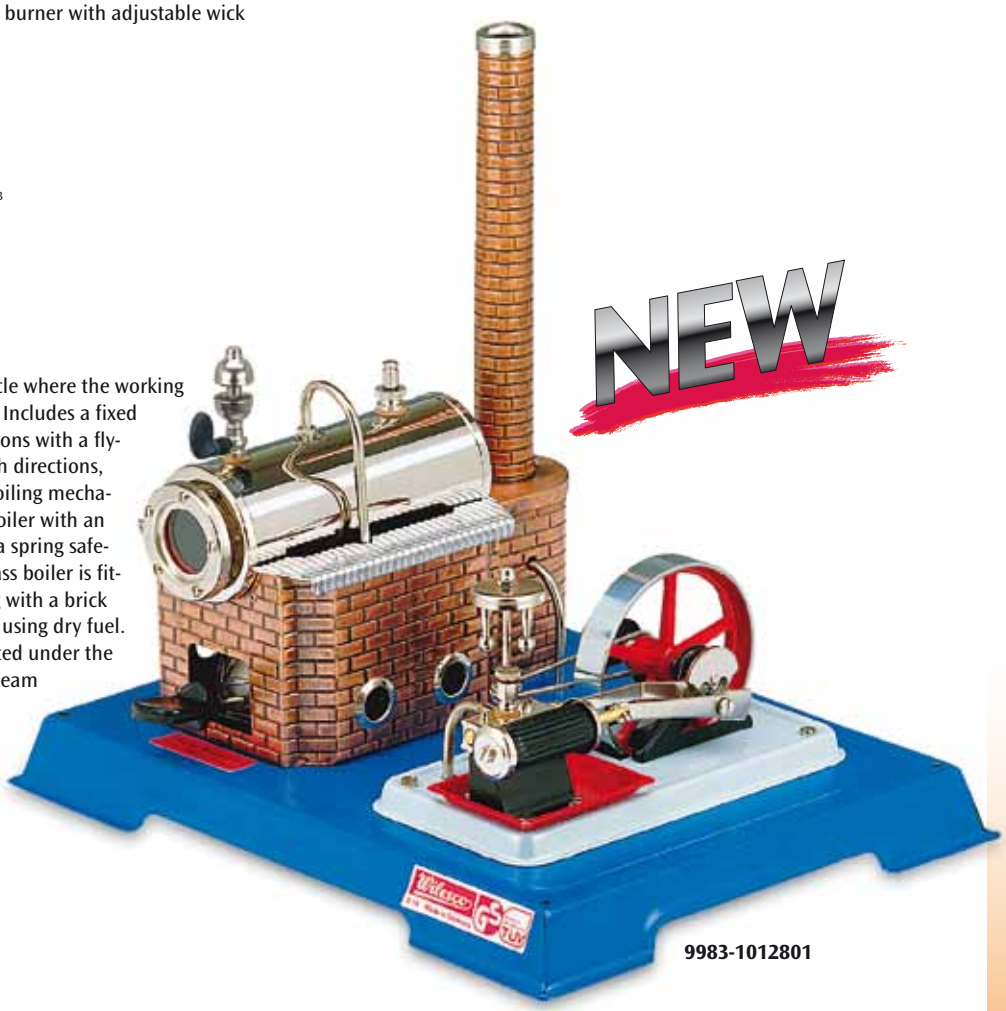
Oil for Steam Engine (not shown)
Oil for lubricating pistons, cylinders and all other bearings of the B-model steam engine (9983-1012801).

9983-1012887

Steam Engine B
Steam engine model for demonstrating a cycle where the working substance (water and steam) changes phase. Includes a fixed brass cylinder which operates in both directions with a flywheel and drive wheel also operating in both directions, plus a centrifugal governor and a steam-jet oiling mechanism. Highly polished, nickel-coated brass boiler with an inspection window to show the water level, a spring safety valve and a domed steam whistle. The brass boiler is fitted onto old-copper-coloured boiler housing with a brick pattern and a chimney. The water is heated using dry fuel. A tray for collecting condensed water is located under the chimney, allowing it to "smoke" like a real steam train.

Base:	260x200 mm
Height:	240 mm
Flywheel:	70 mm diam.
Boiler:	115 mm x 45 mm diam.
Boiler volume:	155 ml
Capacity:	120 ml approx.
Weight:	1.3 kg

9983-1012801



9983-1012801

www.EngineeringBooksPDF.com

Function Models, Transparent
Movable, transparent, function cutaway models for demonstrating the operation of various engine types on an overhead projector.
The models are made of high-grade, transparent acrylic glass, 3 – 5 mm thick, and extremely robust and durable.
Dimensions: approx. 250x250 mm²



Wankel Engine, Transparent
Cutaway model for the overhead projector
9983-1002994



Four-Stroke Engine, Transparent
Cutaway model for the overhead projector
9983-1002995



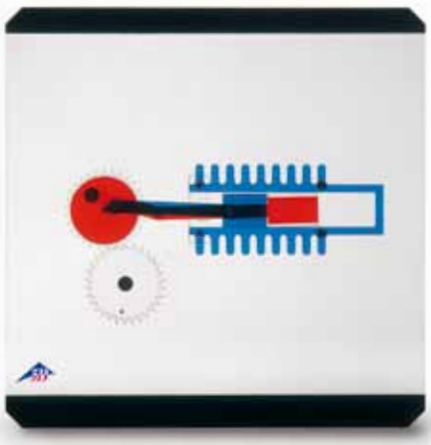
Diesel Engine, Transparent
Cutaway model for the overhead projector
9983-1002996



Steam Engine, Transparent
Cutaway model for the overhead projector.
9983-1002997



Two-Stroke Engine, Transparent
Cutaway model for the overhead projector.
9983-1002998



Stirling Engine, Transparent
Cutaway model for the overhead projector.
9983-1003000

Spirit Lamp
Made of metal, with a knurled screw for feeding the wick and cap for extinguishing the flame.
Contents: 60 ml
Dimensions: 55mm x 65 mm diam.
Weight: 50 g approx.
9983-1003565

Wick (not shown)
Spare wick for the (9983-1003565) spirit lamp.
Length: 100 mm
9983-1001048

Immersion Heater – 300 W
Immersion heater with protection against overheating (VDE-compliant).
Important: operates solely on a mains voltage of 230 V.
9983-1003566



9983-1003565



9983-1003566

www.EngineeringBooksPDF.com

Electrical Burners

Burners for experiments which would have formerly needed to be undertaken using a Bunsen burner. Designed to be both thermally and electrically safe. Heating via a column of hot air with a patented air management system. Featuring operation and temperature displays.

- Controlled via energy regulator with bimetallic strips
- Protected against overheating
- No overheating of housing during long periods of use
- Boils liquids without causing them to spit
- Perfectly sealed against spilt liquids

Liquid reservoir: Up to 140 mm in diameter
Dimensions: 170x130x195 mm³
Weight: 3.8 kg



NEW

9983-1010252

LAB2 Electrical Burner (230 V, 50 Hz)
Operating temperature: 20 … 650°C
Temperature of heating element: max. 900°C
Electrical power consumption: 500 W
Fuse: F-type, 5A, 250 V

9983-1010252



9983-1010253

NEW

LAB3 Electrical Burner (230 V, 50 Hz)
Operating temperature: 20 … 750°C
Temperature of heating element: max. 1000°C
Electrical power consumption: 900 W
Fuse: F-type, 6.3A, 250 V

9983-1010253



9983-1010254

Holder for Glassware
Complete accessories for holding test tubes or round-bottom flasks onto the grid of the LAB2 and LAB3 electrical burners. The holder remains sufficiently cool while the glassware is being heated to be safely touched with fingers.
Tube diameter: 12 mm or 35 mm approx.

9983-1010254

NEW



Set of 60 Ecoflam Pellets
Pellets for environmentally friendly generation of an open flame on the grid of the LAB2 and LAB3 electrical burners.

9983-1010255

9983-1010255



NEW

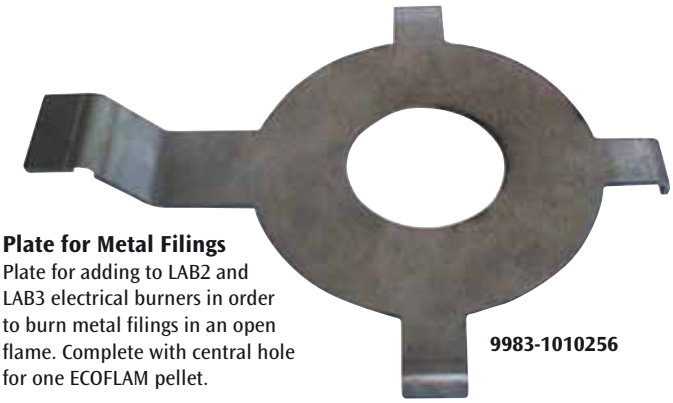


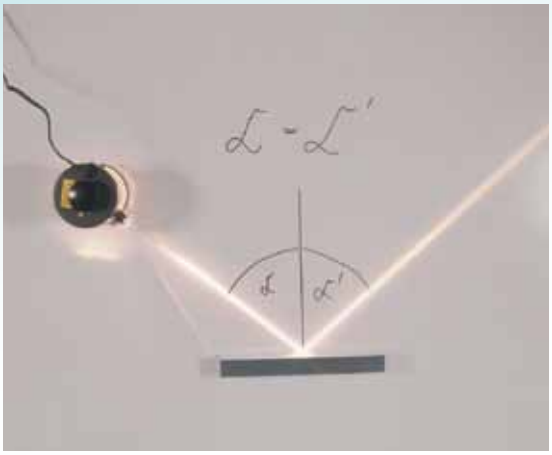
Plate for Metal Filings
Plate for adding to LAB2 and LAB3 electrical burners in order to burn metal filings in an open flame. Complete with central hole for one ECOFLAM pellet.

9983-1010256

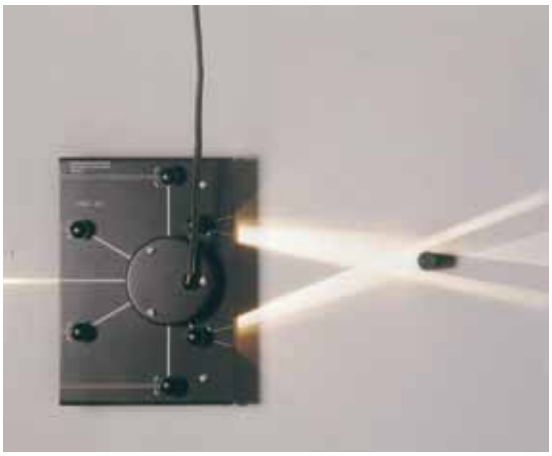
9983-1010256

NEW

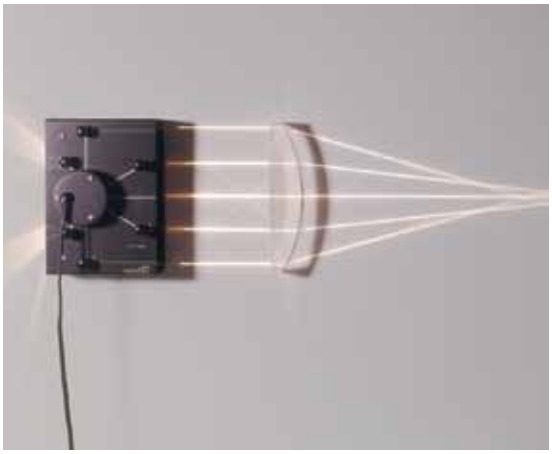
www.EngineeringBooksPDF.com



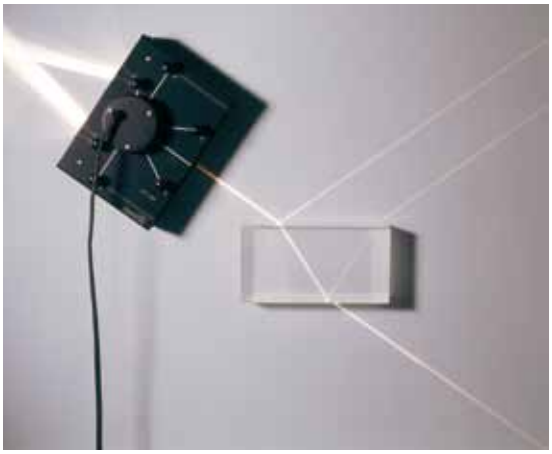
Reflection



Shadow projection



Lens errors



Refraction

Experiment topics:

- Laws of reflection
- Laws of refraction
- Total reflection
- Minimum deflection angle for a prism
- Focal determination of mirrors and lenses
- Laws of lenses and image errors
- Shadow casting



Single-Ray Projector
Light source for experiments demonstrating ray optics on a whiteboard (9983-1002591 resp. 9983-1002592). With an adjustable aperture for producing a concentrated or divergent light beam.

Lamp:	12 V, 35 W
Connecting line:	1.5 m long with 4 mm plug
Dimensions:	approx. 120 mm x 70 mm diam.
Weight:	approx. 0.25 kg

9983-1000682

Additionally required:
9983-1003323 Magnetic Holder for Single-Ray Projector

9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1006780 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

Halogen Lamp, 12 V, 35 W
(not illustrated)
Spare lamp for single-ray projector (9983-1000682).

9983-1003324

Magnetic Holder for Single-Ray Projector
Magnet holder for mounting single-ray projector (9983-1000682) on a whiteboard (9983-1002591 resp. 9983-1002592).

9983-1003323

www.EngineeringBooksPDF.com

Optics Kit for Whiteboard

Set of optical components for use in conjunction with a single-beam lamp (9983-1000682) or multiple-beam lamp (9983-1003321) on a whiteboard (9983-1002591 resp. 9983-1002592). All components are lined with magnetic foil or furnished with a magnet holder and can be easily mounted and aligned on the whiteboard. This apparatus permits a wide range of experiments demonstrating ray optics without the need for a dark room; handwritten notes can be added to provide a clearer explanation.

9983-1000604

Additionally required:
9983-1002591 Whiteboard 600x900 mm²
or
9983-1002592 Whiteboard 900x1200 mm²

9983-1000682 Single-Ray Projector
9983-1003323 Magnetic Holder for Single-Ray Projector
or
9983-1003321 Multiple-Ray Projector



9983-1000604

Contents:

Art. No.	Designation	Dimensions	Material
Mirrors:			
9983-1002984	**Plane mirror**	200x35x35 mm³	Plastic
9983-1002985	**Convex – concave mirror, f = ±100 mm**	200x35x35 mm³	Plastic
Transparent objects:			
9983-1002986	**Plano-concave lens, f = -400 mm**	200x40x35 mm³	Acrylic glass
9983-1002987	**Plano-convex lens, f = +400 mm**	200x40x35 mm³	Acrylic glass
9983-1002988	**Plane-parallel plate**	200x100x35 mm³	Acrylic glass
9983-1002989	**Semi-circular body, f = +200 mm**	diam. 200x35 mm²	Acrylic glass
9983-1002990	**Right-angled prism**	200x200x35 mm³	Acrylic glass
Shadow-casting bodies:			
	Cuboid	100x20x35 mm³	Plastic
9983-1002992	**Cylinder**	diam. 5x35 mm²	Plastic
	Cylinder	diam. 60x35 mm²	Plastic

Multiple-Ray Projector, Magnetic

Light source for experiments demonstrating ray optics on a whiteboard (9983-1002591 resp. 9983-1002592). In metal housing on magnetic foil. Experiments on reflection, refraction and basic lens laws can be performed using five narrow light rays which emerge from the right-hand side. With the help of rotating mirrors, these rays can be directed to make parallel, divergent or convergent beams, or can be masked out individually. Highly demonstrative experiments on shadow casting can be conducted using the two divergent light rays emerging from the left-hand side. With the help of rotating mirrors, these rays can be directed or masked out individually.

Lamp: 12 V, 55 W
Connecting line: 1.5 m long with 4 mm plug
Dimensions: approx. 150x200x50 mm³
Weight: approx. 0.9 kg

9983-1003321

Additionally required:
9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1006780 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

9983-1003321



Halogen Lamp, 12 V, 55 W

(not shown)
Spare halogen lamp for multiple-ray projector (9983-1003321).

9983-1003322

Whiteboards

Metal board with enamelled surface for demonstration experiments using magnetic components, e.g., for mechanics or optics. Scratch and acid resistant steel board that can be written on using water soluble pens. Can be wall mounted or set up on a stand (9983-1002664 or 9983-1002665).

Art. No.	Designation	Dimensions
9983-1002591	**Whiteboard**	600x900 mm²
9983-1002592	**Whiteboard**	900x1200 mm²



9983-1002591 + 9983-1002664

www.EngineeringBooksPDF.com

Laser Ray Box
Laser diode capable of producing up to five parallel rays, for use with related board (9983-1003056). In metal housing with magnetic foil. The number of emerging light beams can be selected electronically via switches. Power is supplied via a plug-in unit or batteries that are automatically disconnected after 60 minutes.

Diode laser:	5 beams, each max. 1 mW, Laser safety class II
Wavelength:	635 nm
Separation of laser beams:	18 mm
Plug-in power supply:	Primary 100 – 240 VAC, Secondary 3 V DC, 300 mA
Battery compartment:	for 2x 1.5 V AA-batteries (batteries not included)
Dimensions:	approx. 110x60x20 mm³

Laser Ray Box (230 V, 50/60Hz)
9983-1003052

Laser Ray Box (115, 50/60 Hz)
9983-1003051

Experiment topics:

- Law of refraction
- Law of reflection
- Total reflection
- Determining the focal length of curved mirrors and lenses
- Lens laws
- Correction of spherical aberration
- Short-sightedness and long-sightedness of the human eye and the correction of such defects
- Beam paths in cameras, microscopes and telescopes

BEST SELLER

9983-1003052



9983-1003056

9983-1003049

Board for Laser Ray Box
Magnetic board for conducting experiments with laser ray box (9983-1003052 resp. 9983-1003051). With a removable prop for inclining board.

Dimensions:	app. 600x450 mm²

9983-1003056

Equipment Set Optics with Laser Ray Box
Set of optical components for use in combination with a laser ray box (9983-1003052 resp. 9983-1003051) and related board (9983-1003056). This equipment set is ideal for conducting a wide variety of experiments on ray optics. Equipped with magnetic foil, the components can be easily attached to the board and aligned. Six work templates with pre-defined positions facilitate experiment setup. The beam paths can be observed from a relatively long way away without any need for darkening the room.

Basic length:	100 mm each (in most cases)
Thickness:	15 mm each

Contents:

1 Biconcave lens	1 Convex mirror
4 Biconvex lenses	1 Flat parallel block (60x100 mm²)
1 Plano-concave lens	1 Prism
1 Hemispherical body (45 mm)	1 Wave guide (20x200 mm²)
1 Hemispherical body (75 mm)	6 Work sheets (410x290 mm²)
1 Plane mirror	1 Experiment guide
1 Concave mirror	

9983-1003049

Additionally required:
9983-1003052 Laser Ray Box (230 V, 50/60 Hz)
or
9983-1003051 Laser Ray Box (115 V, 50/60 Hz)

9983-1003056 Board for Laser Ray Box

Laser Optics Supplemental Set with Laser Ray Box
Supplementary kit to the demonstration laser optic set with laser ray box, consisting of 13 optical components for more advanced experiments on geometric optics, e.g. experiments using air lens that show why optical elements cause either negative or positive refraction. All components are coated with magnetic foil.

Base length:	100 mm each (in most cases)
Thickness:	15 mm each

Contents:

1 Biconcave lens	2 Flat parallel blocks (rectangular)
1 Biconvex lens	2 Plane mirror
1 Equilateral prism	1 Biconcave 'air lens'
2 Rectangular prisms	1 Biconvex 'air lens'
1 Flat parallel block (square)	1 'Air prism'

9983-1003050



9983-1003050

www.EngineeringBooksPDF.com

Experiment topics:

- Focal point of a converging lens
- Focal length
- Diverging lens
- Prism
- Parallel block



9983-1003187

Five-Beam Optical Halogen Lamp 12 V, 55 W

Bright light source with five parallel light apertures for experiments involving ray optics to be conducted on a lab bench. In metal housing with integrated ventilation fan. Includes an adjustable reflecting mirror for setting the beam length. Thanks to a magnetic foil the lamp can also be used on a whiteboard.

Halogen lamp:	12 V, 50 W
Connection:	4 mm safety sockets
Slit width:	2 mm
Slit spacing:	18 mm
Housing dimensions:	approx. 210x118x85 mm³

9983-1003187

Set of Optical Components

In conjunction with the five-beam optical lamp (9983-1003187), this equipment set is intended for experiments introducing students to geometric optics. The optical components are made of acrylic glass.

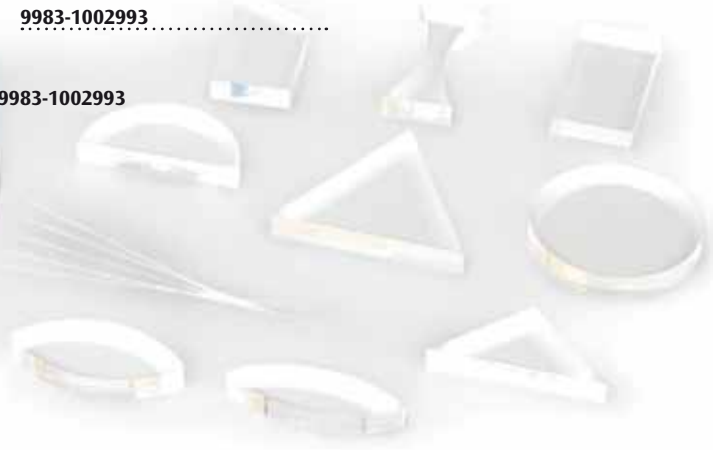
Height: 15 mm each

Contents:

1 Planar-convex lens	1 Irregular prism
2 Bi-convex lenses	1 Plane-parallel plate
1 Bi-concave len	1 Semicircular element
1 Equilateral prism	1 Cylindrical lens
1 Rectangular prism	

9983-1002993

9983-1002993



Additionally required:
9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1006780 Transformer 12 V, 60 VA (115 V, 50/60 Hz)
9983-1002993 Set of Optical Components

Experiment topics:

- Reflection and refraction of light by semicircular elements and prisms
- Snell's law
- Critical Angle

9983-1003058
9983-1003057



Optical Disc with Diode Laser

Set of apparatus for a comprehensive and easily understandable introduction to the basic principles of refraction and reflection of light by means of demonstration or student experiments. The laser can be easily attached via its built-in magnet and aligned on the end of the metal base. The rotating optical disc has an angular scale with 1° divisions and marked lines to position the elements. The set includes a semi-circular disc and an equilateral prism for use in optical experiments, as well as a plug-in mains-adapter power supply and a battery compartment (batteries are not included in the apparatus as supplied).

Diode Laser:	1 beam, Class II
Output power:	<1 mW
Wavelength:	635 nm
Operating voltage:	3 V DC
Battery-box:	for 2x 1.5 V batteries (AA, LR6, MN1500, Mignon)

9983-1003191



Laser ray box:	80x25x21 mm³
Metal base:	320x40x35 mm³
Optical disc:	250 mm diam.
Semicircular element:	90 mm diam.
Prism:	100 mm equilateral

Optical Disc with Diode Laser (230 V, 50/60 Hz)

9983-1003058

Optical Disc with Diode Laser (115 V, 50/60 Hz)

9983-1003057

Additionally recommended:
9983-1003191 Semicircular Cell

Semicircular Cell

Graduated cell with 1 mm scale division, made of acrylic glass.

Dimensions:	200 mm diam.
Height:	20 mm

9983-1003191

www.EngineeringBooksPDF.com

With a dependability that has been proven over the course of decades, the Kröncke optical system provides the precision necessary for student exercises and practical experiments in a wide range of experiments on ray optics and wave optics.

All optical components are mounted in diaphragms with no stem and can easily be moved up and down on an optical rider, perpendicular to the popular optical axis for the purpose of precise adjustment. The optical riders can be freely moved along the optical bench's U-shaped profile and secured by means of a simple clamping mechanism.

Optical Bench K

Optical bench made of black anodised aluminium profile with printed millimetre scale.
Cross-section: approx. 70x30 mm

Art. No.	Length	Weight
9983-1009699	2000 mm	2.4 kg
9983-1009696	1000 mm	1.2 kg
9983-1009926	500 mm	0.6 kg



9983-1009696

9983-1009926

9983-1000862

Halogen Lamp 12 V/20 W

(not shown)
Special substitute lamp for the optical lamp K (9983-1000863).

9983-1003533



9983-1000863

Optical Lamp K

Halogen lamp in cylindrical housing attached to diaphragm screen (100x100 mm²) for mounting on optical rider K (9983-1000862).
The filament can be aligned horizontally or vertically.
Halogen lamp: 12 V, 20 W
Terminals: 4 mm safety sockets
Dimensions: approx. 60x100x100 mm³
Weight: approx. 130 g

9983-1000863

Additionally required:
9983-1000866 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
9983-1000865 Transformer 12 V, 25 VA (115 V, 50/60 Hz)

Optical Rider K

Optical rider for K-model optical benches (9983-1009699, 9983-1009696 and 9983-1009926). With two clamps for diaphragms from the Kröncke optical system or for plates up to 2 mm thick.
Dimensions: approx. 40x50x35 mm³
Weight: approx. 70 g

9983-1000862

Prism Table K

Prism table with clip for clamping prisms. Holder fits the optical rider K (9983-1000862).

9983-1000876



9983-1000876

Micrometer Screw K

Micrometer screw with fine tip for measuring diffraction and interference lines. Holder fits the optical rider K (9983-1000862).
Dimensions: approx. 80x30x60 mm³
Weight: approx. 120 g

9983-1000887

Plane Mirror K

Simple plane mirror, glass.
Dimensions: 100x100 mm²
Weight: approx. 70 g

9983-1003532

Concave Mirror K

Concave mirror on diaphragm screen 100x100 mm².
Focal length: 180 mm
Mirror diam.: 38 mm
Dimensions: 100x100 mm²

9983-1000859

Iris Diaphragm K

Continuously adjustable iris on diaphragm screen 100x100 mm².
Aperture: 2 – 18 mm
Dimensions: 100x100 mm²

9983-1000850



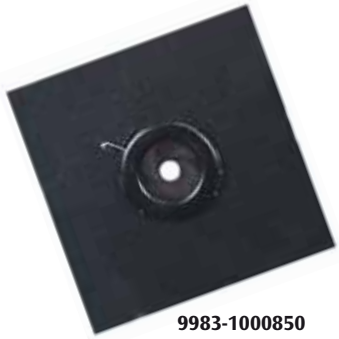
9983-1000887



9983-1003532



9983-1000859



9983-1000850

www.EngineeringBooksPDF.com

Optical Lenses K

Lenses made of high-grade optical glass. Shock-proof and crack-proof installation in optical diaphragm (100x100 mm²). With focal length specification.
Dimensions: 100x100 mm²
Lens diameter: 38 mm



9983-1000869 – 9983-1009863

Art. No.	Designation
9983-1000869	Convex Lens K, f = 50 mm
9983-1010300	Convex Lens K, f = 100 mm
9983-1000871	Convex Lens K, f = 150 mm
9983-1009861	Convex Lens K, f = 200 mm
9983-1009866	Convex Lens K, f = 300 mm
9983-1009863	Convex Lens K, f = 500 mm
9983-1009864	Concave Lens K, f = -100 mm
9983-1009865	Concave Lens K, f = -500 mm



9983-1009864 – 9983-1009865



9983-1003571



9983-1009927

Storage Box

Box made from smoked beech, varnished, with 20 compartments for lenses and optical elements of width 100 mm.
Dimensions: 400x130x90 mm³
Weight: approx. 1,000 g

9983-1003571

Projection Screens K

(not shown)
Plastic projection screens for mounting on optical rider K (9983-1000862).
Dimensions: 200x150 mm²

Projection Screen K, transparent

9983-1000878

Projection Screen K, white

9983-1000879

Fresnel Mirror K

Fresnel mirror with holder for use on K-model optical benches (9983-1009699, 9983-1009696 or 9983-1009926). Two mutually inclined surface-coated mirrors are bonded to a common metal plate. A knurled screw at the rear can be used to adjust the angle between the mirrors. The wave nature of light can be demonstrated by interference following reflection at both mirrors. Holder matches the optical rider K (9983-1000862).
Dimensions: 135x100x40 mm³
Weight: approx. 123 g

9983-1009927

Holder K for Diode Laser

Magnetic holder for diode laser (9983-1003201 resp. 9983-1003202). On diaphragm screen 100x100 mm².

9983-1000868

Clamp K

Tough clamp for diaphragms, filters, diffraction objects and other objects in a slide frame (see as of page 149). On diaphragm screen 100x100 mm².
Clamping range: 0,2 – 4 mm
Dimensions: 100x100 mm²
Round opening: 38 mm diam.

9983-1008518

Adjustable Slit K

Continuously adjustable slit on diaphragm screen (100x100 mm²). The slit width can be adjusted by means of a micrometer screw.
Slit width: 0 – 3 mm
Slit height: 25 mm
Dimensions: 100x100 mm²
Weight: approx. 240 g

9983-1008519

Pair of Polarsation Filters K

Two polarising filters on a diaphragm screen (100x100 mm²) for producing and analysing polarised light. In a rotating frame with a pointer and protractor scale.
Scale: 0 – 180°
Scale division: 5°
Dimensions: 100x100 mm²
Filter diameter: 32 mm

9983-1009929



9983-1008518



9983-1008519



9983-1009929



9983-1000868

www.EngineeringBooksPDF.com

NEW

The inexpensive NEVA optics system offers reliability and ease of use for setting up basic experiments in ray optics.

All the optical components are set in a slide with a magnetic base and can easily be aligned on a sturdy optical base and moved into a beam of light.



9983-1006791
9983-1006790



9983-4003987

Optical Bench N

Metal rail with millimetre scale and guide slots for accommodating optical components on a magnetic base.
Dimensions: 400x75x10 mm³
Weight: 230 g approx.

9983-4003987

Parallel Light Optical Lamp N

Light source for parallel and divergent beams based on a high-powered white LED in a plastic housing with a magnetic base. The outlet side for parallel light has a slot for a slide and there is also a side for outputting divergent beams. Includes 5-V-DC, 1000-mA plug-in power supply.
Dimensions: 90x70x70 mm³
Weight: 400 g approx.

Parallel Light Optical Lamp N (230 V, 50/60 Hz)

9983-1006791

Parallel Light Optical Lamp N (115 V, 50/60 Hz)

9983-1006790

Optical Lamp N

High-powered white LED in a plastic housing with a magnetic base. Includes 5-V-DC, 1000-mA plug-in power supply.
Dimensions: 90x70x70 mm³
Weight: 200 g approx.

Optical Lamp N (230 V, 50/60 Hz)

9983-1009946

Optical Lamp N (115 V, 50/60 Hz)

9983-1009945

Projection Screen N

Angled, white-painted metal projection screen for horizontal or vertical use or placement beyond the N-model optical bench (9983-4003987).
Screen area: 120x170 mm²

9983-1012891

Object Holder N

Object holder with magnetic base to accommodate optical apertures in slides (50x50 mm²), e.g. single slit N (9983-4004002) or triple/quintuple slit N (9983-4004057).

9983-1000845



9983-1009946



9983-1012891



9983-1000845

Optical Lenses N

Lenses made of high-quality optical glass. Breakage and impact-resistant, set in a slide with magnetic base.
Dimensions: 70x70 mm²
Lens diameter: 36 mm

Art. No.	Designation
9983-1000843	Convex Lens N, f = +50 mm
9983-1000842	Convex Lens N, f = +100 mm
9983-1000841	Convex Lens N, f = +300 mm
9983-1000844	Concave Lens N, f = -100 mm

Single Slit N

Single slit slide for mounting in N-model object holder or in the filter slot of the N-model parallel light optical lamp to use in optical experiments requiring a tight single beam.
Dimensions: 50x50 mm²

9983-4004002

Triple/Quintuple Slit N

Slide with a triple and a quintuple slit arrangement for mounting in N-model object holder (9983-1000845) or in the slide slot of the N-model parallel light optical lamp (9983-1006791 resp. 9983-1006790) to use in optical experiments requiring multiple tight beams.
Dimensions: 50x50 mm²

9983-4004057



9983-1000841 – 9983-1000844



9983-4004002



9983-4004057

www.EngineeringBooksPDF.com



9983-1003039 9983-1003040

9983-1003044



Optical bench U

Comprising a solid aluminium profile, anodised with natural finish, robust and resistant to twisting, with mm scale along the full length. For experiments with optical attachments on a stem.
Cross-section: approx.100x40 mm²

Art. No.	Length	Scale length	Weight
9983-1003039	1200 mm	1000 mm	approx. 3.0 kg
9983-1003040	600 mm	500 mm	approx. 1.5 kg

Optical Rider U

Optical rider for U-model optical benches (9983-1003039 and 9983-1003040) for mounting optical attachments on a stem. A smooth base ensures easy movement on the optical bench.
Clamping width for stems: 10 mm

Art. No.	Sleeve height
9983-1003041	75 mm
9983-1003042	30 mm

Experiment topics:

- Demonstration of various light beams
- Reflection of a light ray by a plane mirror
- Reflection of a beam of rays by a plane mirror
- Reflection of a beam of rays by a concave / convex mirror
- Snell's law of refraction
- Refraction by a plane-parallel plate
- Refraction by a prism
- Inverting prism
- Concave and convex lenses

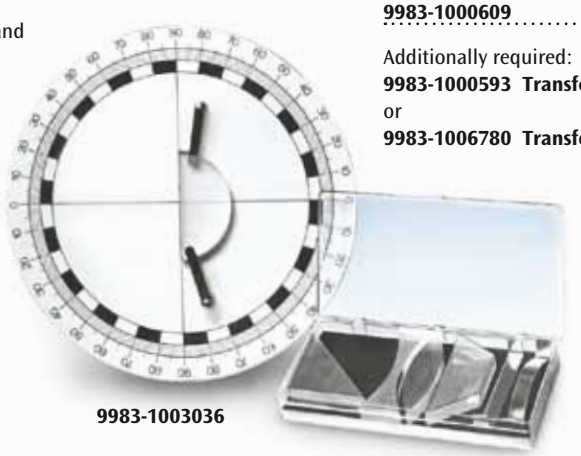
Optical Disc with Accessories

This equipment set introduces the fundamentals of geometric optics. It consists of a base plate with an angular scale possessing 1° divisions, a block scale and two bore holes for mounting clamps for optical components (lenses, prisms, mirrors). An adjustable holder and tripod permit horizontal as well as vertical installation.

Delivered with a storage case, this equipment set comprises the following items:

1 Optical disc with a holding stem and 2 clamps, 240 mm diam.
1 Bi-concave lens, 90 mm
1 Bi-convex lens, 90 mm
1 Semi-circular element, 90 mm
1 Trapezoid element, 45° and 60°
1 Prism, rectangular, leg length 50 mm
1 Combined mirror (planar, convex, concave)

9983-1003036



9983-1003036

Pair of Rail Supports

Two support feet made of natural-finish, anodised aluminium for U-model optical benches (9983-1003039 und 9983-1003040).
Dimensions: 220x20x15 mm³

9983-1003044

Swivel Joint with Scale

Connecting piece for articulated linking of two U-model optical benches (9983-1003039 and 9983-1003040). Profile rails. 90° articulation angle in both directions. Natural-finish, anodised aluminium. With a mounting for optical attachments on a stem at the axis of rotation.
Clamping width for stems: 10 mm
Scale division: 5°
Dimensions: 180x82x100 mm³

9983-1003043



9983-1003041, 9983-1003042



9983-1003043

Basic Optics Equipment Set

Complete set of apparatus for performing experiments with optical disc (9983-1003036).

Contents:

Art. No.	Description	Quantity
9983-1003039	**Optical bench U, 120 cm**	1
9983-1003041	**Optical rider U, 75 mm**	3
9983-1003042	**Optical rider U, 30 mm**	1
9983-1003038	**Experiment lamp, halogen**	1
9983-1002837	**Spare lamp, Halogen 12 V, 50 W**	1
9983-1000855	**Object holder on a stem**	1
9983-1003024	**Convex lens, f = + 150 mm (50 mm diam.)**	1
9983-1000607	**Set of slits and apertures**	1
9983-1003036	**Optical disc with accessories**	1
9983-1003034	**Storage strip**	1

9983-1000609

Additionally required:
9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1006780 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com



9983-1002628

Optical Precision Bench D

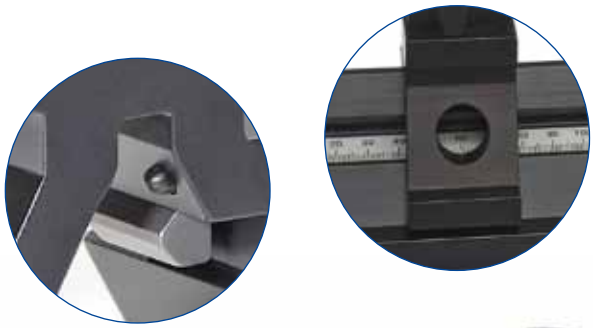
Optical precision bench with a triangular profile for research and demonstration experiments requiring maximum accuracy. Made of black, anodised aluminium. Tilt-proof, slip-proof, resistant to bending and twisting, equipped with a full-length scale with cm/mm divisions. Bore holes on front end for securing connecting elements for additional rails or swivel joint (9983-1002632). Available in three designs. On request, also available in any length up to 2000 mm (inquire about price).

Cross-section: approx. 90x60 mm³

Art. No.	Length	Weight
9983-1002630	500 mm	approx. 1.75 kg
9983-1002628	1000 mm	approx. 3.5 kg
9983-1002629	2000 mm	approx. 7 kg



9983-1002628





9983-1012400 9983-1002635 9983-1002637

Optical Rider D

Optical rider for D-model precision optical benches (9983-1002628, 9983-1002629 and 9983-1002630) for mounting optical attachments on a stem. For research and demonstration experiments requiring maximum accuracy. Made of black anodized aluminum. Thanks to a hole drilled in the middle of the base and an accompanying scale, it is possible to read off the position of the centre of the rider on the optical bench directly. The riders are preliminarily fixed to the optical bench via springy built-in plastic nipples until the grub screw is tightened. Long-term attachment is designed to protect the materials using a stainless steel pressure shoe rather than the point of a screw. The stems of the optical equipment placed on the bench are also designed to protect the materials in that they are clamped using a stainless bracket.

Clamping width for rods: 10 – 14 mm

Art. No.	Sleeve height	Base width
9983-1012400	60 mm	50 mm
9983-1002635	90 mm	50 mm
9983-1002637	120 mm	50 mm
9983-1002639	60 mm	36 mm
9983-1012401	90 mm	36 mm
9983-1012402	120 mm	36 mm



9983-1002644

Sliding Rider D

Optical rider with a mounting for optical attachments on a stem, adjustable vertically with respect to the optical axis. Sliding rider with micrometer screw for position adjustment.

Sliding range: ±12.5 mm
Sleeve height: 90 mm
Base width: 50 mm
Clamping width for rods: 10 – 14 mm

9983-1002644



9983-1012467

Tilting Rider D

Optical rider for tilting optical elements out of the optical axis.

Sleeve height: 90 mm
Base width: 50 mm
Clamping width for rods: 10 – 14 mm
Tilting range: 90°

9983-1012467

www.EngineeringBooksPDF.com

Support for Optical Bench D
One rail support and a single-point support with screws for adjusting optical bench. Made of black, anodised aluminium.
Length of rail support: 270 mm

9983-1012399



Swivel Joint for Optical Bench D
For experiments where light is deflected and where the highest precision requirements prevail. Black anodized aluminum with adjustable protactor scale ±180° in 1° divisions. Sleeve for holding optical elements shaft mounted.

Protractor scale:	±90°
Sleeve height:	60 mm
Clamping width for rods:	10 – 14 mm

9983-1002632



Optical Base D
Optical base used for mounting a U-shaped transformer core (9983-1000979) with coils and pole terminals for conducting experiments on the Faraday effect using precision optical bench D (9983-1002628).

Dimensions:	148x85x60 mm³ approx.

9983-1009733



Extension Arm D
Extension Arm to clamp on an optical rider D, for positioning optical elements out of the optical axis.

Extension arm:	100 mm
Clamping width for rods:	10 – 14 mm

9983-1002646



Optical Lamp, Halogen
Ultra-bright light source for experiments on optical bench and for projection. It consists of a metal housing with a condenser, a movable element for axial light adjustment, a holding stem with a screw mounting and an integrated fan.

Halogen lamp:	12 V, 50 W
Connection:	via 4 mm safety jacks
Condenser focal length:	75 mm
Condenser diameter:	45 mm
Stem:	120 mm x 10 mm diam.
Housing:	approx. 190x125x110 mm³

9983-1003188

Additionally required:
9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1006780 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

Experimental Lamp, Halogen
Light source with low-divergence beam for optical experiments. Black-painted metal housing on a stem, with fixture for vertical or horizontal set-up.

Halogen lamp:	12 V, 50 W
Connection:	via 4 mm safety sockets
Light aperture:	40 mm diam.
Shaft diameter:	10 mm
Dimensions:	approx. 80x80x105 mm³

9983-1003038

Additionally required:
9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1000593 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

Spare Halogen Lamp, 12 V, 50 W
(not shown)
Spare halogen lamp for optical lamps (9983-1003038 and 9983-1003188).

9983-1002837



www.EngineeringBooksPDF.com



9983-1003201

9983-1003202

Laser Diode, Red

Red light source giving a beam with minimal divergence, housed in a compact and sturdy aluminium body. It is based on a 650 nm class II industrial laser module with a glass collimating lens. Fitted with a 10 cm stainless steel rod. A 100-230V AC/DC converter is included.

Laser protection class:	II
Output power:	0.6 – 1mW
Wavelength	650 nm ±5 nm
Spot size at 5 m distance:	<8 mm diam.
Divergence	<1 mrad
Operating voltage:	6 – 12 V DC

9983-1003201

Laser Module, Green

High performance 532 nm green laser (doubled NdYag). The laser (safety classification II) produces green light ideally suitable for optical demonstrations, as the wavelength is in the range where the human eye has maximum sensitivity. The visibility is as good as that for red laser light from a 5 mW source. Fitted with a 10 cm stainless steel stem. The apparatus supplied includes a plug-in mains-adapter power supply.

Laser protection class:	II
Output power:	0.4 – 1 mW
Wavelength:	532 nm ± 0.1 nm
Spot size at 5 m distance:	< 9 mm diam.
Divergence:	< 2 mrad
Operating voltage:	3 V DC

9983-1003202

Achromatic Objective – 10x/0.25

Microscope objective for diverging beam in conjunction with He-Ne laser 9983-1003165.

9983-1005408

Objective for Beam Divergence

Microscope objective 4x mounted on an adapter for diverging the beam in conjunction with the red laser diode (9983-1003201) or the green laser module (9983-1003202).

9983-1000675



Divergence of laser beam by a microscope objective.



9983-1000675

Diode Laser

Extremely compact light source for experiment set-ups in geometrical and wave optics. Due to its compact design, sophisticated and space-saving configurations can be set up. A laser with all the safety features for both school and practical training applications:

- Instruction laser of safety class 2 with key-operated switch
- Clearly visible LED operating mode indicator
- Potentiometer to adjust output power

Laser protection class:	II
Output power:	0.5 mW up to < 1 mW, Adjustable with potentiometer
Wavelength:	650 nm ± 3 nm
Beam diameter:	2.5 mm, ±10%
Stability of the output power:	±5% in 24 h
Beam divergence:	< 2 mrad
Polarization:	random
Supply voltage:	12 V from a power supply unit
Shaft:	130 mm x 10 mm diam.
Dimensions:	approx. 50x72x54 mm³

Diode Laser (230 V, 50/60 Hz)

9983-1003007

Diode Laser (115 V, 50/60 Hz)

9983-1003006



9983-1003007
9983-1003006

He-Ne Laser

Monochromatic, coherent light source for optical experiments, e.g. on diffraction, interference, and hologram reconstitution. Anodised metal housing with key switch, neutral filter for attenuating beam, 2 stand rods and power supply unit. To widen the beam, microscope objectives (e.g. 9983-1005408) can be screwed to the beam aperture.

Laser protection class:	II
Output power:	<0.2 mW (with neutral grey filter) <1 mW (without neutral grey filter)
Wavelength:	633 nm
Beam diameter:	0.48 mm
Radiation divergence:	1.7 mrad
Mode:	TEMoo
Polarisation:	Random
Service life:	> 12000 hours
Plug-in power supply:	12 V DC, 1 A
Dimensions:	approx. 200x60x50 mm³
Weight:	approx. 0.6 kg

Contents:
1 Helium-Neon Laser
2 Keys
1 Long stand rod
1 Short stand rod, 6-edges
1 Transformer 12 V

9983-1003165



9983-1003165

www.EngineeringBooksPDF.com

Note:
All the components on stems illustrated on the following pages are supplied without an optical rider.



9983-1003028



9983-1003029

Lenses on Stem

Lenses in black frame on stem. With a lens protection ring for preventing damage to the lens.
Holder: 130 mm diam.
Shaft: 10 mm diam.

Art. No.	Designation	Focal length	Diaphragm diameter
9983-1003022	**Convex lens on stem**	+50 mm	50 mm
9983-1003023	**Convex lens on stem**	+100 mm	50 mm
9983-1003024	**Convex lens on stem**	+150 mm	50 mm
9983-1003025	**Convex lens on stem**	+200 mm	50 mm
9983-1003026	**Convex lens on stem**	+300 mm	50 mm
9983-1003029	**Convex lens on stem**	+150 mm	75 mm
9983-1003027	**Concave lens on stem**	-100 mm	50 mm
9983-1003028	**Concave lens on stem**	-200 mm	50 mm

Mirrors on Stem

Mirrors in black metal frame on stem. With protective ring for preventing damage to mirror.
Holder 130 mm diam.
Diaphragm: 50 mm diam.
Shaft: 10 mm diam.

Art. No.	Designation	Focal length
9983-1003031	**Concave mirror, on stem**	+75 mm
9983-1003032	**Convex mirror, on stem**	- 75 mm
9983-1003033	**Plane mirror, on stem**	–



9983-1003031

9983-1003032

9983-1003033



9983-1003030

Variable Focus Lens

Transparent silicone lens, on stem. The radius of curvature of the soft silicone lens can be adjusted via the water pressure in the lens using a plastic syringe, e.g. for demonstrating the accommodation capacity of the eye. Includes plastic syringe and connecting tube.
Holder: 130 mm diam.
Lens: 65 mm diam.
Shaft: 10 mm diam.

9983-1003030

www.EngineeringBooksPDF.com



9983-1000857



9983-1008667



9983-1003203



9983-1008668



9983-1000856



9983-1000855

Component Holder on Stem
Holder on steel rod for supporting an optical component of circular shape. The component is held in place by a metal ring.

Aperture:	36 mm diam.
Components:	7 mm x 42 mm diam. max.
Height of optical axis:	150 mm
Mounting:	100 mm diam.
Stem:	10 mm diam.

9983-1003203

Object Holder on Stem
Object holder in black metal frame on stem. With plug-in frame for diaphragms, filters, diffraction gratings and other objects in slide frame (see as of page 149). Includes panels to partially cover the inserted objects.

Metal frame:	130 mm diam.
Plug-in socket:	50x50 mm²
Shaft diameter:	10 mm

9983-1000855

Holder for Four Optical Components on Stem
Revolving holder on steel rod for supporting up to four circular optical components. One component at a time is rotated into the beam path, while the others are covered by a metal disc on one side.

Mounting:	130 mm diam.
Components:	7 mm x 42 mm diam. max.
Height of optical axis:	180 mm
Stem:	10 mm diam.

9983-1008667

Adjustable Slit on Stem
Slit with symmetric aperture, in black metal frame on stem. With micrometer screw.

Holder:	130 mm diam.
Slit width:	0 – 3 mm
Slit height:	25 mm
Shaft:	10 mm diam.

9983-1000856

Polarisation Filter on Stem
Precision glass polarisation filter, which is in a mounting on a steel rod and can be rotated on a ball-bearing. With angular scale marked in 1° intervals.

Aperture:	38 mm diam.
Extinction coefficient:	>99,9 % at λ = 450 – 750 nm
Height of optical axis:	150 mm
Mounting:	100 mm diam.
Stem:	10 mm diam.

9983-1008668

Total Reflection Apparatus on Stem
Plexiglas rod with bend in black metal frame on stem. Parallel light shone through the rod undergoes total internal reflection and is guided around the bent end.

Metall holder:	130 mm diam.
Shaft:	10 mm diam.

9983-1000857

www.EngineeringBooksPDF.com



9983-1003164



9983-1003016



9983-1003017



9983-1012863

Holder on Stem for Lenses without Frame
Holder with a clamp for mounting frameless lenses. In black metal frame on stem.
Holder : 130 mm diam.
Aperture: 40 mm diam.
Shaft: 10 mm diam.

9983-1003164

Iris on Stem
Iris diaphragm in black metal frame, shaft-mounted. Continuously adjustable diaphragm diameter.
Holder: 130 mm diam.
Iris diameter: 3 – 29 mm
Shaft: 10 mm diam.

9983-1003017

Rotating Object Holder on Stem
Object holder in black metal frame on stem. With rotating, plug-in frame for diaphragms, filters, diffraction gratings and other objects in slide frame (see as of page 149) with protractor scale.
Holder: 130 mm diam.
Plug-in frame: 50x50 mm
Angular scale: ±90°
Divisions: 5°
Shaft: 10 mm diam.

9983-1003016

Holder on Stem for Direct-Vision Prism
Holder with rotating mounting for direct-vision prism (9983-1002862). In black metal frame on stem.
Holder: 130 mm diam.
Shaft: 10 mm dia

9983-1012863

Storing Base for Lenses
Wooden strip with ten bore holes for storing instruments with 10 mm-shaft.

9983-1003034

Prism Table on Stem
Round prism table with a height-adjustable clamp, e.g. for fixing prisms. On stem for mounting on optical rider.
Table: 60 mm diam.
Shaft: 10 mm diam.

9983-1003019



9983-1003019

9983-1003034



...going one step further
www.EngineeringBooksPDF.com



9983-1008669

NEW

Glass Inset for Newton's Rings Experiments

Optical component for demonstrating and investigating Newton's interference rings. Composed of flat and curved glass pane in setting on a stem. Includes three adjustment screws for centring the interference module.

Height of optical beam:	150 mm
Usable diameter:	38 mm
Thickness of glass pane:	3 mm
Radius of curvature:	50 m
Diameter of setting:	100 mm
Diameter of stem:	10 mm

9983-1008669



9983-1008670

9983-1003203

NEW

Interference Filters

Narrow frequency-range optical filters for filtering out light of a specific wavelength from a spectrum featuring multiple wavelengths or for making a nearly mono-chromatic light source from a continuous spectrum.

Diameter:	40 mm
Thickness:	3 mm
Precision:	3 nm
Band width (full width half maximum):	10 nm
Transmission:	> 60 %
Parasitical transmission:	< 1 %

Art. No.	Wavelength	Filtered spectral lines
9983-1008671	436 nm	Blue mercury line
9983-1008670	546 nm	Green mercury line
9983-1008672	578 nm	Yellow mercury doublet

Additionally required:
9983-1003203 Component Holder
or
9983-1008667 Holder for Four Optical Components



9983-1002649

9983-1000608



Fresnel Mirror on Stem

This device is used to demonstrate the wave nature of light by observing interference caused by reflection at two mirrors and can be used to calculate the wavelength of light. It consists of two mutually inclined, front-coated mirrors made of black acrylic glass and fitted in black, anodized aluminum holders with firmly mounted mirror protection elements on a tripod made of high-grade steel. The angle of inclination can be finely adjusted from the rear.

Total mirror area:	30x95 mm²
Adjustment range:	-0.3° – +0.7°
Shaft:	10 mm diam.

9983-1002649

Projection Screen

Translucent screen, on stem, for all projection purposes on optical bench.

Dimensions:	250x250 mm²
Shaft:	10 mm diam.

9983-1000608



9983-1000853



9983-1000854

E14 Lamp Socket on Stem

E14 lamp socket on stem, with mains connection cable and Euro-plug conforming to CEE 7/16.

Shaft:	113 mm x 10 mm diam.
Weight:	approx. 135 g

9983-1000853

E27 Lamp Socket on Stem

E14 lamp socket on stem, with mains connection cable and earthed plug conforming to CEE 7/4.

Shaft:	113 mm x 10 mm diam.
Weight:	approx. 240 g

9983-1000854

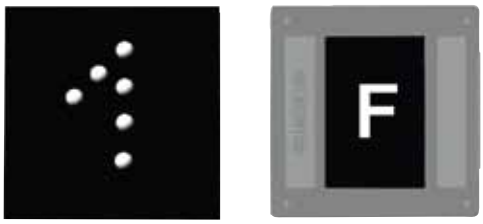
www.EngineeringBooksPDF.com

Diaphragms, diffraction objects and filters

For fitting on an object holder on a stem (9983-1000855), in a rotatable object holder on a stem (9983-1003016) or in a clamping holder K (9983-1008518).



9983-1000886



Set of 4 Image Objects

Set of four image objects in a slide frame.
Dimensions: 50x50 mm²

9983-1000886

Contents:
1 Scale, 15 mm with scale divisions of 0.1 mm
1 Photograph
1 F diaphragm
1 Number 1 diaphragm

Set of 5 Hole Diaphragms

Five hole diaphragms of different diameters in a slide frame.
Hole diameter: 1/ 3/ 6/ 10/ 15 mm
Dimensions: 50x50 mm²

9983-1000848



9983-1003185



9983-1003186

Set of 3 Colour Filters, Primary Colours

Set of 3 colour filters, primary colours, in slide frames.
Colours: Red, green, blue
Dimensions: 50x50 mm²

9983-1003185

Set of 3 Colour Filters, Secondary Colours

Set of 3 colour filters, secondary colours, in slide frames.
Colours: Cyan, yellow, magenta
Dimensions: 50x50 mm²

9983-1003186



9983-1000607

Set of 5 Slit and Hole Diaphragms

Five slit and hole diaphragms in a slide frame.
Dimensions: 50x50 mm²

Contents:
1 Slit, slit width 1 mm
1 Threefold slit, slit width 1 mm, slit spacing 5 mm
1 Fivefold slit, slit width 1 mm, slit spacing 5 mm
1 Apertured diaphragm, diam. 8 mm
1 F diaphragm

9983-1000607



9983-1000848

Set of 7 Colour Filters

Set of 7 colour filters for experiments on additive and subtractive colour combination. Colored plastic transparencies fitted in slide frame between glass plates.
Primary colours: Red, blue, green
Secondary colours: Cyan, magenta, yellow and violet
Dimensions: 50x50 mm²

9983-1003084



9983-1003084

www.EngineeringBooksPDF.com

Transmission Grating

Transmission grating for spectroscopic examinations and for experiments on diffraction and interference. Suitable to resolve the Na-D lines. Mounted on glass carrier.
Dimensions: 38x50 mm²

Art. No.	Description	Lines/mm
9983-1003080	Transmission Grating	300
9983-1003079	Transmission Grating	600



9983-1003079

9983-1003080

Diaphragm with a Single Slit and Rib

Photographic diffraction object in a slide frame.
Slit and rib width: 0.5 mm each
Dimensions: 50x50 mm²

9983-1000602



9983-1000602

Diaphragm with 3 Single Slits and 1 Double Slit

Photographic diffraction object in a slide frame.
Single slit widths: 0.075 / 0.15 / 0.4 mm
Double slit width: 0.1
Double slit spacing: 0.5 mm
Dimensions: 50x50 mm²

9983-1000885



9983-1000885



9983-1000846

Set of 5 Single Slits

Five single slits of different widths in a slide frame.
Slit widths: 0.1/ 0.2/ 0.4/ 0.8/ 1.6 mm
Dimensions: 50x50 mm²

9983-1000846

Copy of a Rowland Grating

This copy of a Rowland grating is supplied on a collodion foil between two glass plates in a metal frame for the purpose of projecting diffraction spectra, measuring wavelengths and observing spectra with spectrum lamps.
Number of lines: 600 Lines/mm
Dimensions: 50x50 mm²

9983-1002917

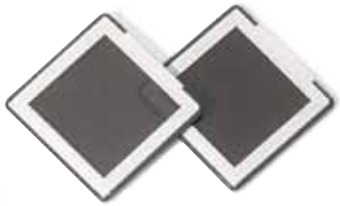


9983-1002917

Polarisation Filter

Set of two polarisation filters in a slide frame.
Dimensions: 50x50 mm²

9983-1003328



9983-1003328



9983-1003177

Hologram

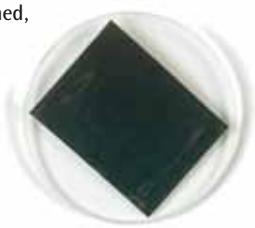
Transmission hologram in slide holder.
Dimensions: 50x50 mm²

9983-1003177

Reflection Grating

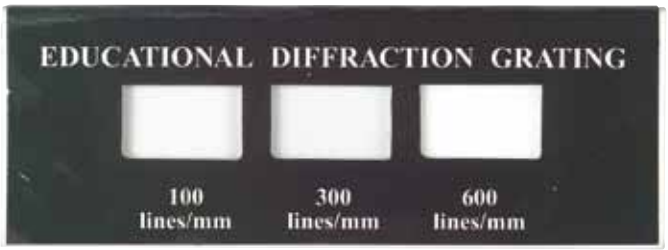
Reflection grating for demonstrating visible spectra and UV-spectra of 1st and 2nd order and when inclined, of up to 5th order. Mounted on round, concave glass carrier.
Curvature radius: 500 mm
Number of lines: 530 lines/mm
Grating dimensions: 40x30 mm²
Glass carrier: 50 mm diam.

9983-1003083



9983-1003083

9983-1003082



Demonstration Gratings

Three diffraction gratings on a frame for demonstrating the relationship between line spacing and diffraction angle.
Number of lines: 100/ 300/ 600 lines/mm.
Dimensions: 90x30 mm²

9983-1003082

www.EngineeringBooksPDF.com

9983-1000891



9983-1000889



9983-1000603



Diaphragms with Circular Holes and Discs

Photographic diffraction objects in a slide frame.
Dimensions: 50x50 mm²

Art. No.	Description	Diameter
9983-1000603	Diaphragm with 3 Circular Hole and Disc Pairs	1.0/1.5/2.0 mm
9983-1000889	Diaphragm with 9 Circular Discs	0.1 – 1.8 mm
9983-1000891	Diaphragm with 9 Circular Holes	0.1 – 1.8 mm

9983-1000596



9983-1000597



9983-1000598



Diaphragms with Double and Multiple Slits

Photographic diffraction objects in a slide frame.
Dimensions: 50x50 mm²

Art. No.	Description	Slit spacing	Slit width	No. of slits
9983-1000596	Diaphragm with 3 Double Slits of Different Widths	0.3 mm	0.10/0.15/0.20 mm	2
9983-1000597	Diaphragm with 4 Double Slits of Different Spacings	0.25/0.50/0.75/ 1.00 mm	0.15 mm	2
9983-1000598	Diaphragm with 4 Multiple Slits and Gratings	0.25 mm	0.15 mm	2/3/4/5/40

9983-1000599



9983-1000600



9983-1000601



Diaphragms with Gratings

Photographic diffraction objects in a slide frame.
Dimensions: 50x50 mm²

Art. No.	Description	Grating constant	Slit width	No. of lines
9983-1000599	Diaphragm with 3 Ruled Gratings	0.5/0.25/0.125 mm	0.25/0.125/ 0.063 mm	2/4/8 Lines/mm
9983-1000600	Ruled Gratings	0.125 mm	0.063 mm	8 Lines/mm
9983-1000601	Diaphragm with 2 Cross Gratings	0.25 mm	0.125 mm	4 Lines/mm

Gratings

Line gratings in slide frames. For students and demonstration experiments.
Dimensions: 50x50 mm²



9983-1003178



9983-1003179



9983-1003180



9983-1003181

Art. No.	Description	Lines/mm
9983-1003178	Grating	140
9983-1003179	Grating	530
9983-1003180	Grating	600
9983-1003181	Grating	1000



9983-1003081

Set of 4 Gratings

Four line gratings mounted in slide frame with protective glass plates.
For student and demonstration experiments.
Number of lines: 80/ 100/ 300/ 600 Lines/mm
Dimensions: 50x50 mm²

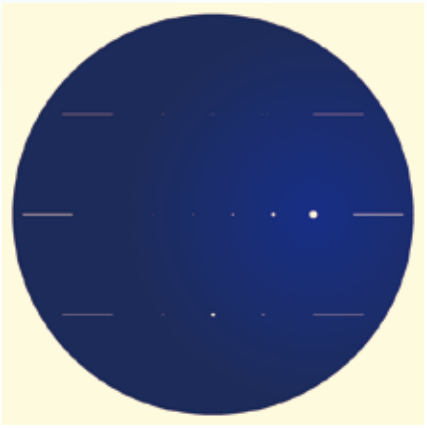
9983-1003081

www.EngineeringBooksPDF.com

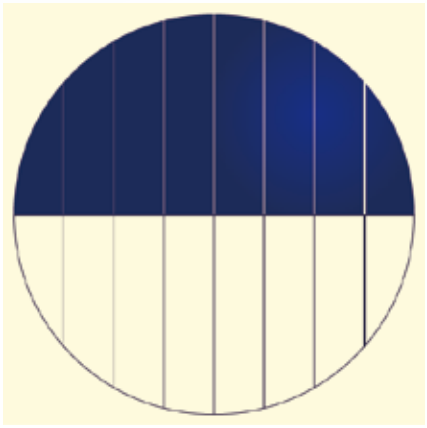
Diffraction Targets on Glass Plates

Suitable for mounting in the optical component holder (9983-1003203) or holder for four components (9983-1008667).

Chromium-coated glass plates with diffraction targets of high precision and regularity applied by microlithography. The glass supports are highly resistant against ageing and contamination.



9983-1008664



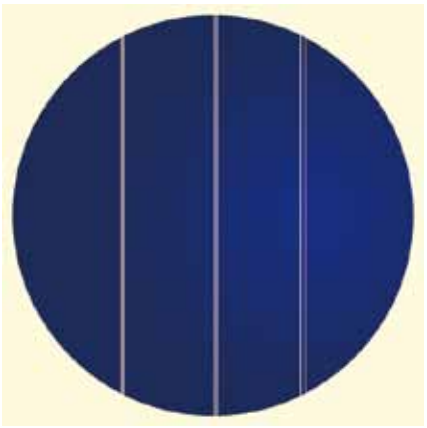
9983-1008665

Diffraction Apertures on Glass Plate

Glass plates with 12 different single and double diffraction apertures for quantitative diffraction experiments.

Diameter of support:	40 mm
Aperture irregularities:	<1 µm
Single apertures:	
Diameters:	20, 30, 50, 100, 200 and 500 µm
Double apertures:	
Separations:	100, 200 and 400 µm
Diameter:	50 µm
Rectangular apertures:	
Dimensions:	70x70 µm², 200x200 µm² and 70x200 µm²

9983-1008664



9983-1003204



9983-1008666

Slits and Bars on Glass Plate

Glass plates with 7 sets of slits and bars of different widths for quantitative diffraction experiments.

Diameter of support:	40 mm
Irregularities:	<1 µm
Slit widths:	30, 40, 60, 80, 100, 150 and 200 µm
Bar widths:	30, 40, 60, 80, 100, 150 and 200 µm

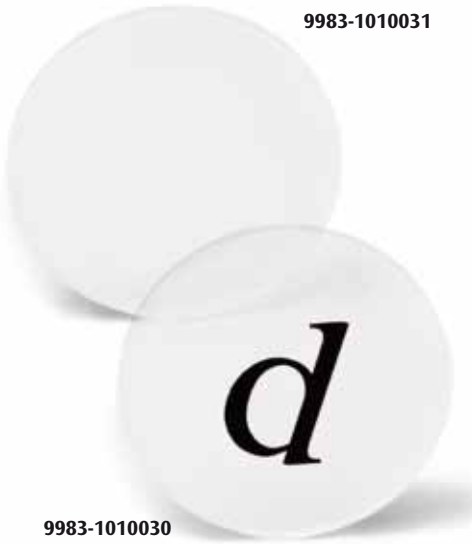
9983-1008665

Double Slits on Glass Plate

Glass plates with three double slits of different separations for quantitative diffraction experiments.

Diameter of support:	40 mm
Irregularities:	<1 µm
Slit width:	70 µm
Separations:	200, 300 and 500 µm

9983-1003204



9983-1010031

9983-1010030

Frosted Discs

Glass discs with frosted surface. Suitable for use as frosted transparent object in optical experiments.

Diameter:	40 mm
Thickness:	2 mm

Frosted Disc with "d"

9983-1010030

Frosted Disc

9983-1010031

NEW

Multiple Slits on Glass Plate

Glass plates with four different numbers of multiple slits for quantitative diffraction experiments.

Diameter of support:	40 mm
Irregularities:	<1 µm
Slit width:	40 µm
Slit separation:	100 µm
Number of slits:	3, 4, 6 and 14

9983-1008666

www.EngineeringBooksPDF.com

60° Prisms

Equilateral prisms for use on the prism table on shaft (9983-1003019) or prism table K (9983-1000876).

	9983-1002858	9983-1002859
Material	Crown glass	Crown glass
Refractive index	1.515	1.515
Side length	27 mm	45 mm
Height	50 mm	50 mm

	9983-1002864	9983-1002865
Material	Crown glass	Flint glass
Refractive index	1.515	1.608
Average dispersion	0.008	0.017
Side length	30 mm	30 mm
Height	30 mm	30 mm

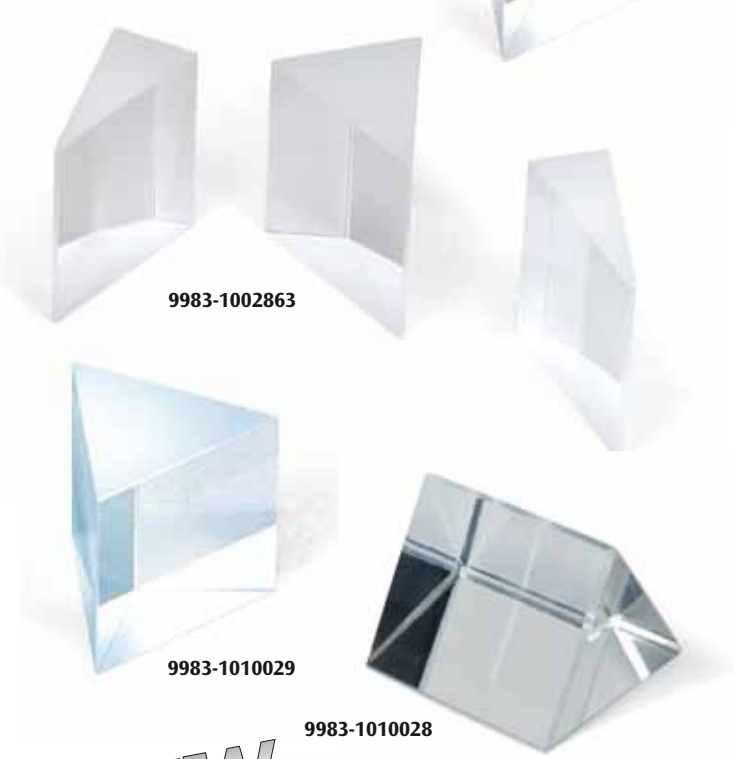
	9983-1010028	9983-1010029
Material	Crown glass	Flint glass
Refractive index	1.515	1.608
Side length	40 mm	40 mm
Height	40 mm	40 mm



90° Prisms

Rectangular prisms for use on the prism table on stem (9983-1003019) or prism table K (9983-1000876).

	9983-1002860	9983-1002861
Material	Crown glass	Crown glass
Refractive index	1.515	1.515
Side length	30 mm	45 mm
Height	30 mm	30 mm



Set of 3 Prisms

Set of prisms for demonstrating the design of an achromatic prism and a direct vision prism. Consists of a thin flint glass prism, as well as thin and thick crown glass equilateral prisms. The two thin prisms deflect a light beam equally strongly but with different dispersions. Moving them closer together in the light path results in a direct vision prism which decomposes light into its spectral components without deflecting it. The thick crown glass prism has the same dispersion as the flint glass prism, but deflects the light beam twice the distance. This permits configuration of an achromatic prism which deflects light without splitting it into a spectrum.

9983-1002863 .....

Material	Flint glass	Crown glass	Crown glass
Refractive index	1.608	1.515	1.515
Average dispersion	0.017	0.008	0.008
Base	15 mm	30 mm	18 mm
Side length	40 mm	40 mm	40 mm
Height	40 mm	40 mm	40 mm



Glass Prism, 60°

Equilateral prism made of ordinary glass.
Length of sides: 55 mm, height: 60 mm.

9983-1008681 .....

Glass Prism, 90-60-30°

Equilateral prism cut in half, made of ordinary glass.
Hypotenuse: 70 mm, height: 40 mm.

9983-1009811 .....

www.EngineeringBooksPDF.com

Accessories for Faraday Effect

Three-part set of accessories for holding a flint glass block (9983-1012860) and a U-shaped transformer core (9983-1000979) in experiments on the Faraday effect.

9983-1012861



9983-1012861

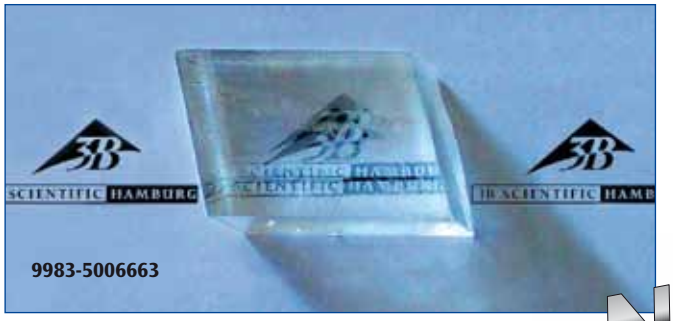
NEW



Set-up for Faraday effect

Equipment for Faraday Effect:
9983-1002628 Optical Precision Bench D
9983-1009733 Optical Base D
9983-1012860 Flint Glass Block for Faraday Effect
9983-1012861 Accessories for Faraday Effect
9983-1000979 U Core
9983-1000978 Pair of Pole Shoes
9983-1000977 Pair of Clamps
9983-1012859 Coil D 900 Turns (2x)

9983-1012857 DC Power Supply 1 – 32 V, 0 – 20 A (230 V, 50/60 Hz)
or
9983-1012858 DC Power Supply 1 – 32 V, 0 – 20 A (115 V, 50/60 Hz)
9983-1002843 Set of 15 Safety Experiment Leads, 75 cm
9983-1008668 Polarisation Filter on Stem (2x)
9983-1002635 Optical Rider D, 90/50
Light source with colour filter or laser



9983-5006663

Flint Glass Block for Faraday Effect

Rectangular block made of flint glass for demonstrating optical activity in a magnetic field (Faraday effect).
Dimensions: 20x10x10 mm³

9983-1012860

NEW



9983-1012860

Doubly Refracting Crystal

Calcite crystal showing the birefringence in crystals.

9983-5006663

NEW



9983-1008652

Fresnel Biprism

Fresnel biprism for observing interference by creating two virtual sources of light by refracting the light from a single coherent source.
Dimensions: 50x50x2 mm³
Prism angle: 179° approx.
Refractive index: 1.5231

9983-1008652



9983-1000895

Inverting Spectacles

Spectacles with two fully rotatable inverting prisms in a shielded spectacle frame. The inverting prisms reverse incoming light rays, turning the world upside down, so to speak, and making it unexpectedly difficult for the wearer to perform even the simplest of daily tasks such as reaching for objects, drawing, moving about in a room etc.

9983-1000895

Amici Direct Vision Prism

A combined prism for splitting light beams into a spectrum without deflecting them. Comprises an alternating combination of two crown glass prisms and one flint glass prism; blackened on the outside.
Dispersion angle: 4.2°
Dimensions: approx. 105x20x20 mm³

9983-1002862



9983-1002862

Additionally recommended:
9983-1012863 Holder for Direct-Vision Prism on Stem

www.EngineeringBooksPDF.com

Experiment Topics:

- Refraction and interference at the surfaces of a glass block, apertured diaphragm, square diaphragm, grating with slits, cross grating
- Michelson interferometer
- Investigation of linearly polarised light
- Absorption of light
- Reconstruction of a hologram



9983-1003053

Equipment Set for Wave Optics with Laser

Equipment set for demonstrating fundamental phenomena in wave optics by means of practical experiments. The light source is provided by a partially polarised diode laser with adjustable mount. Power is supplied from a plug-in power supply (included) or from batteries. The components are magnetic and can be placed horizontally or vertically on the included metal board, according to the set-up required for the various experiments. All components are stored in a case with shaped foam inlay.

Diode laser:	max. 1 mW, laser safety class II
Wavelength:	635 nm
Plug-in power supply:	primary 100 V AC – 240 V AC secondary 3 V DC, 300 mA
Battery holder:	for 2x 1.5 V AA batteries (batteries not included)

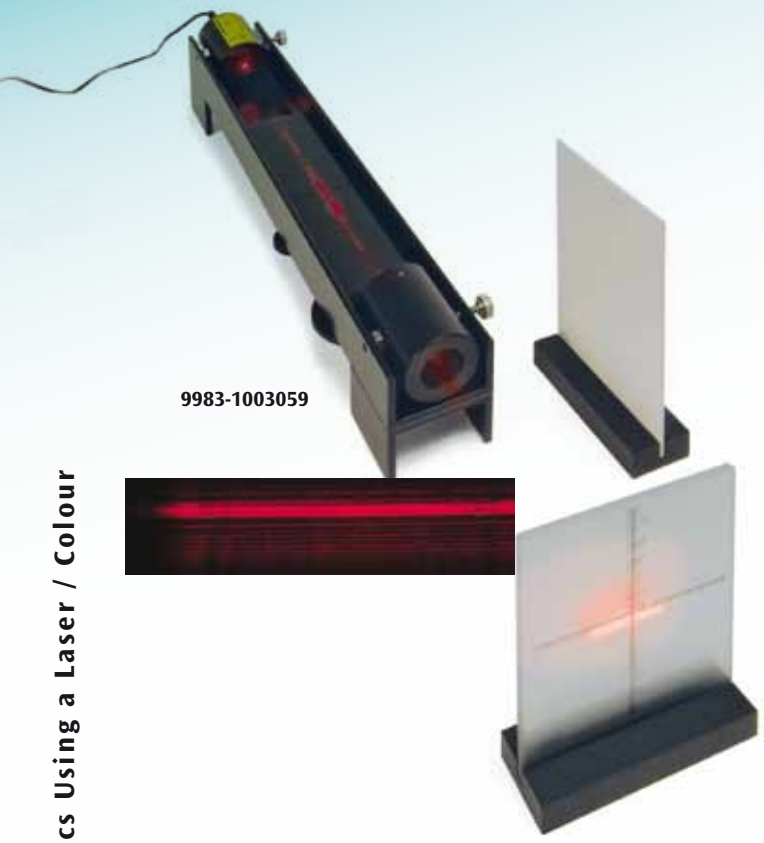
Contents:

1 Diode laser with adjustable mounting
1 Plug-in power supply
1 Battery holder (without batteries)
2 Mirrors with adjustable mounting
1 Half-silvered mirror
1 Screen, white
1 Screen, frosted glass
1 Convex lens
1 Polarisation filter
1 Holder for lens and filter
3 Colour filters in slide frames (red, green, blue)
2 Apertured diaphragms in slide frames
2 Square diaphragms in slide frames
3 Gratings with slits in slide frames
1 Cross grating in slide frame
1 Glass plate in slide frame
1 Holder for slide frames
1 Hologram
1 Metal board (60x45 cm²) with removable strut
4 Rubber feet for metal board
1 Storage case
1 Experiment guide

9983-1003053



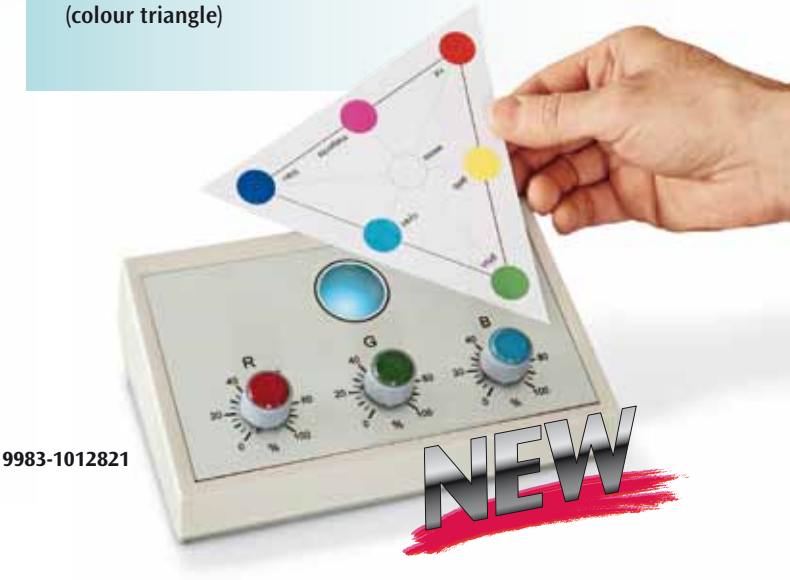
www.EngineeringBooksPDF.com



9983-1003059

Experiment topics:

- The three primary colours
- Creating colours by additive colour mixing
- Components of primary colours in mixed colours
- Colours on a monitor screen
- Principles of perceiving colours (colour triangle)



9983-1012821

NEW

Fresnel Mirror Experiment Set
Complete equipment set for demonstrating the wave nature of light by observing the interference of laser light. This is caused by the reflection of a laser at two black planar glass mirrors which are offset by a small angle of a few minutes. The laser, mirrors and the optical projector are all mounted on a metal base. One mirror is fixed and the other is adjustable to change the angle of inclination. A projection screen, a ground glass screen with scaled crosshairs and a battery box are also included.

Diode Laser:	class II
Output power:	< 1 mW
Wavelength:	635 nm
Operating voltage:	3 V DC
Battery-box:	for 2x 1.5 V batteries (AA, LR6, MN1500, Mignon) (batteries not included)
Dimensions:	
Metal base:	400x75x85 mm³
Screens:	150x90x30 mm³

9983-1003059

Additionally recommended:
9983-1008659 Plug-In Power Supply 3 V DC

Plug-In Power Supply 3 V DC (not shown)
Plug-in mains adapter to provide electrical power supply for the Fresnel mirror experiment set (9983-1003059).

Mains voltage:	100 – 240 V, 50/60 Hz

9983-1008659

"Addition of Colours" School Apparatus
Handy desk-top device for investigating additive mixing of the primary colours, red, green and blue (RGB) to make any other colour. Three adjustment mechanisms allow any intensity of each primary colour to be selected so that various components of LED light can be mixed and observed with the help of a frosted glass screen. Includes 12 V/500 mA plug-in power supply and instruction manual for a colour triangle.

Dimensions:	192x65x120 mm³

9983-1012821

9983-1010194



Newton's Colour Disc, with Crank
Newton's Colour Disc for demonstrating additive combination of colours. Mounted on a stable base, moved with crank.

Diameter of disc:	178 mm
Dimensions of the base:	143x90x282 mm³

9983-1010194

NEW



9983-1010175

NEW

Newton's Colour Disc, with DC Motor
Newton's Colour Disc for demonstrating additive combination of colours. Mounted on a stable box, moved by a DC motor.

Diameter of disc:	90 mm
Motor:	4 … 6 V DC
Connection:	4 mm safety sockets
Dimensions:	135x85x130 mm³

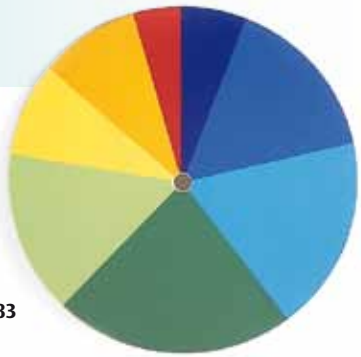
9983-1010175

Additionally required:
9983-1002849 Pair of Safety Experiment Leads, 75 cm
9983-1003560 DC Power Supply 1.5 – 15 V, 1.5 A (230 V, 50/60 Hz)
or
9983-1003559 DC Power Supply 1.5 – 15 V, 1.5 A (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

Experiment topics:

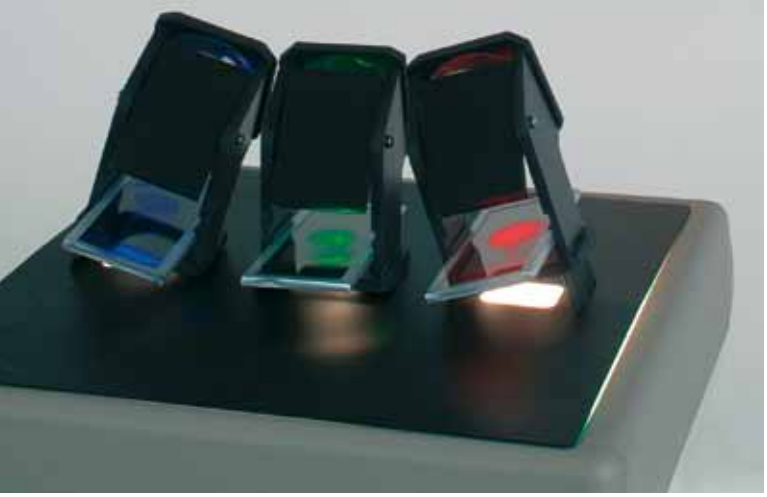
- Additive colour mixing
- Subtractive colour mixing



9983-1002983



9983-1003189



Equipment Set for Colour Mixing

Equipment set for demonstrating how colours combine (with the aid of an overhead projector). This equipment set is designed to permit quick setting up and safe, simple operation. The clear configuration facilitates understanding of the experiments and allows direct viewing of results. The projection plate, along with its three holders for mirrors and lenses, is placed onto the projection surface of the overhead projector. Depending on the projection distance, three large circles with diameters of 30 to 80 cm appear on the projection screen. By turning the holders and mirrors, it is possible to project colours so that they are separated or so that they partially overlap. Such adjustments can be performed easily and precisely. The large colour filters can be simply inserted into the lens holders, or placed directly on the overhead projector.

Contents:
1 Projection plate with three mirror and lens holders
3 Colour filters; red, green, blue (120x50 mm²)
3 Colour filters; cyan, yellow, magenta (120x50 mm²)

9983-1003189

Additionally required:
9983-1003264 Overhead Projector (230 V, 50/60 Hz)
or
9983-1003263 Overhead Projector (115 V, 50/60 Hz)

Newton's Colour Disc

Plastic, circular disc with segments coloured red, orange, yellow, light green, dark green, light blue, dark blue and violet for demonstrating additive combination of colours. When the disc is turned rapidly, its colours merge to produce white.

Diameter: 170 mm

9983-1002983

Additionally required:
9983-1002705 Motor with Drive Control

Motor with Drive Control

Controllable motor for spinning the colour disc fast (9983-1002983). With disc holder and clamp for attachment to a stand rod. Including plug-in power supply.

Control range:	0 – 25 rev/s
Rotation direction:	reversible
Dimensions:	approx. 110x70x45 mm³
Weight:	approx. 0.2 kg

9983-1002705

Additionally recommended:
9983-1002835 Tripod Stand, 150 mm
9983-1002934 Stainless Steel Rod, 470 mm



9983-1002705

www.EngineeringBooksPDF.com

CCD Linear Camera
Intended for investigating all optical phenomena in real time, this precision CCD linear camera consists of a measuring head with a CCD linear array and data acquisition accessories. The scope of supply includes user-friendly software, neutral grey filters, a USB cable and a storage case.

Measurement Head with a CCD Linear Array

Resolution:	2048 pixel (14x200 µm)
Sensitive length:	30 mm
Neutral-grey filter:	density factor 3.0: black/white
Integration time (remote or direct control):	5 ms to 42.5 ms – step 2.5 ms
Rod:	170 mmx10 mm diam.
Computer Connection:	USB interface
Refresh rate:	20 fps @ P233 MMX – RAM 16 Mo

System Requirements

Operating system:	Windows
Screen resolution:	at least 640x480 pixels with 256 colors

Software
The multi-lingual software offers a wide range of functions: Real-time displays for observing time-dependent phenomena, for example, during experiment adjustments

- Adjustable sensitivity of the measuring head in accordance with the intensity of the light source
- Representation of the intensity distribution of interference spectra in diagrams and grey stages, as well as coloured display of measured emission and absorption spectra
- Measurement functions such as adjustable axis scaling, grids, vertical and horizontal cursor with corresponding displays, peak-search routine with display of intensity and position, zoom
- Signal processing functions such as smoothing, averaging and inversion of spectra, Fast-Fourier Transformation
- Simulations for comparing theoretically calculated interference and diffraction intensity distributions with experimental data
- Storage, printing, online help and export of data and graphics (in the form of word processing, spreadsheet and bitmap files)

Experiment topics:

Spectrometer

Investigations of
- Emission and absorption spectra
- Transmission curves of filters
- Spectral resolution of white light

Wave Optics
Display and measurement of diffraction and interference spectra, for example, diffraction at a slit, pinhole, grating, Newton's rings, Fresnel mirrors; comparison of measured spectra with theoretical calculations.

Geometric Optics
For example, measurement of focal lengths, enlargements and divergence of a light beam.

Time-Dependent Data Acquisition
For measuring light modulation on a pixel, for instance, oscillations of monochromatic light sources, measurement of doublets in emission and absorption spectra (e.g. sodium, mercury). Fast Fourier transformation allows wavelengths to be determined.

Contents:
CCD linear camera
Neutral-grey filter
Manual with experiment descriptions
Software for data recording and evaluation
USB cable
Transport case

CCD Linear Camera

9983-1013311

Additionally required:
9983-1003152 Polarisation Filter (2x)

Additionally recommended:
9983-1003007 Diode Laser (230 V, 50/60 Hz)
or
9983-1003006 Diode Laser (115 V, 50/60 Hz)

9983-1003203 Component Holder on stem
9983-1008664 Diffraction Apertures on Glass Plate
9983-1008665 Slits and Bars on Glass Plate
9983-1003204 Double Slits on Glass Plate
9983-1008666 Multiple Slits on Glass Plate



9983-1003007
9983-1003006

9983-1013311

www.EngineeringBooksPDF.com

Polarisation Filter

High-grade glass filter for producing and studying linearly polarised light.
In a rotatable frame with pointer and thread.

Degree of polarization:	99.9 %
Holder diameter:	50 mm
Filter diameter:	45 mm
Thread:	M49

9983-1003152



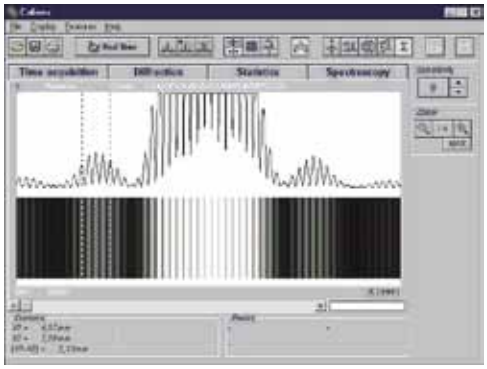
9983-1003152

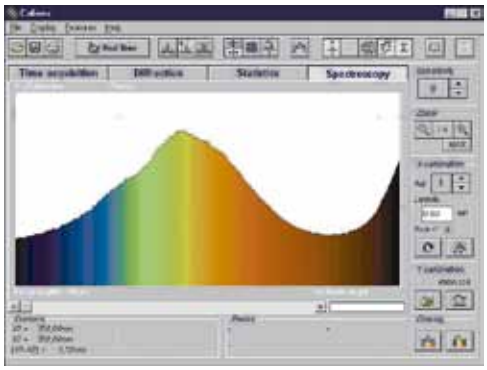


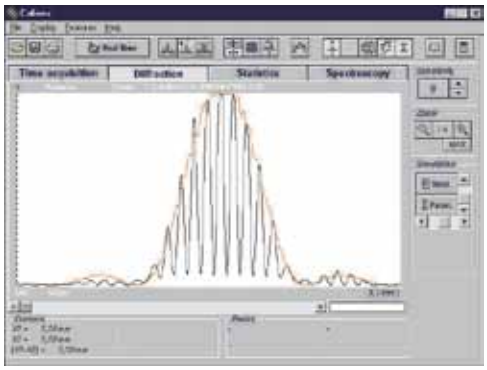
9983-1013311

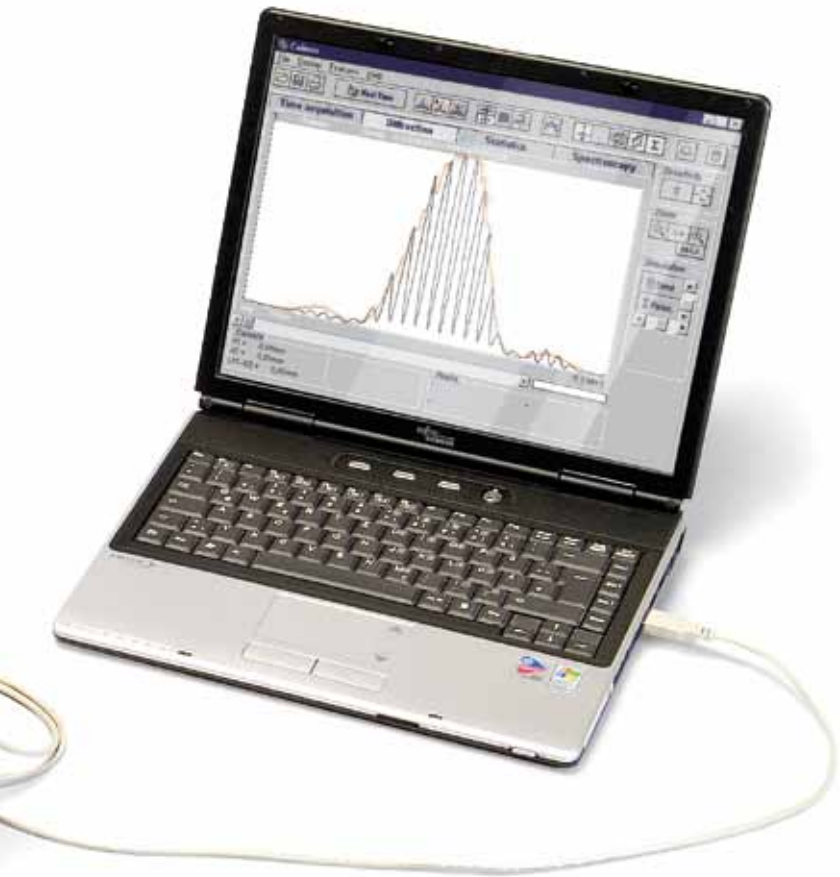












www.EngineeringBooksPDF.com



9983-1002906

Demonstration Polarimeter

Device for use on an overhead projector to demonstrate optical activity and determine specific angles of rotation and concentrations at known specific angles of rotation. A yellow filter (for more precise measurement accuracy) and a polarizer are embedded in a black plastic base plate. A cell containing a solution of the substance to be investigated with 50 mm and 100 mm markings is inserted into the holder. The analyzer is situated above this set-up in a holder with rotary handle and pointer. By turning the analyser, it is possible to ascertain the angle of rotation and read it off a transparent angle scale.

Cuvette:	Markings at 50 mm and 100 mm
Angle scale:	-40° – +40°
Scale divisions:	1°
Dimensions:	approx. 370x330x190 mm³

9983-1002906

Additionally required:
9983-1003264 Overhead Projector (230 V, 50/60 Hz)
or
9983-1003263 Overhead Projector (115 V, 50/60 Hz)

Demonstration Polariscope

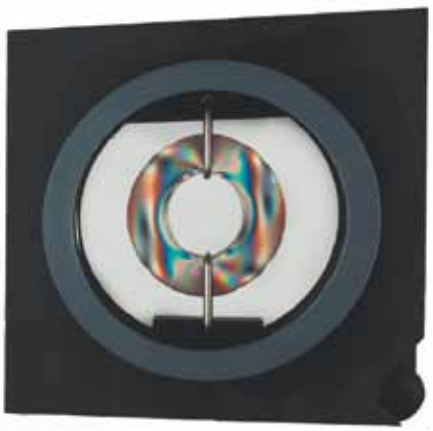
Apparatus for use on an overhead projector to demonstrate a photo-elastic image in samples subjected to stress and strain. The polarising filter is incorporated into the base plate of the frame; the analyser is embedded in the laterally swivelling upper base plate. Via the spindle drive, a tensile or pressure load can be exerted on the test body.

Samples:	Epoxy-resin
Dimensions:	approx. 150x150x45 mm³
Total weight:	approx. 820 g

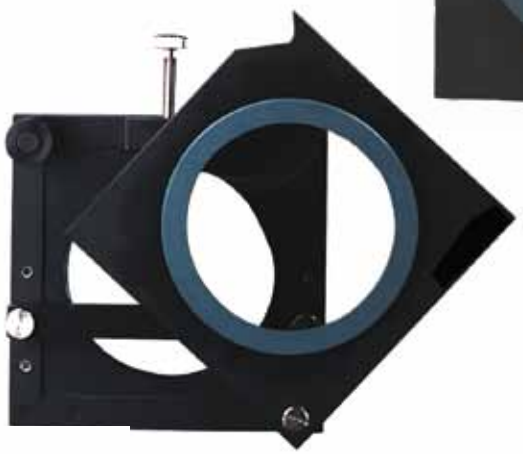
Contents:
1 Basic apparatus
2 Metal clamps for applying tension
1 Ring, 60 mm diam.
1 Block, 60x10x10 mm³
2 Blocks, 20x10x8 mm³
3 Triangles to lay on surface

9983-1000851

Additionally required:
9983-1003264 Overhead Projector (230 V, 50/60 Hz)
or
9983-1003263 Overhead Projector (115 V, 50/60 Hz)



9983-1000851





9983-1001057
9983-1001056

Polarimeter with 4 LEDs

Polarimeter with a lighting unit comprising four monochromatic LEDs for determining the angle and direction of rotation of polarised light as a function of wavelength as well as sample thickness and concentration with the help of an optically active substance. The light emerging from those LEDs that are lit is polarised linearly and transmitted through a fitted sample cylinder filled with the optically active substance. The analyser in the cover is used to identify the direction of polarisation which can be read on the cover's angle scale.

Wavelength of LEDs:	468 nm (blue), 525 nm (green), 580 nm (yellow), 630 nm (red)
Dimensions:	approx. 110x190x320 mm³
Weight:	approx. 1 kg

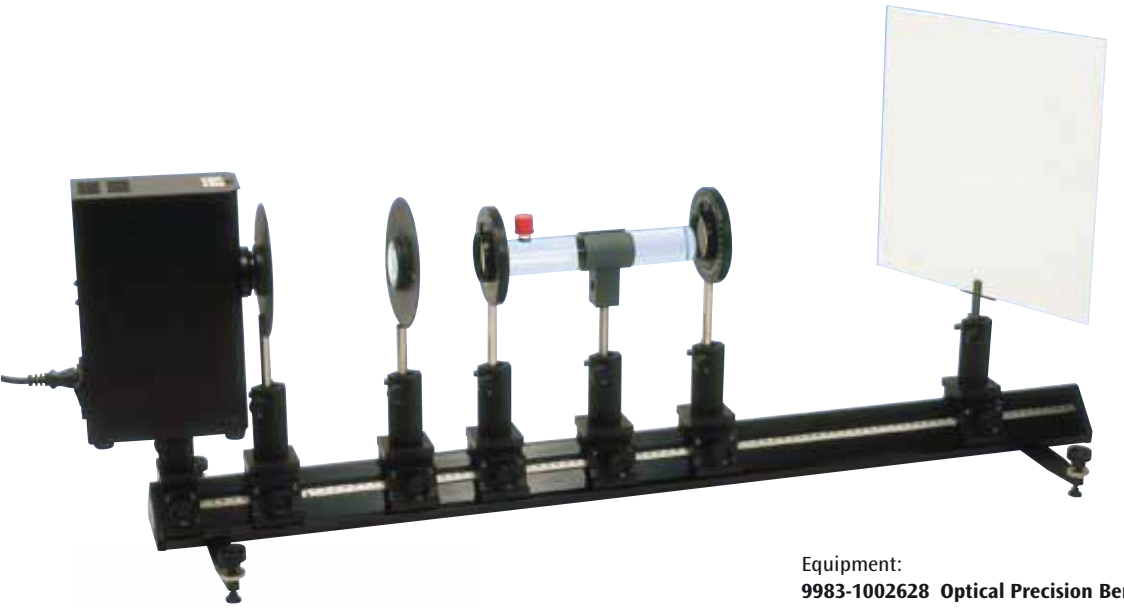
Polarimeter with 4 LEDs (230 V, 50/60 Hz)

9983-1001057

Polarimeter with 4 LEDs (115 V, 50/60 Hz)

9983-1001056

www.EngineeringBooksPDF.com



Determination of the angle of rotation of optically active substances

Equipment:
9983-1002628 Optical Precision Bench D, 1000 mm
9983-1012400 Optical Rider D, 60/50 (2x)
9983-1002635 Optical Rider D, 90/50 (5x)
9983-1002721 Cell Holder on Stem
9983-1002884 Round Cell, 200 mm
9983-1002885 Round Cell, 100 mm
9983-1003017 Iris Diaphragm on Stem
9983-1003022 Convex Lens on Stem, f = 50 mm
9983-1000608 Projection Screen
9983-1008668 Polarisation Filter on Stem (2x)
9983-1003159 Na Low-Pressure Spectral Lamp (230 V, 50/60 Hz)



9983-1002721



9983-1002885

9983-1002884

Round Cells
Duran glass cells with bonded optical discs and GL threads. E.g. for experiments on the determination of the angle of rotation of optically active substances on the optical bench.
Diameter: 35 mm
Thread: GL-14

Round Cell, 100 mm
9983-1002884

Round Cell, 200 mm
9983-1002885

Polarimeter
Polarimeter with a sodium lamp as the light source for the measurement of the rotation and the rotation direction of the polarization plane of polarized light through optically active substances as well as the determination of the concentration of liquids. Robust metal stand with slightly tilted shaft for tubes with lengths up to 220 mm. With swivel cover, analyzer and polarizer. A sodium lamp with filter holder is used as a light source. Includes polarimeter tubes 100 mm, 200 mm and spare sodium lamp.

Measurement range:	2 semi-circles (0 – 180°)
Glass tubes:	100 and 200 mm, 15 mm diam.
Scale division:	1°
Readability:	0.05° (with Vernier scale)
Dimensions:	200x360x450 mm³
Weight:	10 kg
Light source:	Sodium lamp (589 nm)
Mains voltage:	115 V … 230 V, 50/60 Hz

9983-1008696



9983-1008696

Cell Holder on Stem
Plastic holder for round cells (9983-1002884) and (9983-1002885).
Holder: 36 mm diam.
Stem: 90 mm x 10 mm diam.

9983-1002721

Spare Sodium Lamp (not shown)
Spare lamp for polarimeter (9983-1008696).

9983-1012885

Polarimeter Tube 100 mm
(not shown)
Spare glass tube for polarimeter (9983-1008696).
Length: 100 mm, 15 mm diam.

9983-1012883

Polarimeter Tube 200 mm
(not shown)
Spare glass tube for polarimeter (9983-1008696).
Length: 200 mm, 15 mm diam.

9983-1012884

www.EngineeringBooksPDF.com

Control Unit for Spectrum Lamps

Control unit for operating spectral lamps (9983-1003537 – 9983-1003546), including a lamp housing on a stand rod. A second lamp housing on a stand rod can be clamped to the rear side of the stable metal housing and connected to the electricity supply. A switch on the front can be used to change over between the right-hand and left-hand spectral lamps.

Maximum output current:	1 A
Lamp housing:	180 mm x 50 mm diam.
Tripod rod:	300 mm x 10 mm diam.
Lamp socket:	Pico 9
Dimensions:	approx. 255x175x135 mm³
Weight:	approx. 5.3 kg

Contents:
1 Control unit
1 Lamp housing on a stand rod with a 7-pole connection cable

Control Unit for Spectrum Lamps (230 V, 50/60 Hz)
9983-1003196

Control Unit for Spectrum Lamps (115 V, 50/60 Hz)
9983-1003195

Additionally recommended:
9983-1003197 Lamp Housing on a Stand Rod

Lamp Housing on a Stand Rod (not shown)

Additional lamp housing with a cable for connecting to a spectral lamp ballast coil (9983-1003196 resp. 9983-1003195).

9983-1003197

Spectrum Tube Power Supply

Control unit for stable operation of spectral tubes (9983-1003402 – 9983-1003417). The integrated current limiter ensures a long service life of the tubes. Spring-contacts in fully insulated fixtures and a protective window guarantee secure mounting and reliable operation.

Voltage:	5000 V
Maximum current:	10 mA
Dimensions:	approx. 370x120x90 mm³

Spectrum Tube Power Supply (230 V, 50/60 Hz)
9983-1000684

Spectrum Tube Power Supply (115 V, 50/60 Hz)
9983-1000683

Spectrum Tubes

High luminance spectral tubes emitting the line or band spectrum of a gas or mercury vapour. Partly evacuated capillary glass tubes filled with gas or mercury vapour are furnished with electrodes for the application of a voltage to generate the electrical field that provides the necessary energy.

Capillary length:	100 mm
Total length:	approx. 260 mm

Spectral Lamps

Gas discharge lamps for emitting line spectra of inert gases and metal vapours with high luminance and spectral purity.

Socket:	Pico 9
Operating current:	max. 1A
Weight:	approx. 350 g

Additionally required:
9983-1003196 Control Unit for Spectrum Lamps (230 V, 50/60 Hz)
or
9983-1003195 Control Unit for Spectrum Lamps (115 V, 50/60 Hz)



9983-1003537 / 9983-1003546

Art. No.	Filling
9983-1003537	Cd
9983-1003539	He
9983-1003541	Na
9983-1003543	Ne
9983-1003544	Tl
9983-1003545	Hg 100
9983-1003546	Hg/Cd

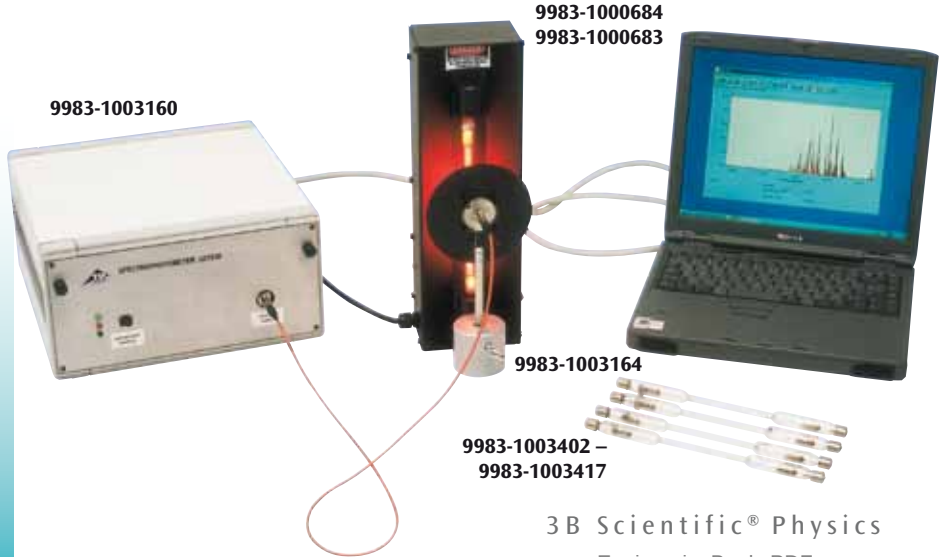


9983-1003196
9983-1003195



9983-1000684
9983-1000683

Additionally required:
9983-1000684 Spectrum Tube Power Supply (230 V, 50/60 Hz)
or
9983-1000683 Spectrum Tube Power Supply (115 V, 50/60 Hz)



9983-1000684
9983-1000683
9983-1003160
9983-1003164
9983-1003402 – 9983-1003417

Art. No.	Filling
9983-1003402	Air
9983-1003403	Argon
9983-1003404	Bromine
9983-1003405	Carbon dioxide
9983-1003406	Chlorine
9983-1003407	Deuterium
9983-1003408	Helium
9983-1003409	Hydrogen
9983-1003410	Iodine
9983-1003411	Krypton
9983-1003412	Mercury
9983-1003413	Neon
9983-1003414	Nitrogen
9983-1003415	Oxygen
9983-1003416	Water vapor
9983-1003417	Xenon

www.EngineeringBooksPDF.com

High-Pressure Mercury Spectral Lamp

Gas discharge lamp for observing high-intensity mercury spectral lines at high vapour pressures. Lines in the ultra-violet range are suppressed by the glass body. Includes a black metal housing with integrated power supply unit, a light aperture with a fine thread for direct screw-mounting of filters and a threaded stand rod.

Luminance:	1800 lm
Operating current:	0.6 A
Power:	50 W
Base:	E27
Service life:	approx. 24000 h
Threaded light aperture:	40 mm diam.
Fine thread for filter:	M49
Dimensions:	approx. 242x153x80 mm³
Weight:	approx. 2.4 kg

9983-1003157

Low-Pressure Mercury Spectral Lamp (230 V, 50/60 Hz)

Gas discharge lamp for observing mercury spectral lines at low vapour pressures with optimal line widths. The body is made of quartz glass to allow detection of lines in the ultra-violet range too. Includes a black metal housing with integrated power supply unit, a light aperture with a fine thread for direct screw-mounting of filters and a threaded stand rod.

Operating current:	0.16 A
Power:	6 W
Base:	G5
Service life:	approx. 3000 h
Threaded light aperture:	40 mm diam.
Fine thread for filter:	M49
Dimensions:	approx. 242x153x80 mm³
Weight:	approx. 2.2 kg

9983-1003158



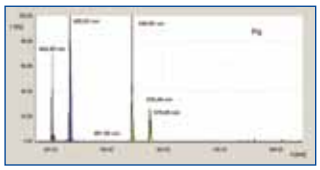
9983-1003158

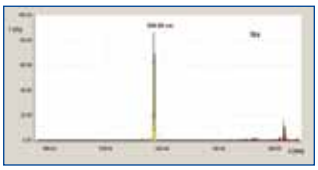


9983-1003157



9983-1003159





Line spectra of Hg (high-pressure) and Na, recorded using the digital spectrophotometer (9983-1003160)

Low-Pressure Sodium Spectral Lamp

Gas discharge lamp for observing Na D lines and investigating of the doublet. Includes a black metal housing with integrated power supply unit, a light aperture with a fine thread for direct screw-mounting of filters and a threaded stand rod.

Luminance:	1800 lm
Operating current:	0.35 A
Power:	18 W
Base:	BY22d
Service life:	approx. 10000 h
Threaded light aperture:	40 mm diam.
Fine thread for filter:	M49
Dimensions:	approx. 242x153x80 mm³
Weight:	approx. 2.5 kg

9983-1003159

Spare Lamps: (not shown)

Art. No.	Description
9983-1003161	Hg High-Pressure Spectral Lamp for 9983-1003157
9983-1003162	Hg Low-Pressure Spectral Lamp for 9983-1003158
9983-1003163	Na Low-Pressure Spectral Lamp for 9983-1003159

High-Pressure Mercury Vapour Lamp

High-pressure mercury vapour lamp in hardened glass bulb made of blackened borosilicate glass, with tube-shaped hole allowing emission of unfiltered ultra-violet radiation. Includes E27 lamp holder on stem and see-through screen to protect users from UV radiation.

Wavelength ranges:	UV-A, UV-B, UV-C
Power consumption:	125 W

9983-1000852

Additionally required:
9983-1003196 Control Unit for Spectrum Lamps (230 V, 50/60 Hz)
or
9983-1003195 Control Unit for Spectrum Lamps (215 V, 50/60 Hz)

9983-1000852



9983-1003196
9983-1003195

www.EngineeringBooksPDF.com

Pocket Spectroscope

High quality optical system with centered visible spectrum, which is linear with respect to the wavelength. In metal sleeve. With fixed slit and prism system with grating

Slit width:	0.2 mm
Number of grating lines:	600 lines/mm
Dimensions:	approx. 115 mm x 25 mm diam.
Weight:	approx. 62 g

9983-1003078

Hand Spectroscope with an Amici Prism

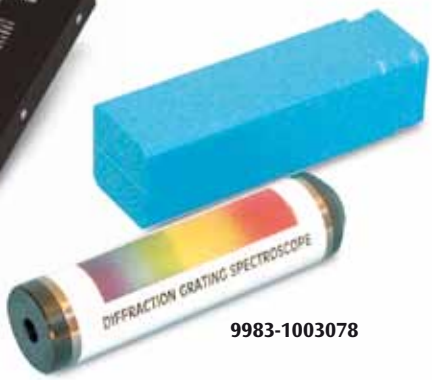
Precise optical system with a visible spectrum that is linear in terms of wavelength around the centre point. In a metal housing with an adjustable slit and high-grade Amici prism. Delivery in hinged case for protective and dust-free storage.

Angular dispersion:	7° (C-F)
Linear dispersion:	60 mm
Slit width:	0 – 1 mm
Folding case:	approx. 150x70x30 mm³
Weight:	approx. 150 g

9983-1003531

9983-1003184





9983-1003078

9983-1003531



Spectroscope in Metal Case

Hand spectroscope in a flat metal case with printed wavelength scale for easy reading of spectral lines and spectra. With holder for mounting a probe in a plastic vessel.

Dimensions:	approx. 180x115x25 mm³

9983-1003184

Spectrometer-Goniometer

Spectrometer with rotatable prism and directionally-adjustable objective tube for observing and measuring emission and absorption spectra. Can also be used for precise determination of the optical parameters of prisms. Includes prism with mounting and a holder for transmission gratings.

Objective tube:	Symmetrical precision slit of hardened steel; adjustable slit width, slit height and distance; f = 160 mm, 18 mm diam.
Eyepiece tube:	Continuous focusing and viewing angle adjustment, eyepiece with cross-wire, f = 160 mm, 18 mm diam.
Prism:	flint glass (60°)
Dispersion ($n_F - n_C$):	0.017
Base length:	33 mm
Height:	22 mm
Angular scale:	0° to 360°
Scale divisions:	0.5°
Reading precision:	1' (Vernier scale with magnifying lens)
Height:	250 mm approx.
Weight:	8 kg approx.

9983-1002912

Kirchhoff-Bunsen Spectroscope

Desktop spectroscope for the observation and measurement of emission and absorption spectra. With adjustable slit, condensor, flint glass prism as well as an observation telescope with sliding ocular. Scale tube with reference division, which is superimposed on the image plane of the spectrum due to reflection at the front surface of the prism. Includes removable prism hood. Ideal for schools and universities.

Observation tube:	moveable, with locking screw, slideable eyepiece
Objective:	f = 160 mm, 18 mm diam.
Slit tube:	stationary, with symmetrical slit
Objective:	f = 160 mm, 18 mm diam.
Scale tube:	stationary, 200-division scale
Eyepiece:	f = 90 mm, 18 mm diam.
Scale:	can be calibrated in wavelengths
Prism:	Flint glass (60°), Dispersion ($n_F - n_C$): 0.017
Length of base:	20 mm, height: 30 mm
Weight:	4.8 kg

9983-1002911



9983-1002912



9983-1002911

www.EngineeringBooksPDF.com

Handheld Spectroscope

Device for observing absorption and emission spectra, e.g. to observe the Fraunhofer line spectrum in sunlight for the observation of absorption spectra through liquids, the emission spectra of gas discharge tubes or for chemical analysis during flame tests.



9983-1003183

9983-1003182

Hand Spectroscope

Simple spectroscope for observing spectra and spectral lines. Made of cardboard and plastic with built-in grid.

Dimensions: approx. 145 mmx28 mm diam.

9983-1003182

Spectroscope in Cardboard Box

Hand spectroscope in a flat cardboard box with printed wavelength scale for easy reading of spectral lines and spectra.

Dimensions: approx. 180x115x25 mm³

9983-1003183

Spectrophotometer S

A new and easy-to-use high resolution spectrophotometer that is ideal for schools and colleges. The solidly constructed spectrometer is designed to examine the near and infrared part of the spectrum from 360 nm to 800 nm; its removable covers allow students to see first hand the spectrum analysis process. Setup is quick and easy. The optical signal enters the device through a flexible fibre optic cable. Connection to a PC is via the USB 2.0 interface. A specially selected transmission grating and precision slit gives high resolution and excellent results. Data collection software is intuitive with real time graphical output. For easier interpretation of the spectrum, each wave band is shaded with the corresponding colour. The spectrum can be viewed either as a graph or in text form, which allows for more advanced calculations. The availability of several toolbars makes it possible to set the spectrometer parameters to exactly fit the requirements of the experiment. Spectrometer S is supplied ready to use; tested and calibrated.

Spectral range:	360 – 800 nm
Spectrometer resolution:	< 2.0 nm
Pixel resolution:	< 0.5 nm
Operating system:	Win XP and Vista
Interface:	USB 2.0
Dimensions:	60x60x120 mm³
Weight:	600 g

Contents:

Spectrometer S with USB cable, fibre optic cable, and a CD containing experimental software and an instruction manual. Laptop not included.

9983-1003061



9983-1003061



9983-1008673

S-system Spectrometer-Goniometer

Spectrometer with rotatable prism or grating and directionally-adjustable objective tube for observing and measuring emission and absorption spectra. Can also be used for precise determination of the optical parameters of prisms or gratings. Includes prism with holder and transmission grating with holder.

Objective tube:	Adjustable slit width and object distance; f = 175 mm, 32 mm diam.
Eyepiece tube:	Continuous focusing and viewing angle adjustment, eyepiece with cross-wire, f = 175 mm, 32 mm diam.
Prism:	flint glass (60°)
Dispersion ($n_F - n_C$):	0.017
Base length:	40 mm
Height:	40 mm
Transmission grating:	300 lines/mm
Angular scale:	0° to 360°
Scale divisions:	0.5°
Reading precision:	0.5' (Vernier scale)
Height:	250 mm
Weight:	approx. 12 kg

9983-1008673

www.EngineeringBooksPDF.com

Digital Spectrophotometer

This digital spectrophotometer is used for quantitative investigations of emission and absorption spectra and transmission curves, and for measurements related to calorimetry and chemical kinetics. Based on the Czerny-Turner principle, this device permits simultaneous, real-time recording and analysis of the entire visible range from 380 nm – 830 nm in conjunction with the user-friendly measurement and evaluation software. Light recorded by means of an optical fibre and projected on a CCD detector via two mirrors and a reflection grating. Includes an absorption module with cell and slide holders for disposable cells and colour filters, a software program and various connecting cables.

Spectral range:	380 – 830 nm
Wavelength accuracy:	0.25 nm
Resolution:	1 nm
Transmission:	0 – 100%
Resolution:	0.1%
Absorption:	0 – 100%
Resolution	0.1%
Optical configuration:	Czerny Turner
CCD detector:	2048 pixels
Absorption module:	
Quartz halogen lamp:	12 V/20 W
Optical connection:	via optical fibre
Mains voltage:	115 V/230 V, 50/60 Hz
Dimensions:	approx. 315x175x322 mm³
Weight:	approx. 6.6 kg

System requirements:

Operating system:	WINDOWS
PC:	Pentium 133 or higher, 32 MB RAM, CD-ROM drive
Free disk space:	at least 15 MB
Screen resolution:	at least 800x600 pixels (16 bit)
Computer connection :	USB interface

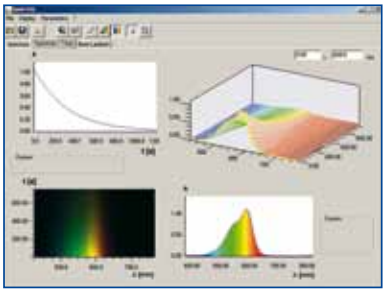
Contents:

1 Spectrophotometer
1 Absorption module
1 CD with software
1 Optical fibre, 1 m
1 PC connection cable (USB)
1 DIN cable for connecting the absorption module
1 Mains connection cable
100 Disposable cells
1 Operating manual

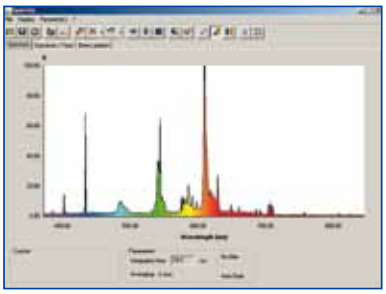
Software:

- Real-time recording of emission and absorption spectra as well as transmission curves
- Simultaneous recording of spectra over the entire wavelength range (recording time per spectrum less than 2 ms)
- Recording of spectra as a function of time (chemical kinetics)
- 3D display; functional relationship between absorption, time and wavelength
- Display of spectra in authentic colours
- Display of several spectra in one diagram
- Manual calibration option
- Wavelength measurements
- Recording and evaluation of concentration measurements (Lambert-Beer law)
- Zoom and cursor function
- Storage of recorded spectra
- Export of measured data to standard text and bitmap formats, as well as Regressi and Excel formats
- Colour printout of spectra

9983-1003160



Decolourization of dissolved potassium permanganate ($KMnO_4$) with oxalic acid ($C_2H_2O_4$)



Line spectrum of a fluorescent lamp



9983-1003160

9983-1003084

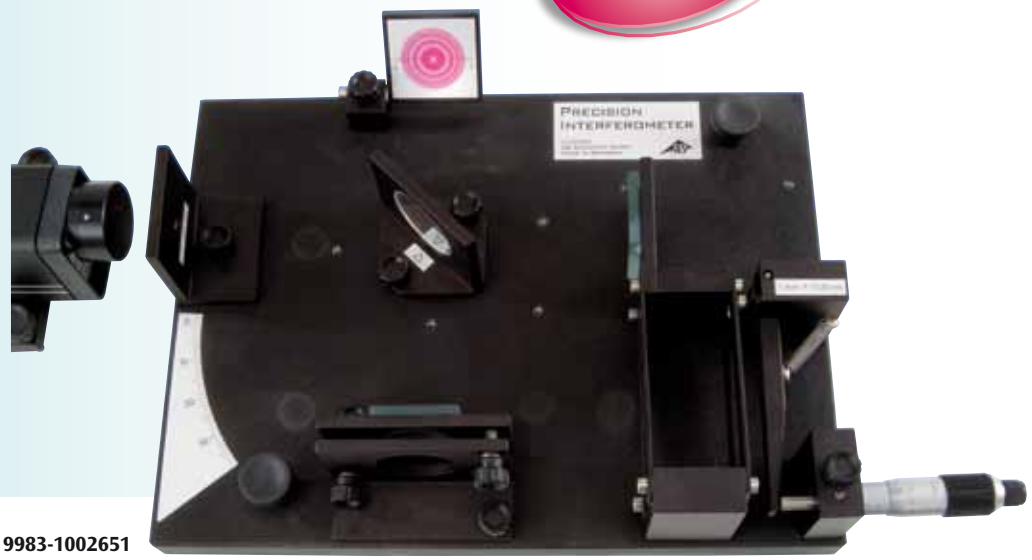
www.EngineeringBooksPDF.com

Experiment topics:

- Michelson Interferometer
- Fabry-Perot Interferometer
- Determination of the refractive index of glass*
- Determination of the refractive index of air*
- Twyman-Green test for optical components (qualitative)*

* Accessory set (9983-1002652) required

See physics experiments catalogue



9983-1002651

Interferometer

This complete equipment set comprises high grade optical components mounted on a heavy, rigid base plate for precise and reproducible measurements. The large optical components permit a generation of clear and well defined interference patterns in daylight. The reflective observation screen has an adjustable inclination. Pre-defined component positions allow quick rearrangement to ensure extremely rapid preparation for the various experiments. The equipment set includes a stable plastic box for storing the mounted and adjusted interferometer as well as the base plate for laser.

Beam splitter:
- Diameter: 40 mm
- Evenness: λ/10 (front side), λ/4 (rear side)

Surface-coated mirror:
- Dimensions 40x40 mm²
- Evenness: <λ/2

Mirror adjustment:
- Eccentric reduction: approx. 1:1000 (individual calibration specified on eccentric base)

Base plate:
- Weight: 5.5 kg
- Dimensions: 245x330x25 mm³

9983-1002651

Additionally required:
9983-1003165 He-Ne Laser



Glass plate in the beam path of the Michelson interferometer

Accessory Set for the Interferometer

This accessory set for the interferometer (9983-1002651) consists of a vacuum cell for determining the refractive index of air and a glass plate on a rotatable holder for determining the refractive index of glass and investigating the surface quality of optical components (Twyman-Green interferometer).

9983-1002652

Additionally required:
9983-1012856 Vacuum Hand Pump
9983-1002622 Silicone Tube



9983-1002652



Vacuum chamber in the beam path of the Michelson interferometer

...going one step further
www.EngineeringBooksPDF.com

For laser experiments refer to pages 170/171



9983-1008632

9983-1008642

Laser Diode Driver and Temperature Controller (cw and pulsed)

- Precise current-controlled continuous wave and pulse-type laser driver
- Two TEC (Thermo Electric Cooler) drivers with PID controllers
- Digital and analogue modulation inputs
- Multiple safety circuits
- Stored configuration (EEPROM)
- Very low power dissipation due to bias voltage control in cw-mode
- Digital control using isolated RS232 serial interface

The diode laser driver and temperature controller is a highly precise, safe and cost-efficient operating solution for continuous wave (cw) and pulsed diode lasers. The power supply unit is designed for current-stabilized control of the laser diode and is also equipped with a control unit for laser diode's controlling optical beam power in cw-mode by means of the integrated photodiode input. In pulsed mode the laser diode can be operated with the freely configurable built-in oscillator or externally using the modulation input. The temperature controllers are designed as PID controllers and configured for standard operation with NTC and Pt100 sensors. The use of silicon temperature sensors or other types is equally possible simply by altering the software.

Laser Diode Driver and Temperature Controller DSc01-0,5

9983-1008633

Laser Diode Driver and Temperature Controller DSc01-2,5

9983-1008632

	9983-1008633	9983-1008632
Laser:		
Laser current range	0...500 mA	0...2500 mA
Laser current resolution	1 mA	1 mA
Laser current accuracy	<1 mA	<1 mA
Laser current noise	<60 µs	<60 µs
Pulse rise time	<10 µs	<10 µs
Pulse fall time	<5 µs	<5 µs
Voltage range	1.2...5 V	1.,2...5 V
Current limit	adjustable between 0...500 mA	adjustable between 0...2500 mA
External digital modulation input	TTL	TTL
TEC Driver:		
Peltier current	max. -4...+4 A	max. -4...+4 A
Peltier current (2nd driver)	---	max. -2…+2 A
Peltier voltage	max. 8 V	max. 8 V
Peltier current limit	adjustable between 0...4 A	adjustable between 0...4 A
Peltier current limit (2nd driver):	---	adjustable between 0…2 A
Peltier current resolution	1 mA	1 mA
Temperature control accuracy	<10 mK	<10 mK
General specs:		
Over-temperature protection	for driver and laser	for driver and laser
Mains voltage	100 bis 240 V AC	100 bis 240 V AC
Dimensions	88x110x240 mm³	88x110x240 mm³



9983-1002866

Laser Safety Goggles for Nd:YAG Laser

Nylon goggles for average protection levels, integral construction for reduced weight with enlarged visual field due to large filter lenses. Supplied in a storage pouch.

Filter colour:	light blue
Degree of light transmission:	TD_{65} = 62%
Specification according to DIN EN 207/208:	750-1100 D L5 + IR L7 > 1100-1200 DIR L5

9983-1002866

www.EngineeringBooksPDF.com

Diode Laser 1000 mW
1000 mW diode laser with built-in Peltier cooler and thermistor, collimator and focusing lens, mounted and aligned with mounting plate and optical rider.
Emitted wavelength: 808 nm
9983-1009497

Diode Laser 100 mW
100 mW diode laser with built-in Peltier cooler, thermistor and photodiode, mounted on a 2-way rotating plate and optical rider.
9983-1009498

Alignment Laser Diode
Alignment laser diode with mounting plate and optical rider
Wavelength: 633 nm
Power: 1 mW
9983-1008634

Nd:YAG Cristal
Nd:YAG crystal, aligned with mounting plate and mounted on optical rider.
9983-1008635

Frequency Doubling Module
Frequency doubling module with KTP crystal and built-in Peltier cooler, thermistor. Alignment holder and optical rider, assembly.
9983-1008636

Passive Q-Switch
Passive Q-switch with mounting plate, mounted on optical rider.
9983-1008637

Laser Mirror I
Laser mirror for decoupling laser beams, pl-cc, r = -200 mm, PR@1064 nm (R = 97%)/AR@1064 nm. Includes an adjustable holder and is mounted on an optical rider.
9983-1008638

Laser Mirror II
Laser mirror for decoupling frequency-doubled laser beams, pl-cc, r = -200 mm, HR@1064 nm +HAT@532 nm/AR@532 nm. Includes an adjustable holder and is mounted on an optical rider.
9983-1008639

PIN Photodiode
PIN photodiode, mounted on optical rider.
9983-1008640

PIN Photodiode, Fast
Fast PIN photodiode, mounted on optical rider.
9983-1008641

Optical Bench KL
Guide rail with leveling platform, 600 mm.
9983-1008642

Cylindrical Lens f = +15 mm
Beam shaping lens for collimation of laser diode's fast axis, anti-reflection coating on both sides, mounted on optical rider.
9983-1008643

Collimator Lens f = +25 mm
Collimator lens with focal length of f = +25 mm, anti-reflection coating on both sides, mounted on optical rider.
9983-1008644

Cylindrical Lens f = +45 mm
Beam shaping lens for the collimation of the laser diode's slow axis, anti-reflection coating on both sides, mounted on optical rider.
9983-1008645

Collimator lens f = +75 mm
Collimator lens with a focal length of f = +75 mm, anti-reflection coating on both sides, mounted on optical rider.
9983-1008646

Focusing lens f = +75 mm
Focusing lens with a focal length of f = +75 mm, anti-reflection coating on both sides, mounted on optical rider.
9983-1008647

Filter Holder with Filter RG850
Filter holder with filter, type RG850, to suppress the pumping beam.
9983-1008648

Filter Holder with Filter-Types RG850 and BG40
Filter holder with filter-types RG850 and BG40 for suppressing the pumped beam as well as the fundamental wavelength.
9983-1008649

Polarization Filter
Polarization filter, mounted on a rotating plate and optical rider.
9983-1008650

Transport Case KL
Padded transport case for all components. Free of charge with order of a complete experiment as per list p. 171
9983-1008651



www.EngineeringBooksPDF.com

This collection of key experiments on the principles and uses of diode pumped solid lasers uses an Nd:YAG crystal. This is probably the most important material in use for solid-state lasers.

Today the diode laser is a popular tool in three different areas of application: in communications engineering, measurement and instrumentation technology and as a pumping source for solid-state lasers. Its emission wavelength is not determined by two discrete energy levels but by the way the energy of the electrons is distributed across the energy bands. Thus the energy level is dependent on the temperature and the injection current. The laser beam propagates within a pn-junction and is thus also limited by this in terms of space and energy. The distinctions resulting from this with respect to "classical resonator lasers" are explored in **Experiment 1**.

Selecting the most suitable light pumping source plays a crucial role in the optical pumping process. The selection of the emission and absorption transitions are critical for the efficiency of the system, as the investigations in **Experiment 2** show.

Experiment 3 investigates optical pumping of Nd:YAG lasers with the aid of laser diodes. This has become established as an efficient method and an alternative to lasers pumped by lamps.

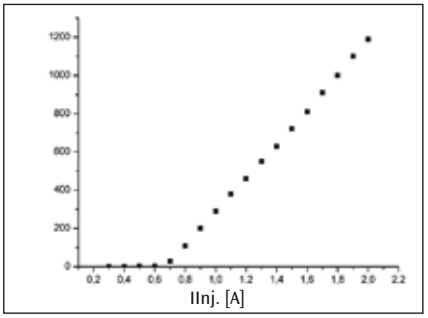
Important applications are explored in **Experiment 4** dealing with the generation of short pulses using a passive Q-switch and in **Experiment 5** on frequency doubling with the aid of a non-linear optical crystal.

Experiment 1: Diode Laser

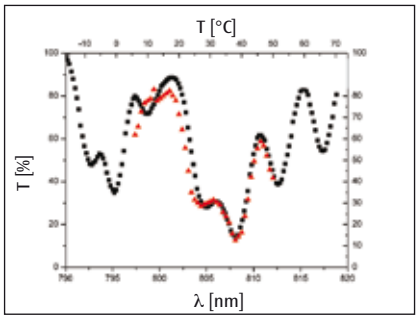
- Measurement of laser diode output power and how it relates to the applied current
- Investigation of how the wavelength of light from the laser diode depends on temperature by means of the transmission spectrum of the Nd:YAG crystal
- Confirmation of how laser diode wavelength depends on temperature to the extent of approximately 0.27 nm/K
- Determination of how the wavelength of light from the laser diode depends on the injection current
- Graph of injection current against temperature at a constant wavelength (maximum absorption) for the laser diode
- Determination of beam divergence from the laser diode in both axes (slow axis and fast axis)
- Determination of polarising components in both axes (slow axis and fast axis)

Experiment 2: Emission and Absorption Experiment

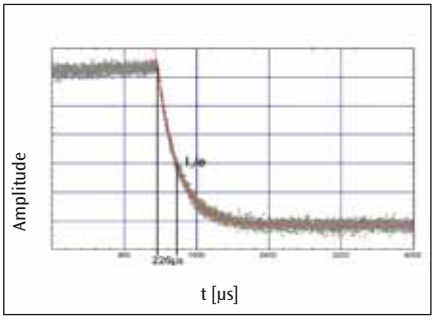
- Measurement of laser diode output power and how it relates to the applied current
- Investigation of how the wavelength of light from the laser diode depends on temperature by means of the transmission spectrum of the Nd:YAG crystal
- Determination of how the wavelength of light from the laser diode depends on the injection current
- Graph of injection current against temperature at a constant wavelength (maximum absorption) for the laser diode
- Determination of lifetime of laser level $^4F_{3/2}$ for laser in pulsed operation



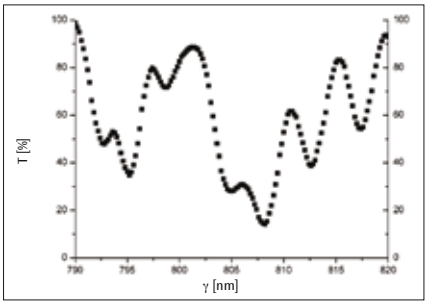
Output power of diode laser at 20° C as a function of the injection current



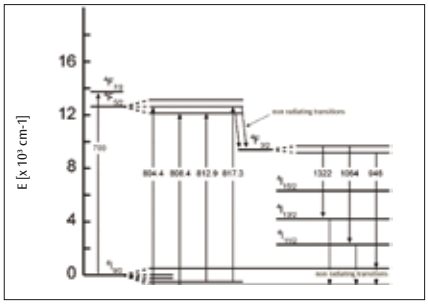
Comparison of transmission functions:
Square– T(λ) recorded using a spectrometer
Triangular – Transmission as a function of temperature



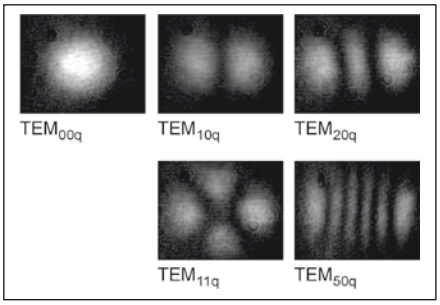
Measurement of half-life for the $^4F_{3/2}$ level in an Nd:YAG crystal.
An exponential function has been fitted to the measurements



Transmission spectrum of an Nd:YAG crystal as a function of wavelength, recorded using a spectrometer



Energy level diagram for an Nd:YAG crystal with the most important transitions for optical pumping and laser operation



Transverse modes

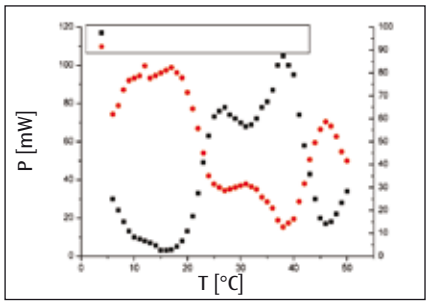
www.EngineeringBooksPDF.com

Experiment 3: Nd:YAG Laser

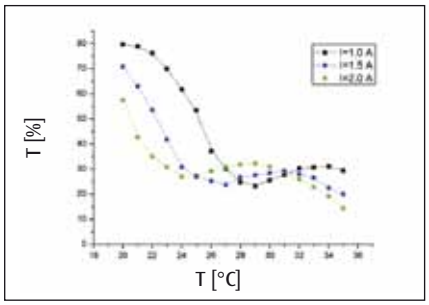
- Investigation of how the wavelength of light from the laser diode depends on temperature by means of the transmission spectrum of the Nd:YAG crystal.
- Graph of injection current against temperature at a constant wavelength (maximum absorption) for the laser diode.
- Determination of lifetime of laser level $^4F_{3/2}$ for laser in pulsed operation.
- Design of an Nd:YAG laser with stable resonator plus determination of laser threshold and output power.
- Determination of output power for an Nd:YAG lasers and how it depends on the wavelength of the pumping diode, plus comparison with the transmission spectrum of the Nd:YAG crystal.
- Recording of transient response (spiking) of a laser by means of an oscilloscope with the laser diode in pulsed operation.
- Demonstration of transverse modes due to detuning of the resonator.

Experiment 4: Generation of Short Pulses

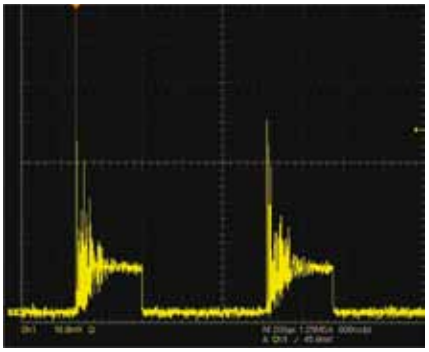
- Investigation of how the wavelength of light from the laser diode depends on temperature by means of the transmission spectrum of the Nd:YAG crystal.
- Graph of injection current against temperature at a constant wavelength (maximum absorption) for the laser diode.
- Determination of lifetime of laser level $^4F_{3/2}$ for laser in pulsed operation.
- Design of an Nd:YAG laser with stable resonator plus determination of laser threshold and output power.
- Recording of transient response (spiking) of a laser by means of an oscilloscope with the laser diode in pulsed operation.
- Q-switch for Nd:YAG laser with Cr:YAG module plus measurement of pulse duration and energy.



Transmission of light from a diode through an Nd:YAG crystal as a function of temperature for various injection currents



Comparison of curve characteristics for transmission of light through an Nd:YAG crystal and output power of the Nd:YAG laser as a function of the diode temperature

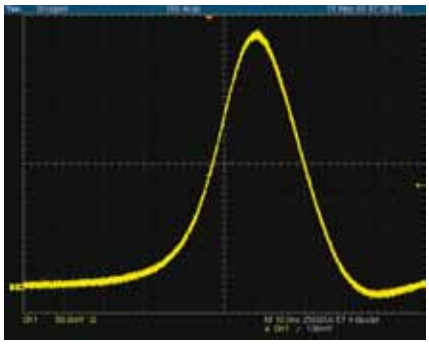


Oscilloscope trace: spiking in a Nd:YAG laser

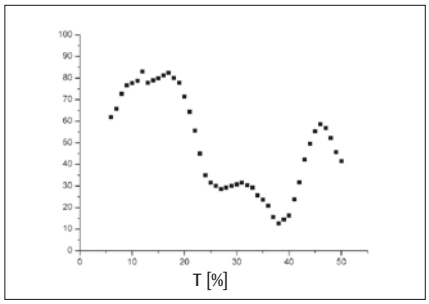
Experiment 5: Frequency Doubling with KTP Crystal

- Investigation of how the wavelength of light from the laser diode depends on temperature by means of the transmission spectrum of the Nd:YAG crystal.
- Graph of injection current against temperature at a constant wavelength (maximum absorption) for the laser diode.
- Determination of lifetime of laser level $^4F_{3/2}$ for laser in pulsed operation.
- Design of an Nd:YAG laser with stable resonator plus determination of laser threshold and output power.
- Determination of output power for an Nd:YAG lasers and how it depends on the wavelength of the pumping diode, plus comparison with the transmission spectrum of the Nd:YAG crystal.
- Recording of transient response (spiking) of a laser by means of an oscilloscope with the laser diode in pulsed operation.
- Demonstration of transverse modes due to detuning of the resonator.
- Frequency doubling inside the resonator with a KTP (potassium titanyl phosphate) crystal, plus measurement of how conversion efficiency depends on the crystal's temperature and orientation.

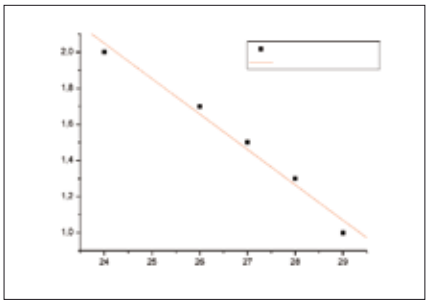
Art. No.	Exp. 1	Exp. 2	Exp. 3	Exp. 4	Exp. 5
9983-1008632		yes	yes	yes	yes
9983-1008633	yes				
9983-1009497		yes	yes	yes	yes
9983-1009498	yes				
9983-1008634		yes	yes	yes	yes
9983-1008635	yes	yes	yes	yes	yes
9983-1008636					yes
9983-1008637				yes	
9983-1008638			yes	yes	
9983-1008639					yes
9983-1008640	yes	yes	yes		yes
9983-1008641				yes	
9983-1008642	yes	yes	yes	yes	yes
9983-1008643	yes				
9983-1008644	yes				
9983-1008645	yes				
9983-1008646		yes			
9983-1008647		yes			
9983-1008648		yes	yes	yes	
9983-1008649					yes
9983-1008650	yes				
9983-1008651	yes	yes	yes	yes	yes



Oscilloscope trace: trace of pulses from a passive Q-switched Nd:YAG laser. Pulse duration 25 ns



Transmission of light from a diode through an Nd:YAG crystal as a function of temperature at an injection current of 1.5 A

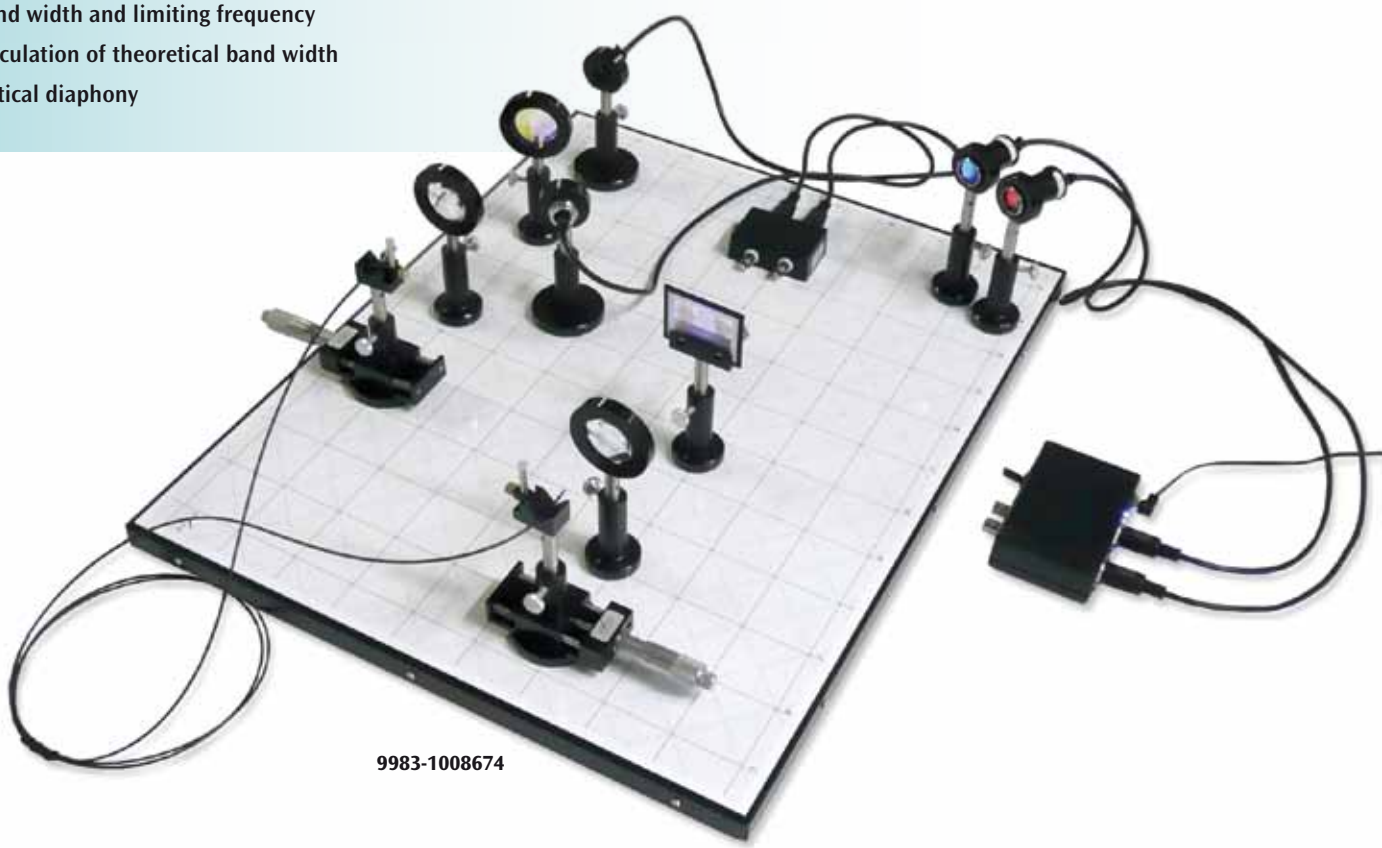


Current-temperature graph at constant wavelength

www.EngineeringBooksPDF.com

Experiment topics:

- Glass fibres and optical telecommunications
- Acceptance cone and optimisation of coupling to a fibre optic cable
- Absorption, effect of the length of the transmission line
- Coupling losses
- Diffraction by an optical grating and optical multiplexing.
- Dichroitic filters and optical demultiplexing
- Spectral composition of light sources
- Spectral dispersion and recomposition
- Colour and interference filters
- Signal shaping and matching
- Band width and limiting frequency
- Calculation of theoretical band width
- Optical diaphony



9983-1008674

"Optical Telecommunications" Equipment Set

Complete experiment system for quantitative investigation of transmission of signals via optical media, plus the processes of optical multiplexing and demultiplexing. To build a two-dimensional optical system of high precision, a magnetic bench with a printed grid is provided, upon which it is possible to write.

Optical bench:

Available surface:	600x480 mm²
Grid radials:	0°, 45°, 90°, 135°
Grid subdivisions:	5 cm, 1 cm
Weight:	6 kg approx.

Contents:

1 Optical bench, 600x480 mm, for attachment of magnetic components
8 Optical riders with magnetic base
2 Movable riders, l = 25 mm, with magnetic base
1 LED with collimating lens, in frame on stem, red
1 LED with collimating lens, in frame on stem, blue
1 Electronic signal transmitter, including power supply
1 Electronic signal receiver, including power supply
2 Phototransistors in housing on stem
1 Fibre-optic cable with SMA plugs, 1 m
1 Diffraction grating, 600 lines/mm
1 Dichroitic filter in housing on stem, blue
1 Dichroitic filter in housing on stem, yellow
2 Converging lenses in housing on stem, f = 50 mm, 40 mm diam.
1 Slide holder for gratings, on stem
Component holders and spring clips

9983-1008674

Additionally recommended:
9983-1008675 "Spectrometry" Supplementary Set
9983-1008677 Two-Channel Function Generator, 20 MHz
9983-1008676 Digital Oscilloscope 4x60 MHz

"Spectrometry" Supplementary Set (not shown)

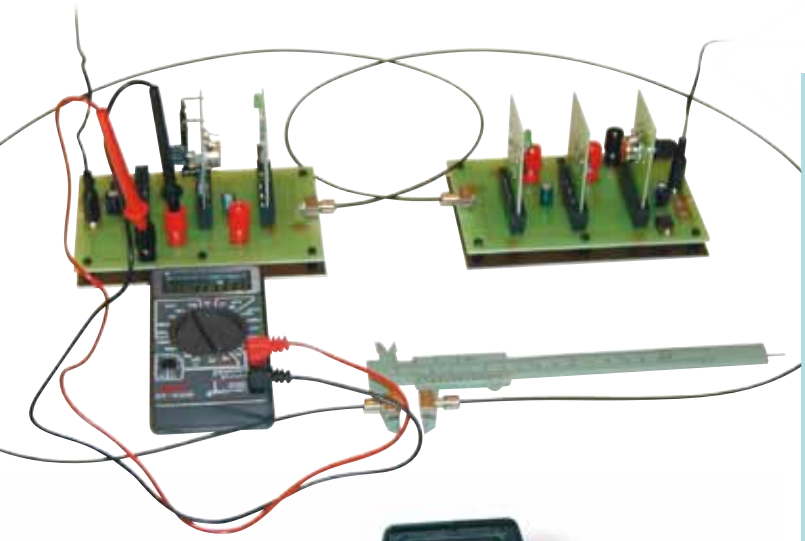
Supplement to the "Optical telecommunications" equipment set for investigating spectrometry of transmitted signals and measurement of absorption losses.

Contents:

1 Spectrometer with SMA connectors
1 Reference light source with SMA connectors
5 Fibre optic cables with SMA plugs, 2 m
1 Fibre optic cable with SMA plugs, 10 m
5 SMA/SMA connectors

9983-1008675

www.EngineeringBooksPDF.com



Experiment Topics:

- Tyndall's light guide experiment
- Attenuation in curved optical waveguides
- Attenuation in liquids
- Attenuation at optical transitions
- Setup for force measurement
- Setup of light barrier
- Setup for proximity sensor
- Transmission of audio signals
- Data transmission between two computers



9983-1003054

Equipment Set for Waveguide Optics

Complete modular experiment set for examining optical waveguide phenomena and their applications. Consisting of one base PCB for use as a transmitting and receiving module, one analogue transmitting and receiving unit, one digital transmitting and receiving unit, one microphone amplifier and low-frequency generator, one low-frequency amplifier with integrated loudspeaker, RS232 interface for transmitter and receiver, one digital multimeter, sheathed and unsheathed optical fibres of different lengths and all connecting cables. Including universal plug-in power supplies and storage case.

Wall power supply units: 100 – 240 V AC (primary)
9 V DC (secondary)

9983-1003054

Additionally recommended:
9983-1002727 Analogue Oscilloscope
9983-1002748 High-Frequency Patch Cord, BNC / 4-mm Plug

Equipment Set for Laser Communication

Experiment system for transmitting audio and video signals with a laser beam. Consisting of power supply for laser diode with variable output power and with audio and video input for modulation of laser beam, receiver unit with integrated amplifier and connectors (CINCH) for loudspeakers and TV set, microphone and loudspeaker. Audio signals are frequency modulated and video signals amplitude modulated. For transmitting video signals, any PAL or NTSC video camera (refer to p. 272) can be connected (not included in scope of delivery). Including universal plug-in power supplies and storage case.

Laser diode: Laser protection class II
Wavelength: 635 nm
Laser power: 0.2 – 1mW continuously variable
Plug-in power supply: 100 – 240 V AC 50/60 Hz (primary),
12 V DC (secondary)

9983-1003055



9983-1003055



www.EngineeringBooksPDF.com

Light Speed Meter

Equipment set for determining the speed of light thanks to electronic run-time measurement. Comprises a compact housing containing a transmitter emitting short LED pulses, a photo receiver and a calibrated, oscillating quartz generator producing chronologically precise square-wave pulses. Emitted light pulses are returned by an internal reflector and by a triple-prism reflector placed a long distance from the light source. The returning light signals are then superimposed on the original signal. A dual-channel oscilloscope is used to measure the time difference between the two signals. The speed of light can be calculated from this difference and the distance to the triple-prism reflector. The triple-prism reflector can be installed by eye without the need for complex adjustments

Contents:
1 Control unit with a transmitter, receiver and integrated power supply unit
1 Fresnel lense on shaft
1 Triple-prism reflector on shaft
3 HF cables, 1 m

Light Speed Meter (230 V, 50/60 Hz)
9983-1000882

Light Speed Meter (115 V, 50/60 Hz)
9983-1000881

Additionally required:
9983-1002729 Oscilloscope, 150 MHz
Optical Bench
Optical Rider (2x)
Stand Equipment



9983-1000882
9983-1000881



Funhouse Mirror

The Funhouse Mirror is a high grade polyester sheet with vacuum deposited silver metal surface. The mirror is 0.8 mm thick; it will not tear but can be cut with normal scissors. Keep out of sunlight as it can focus light and heat to start fires. Comes rolled into 4 cm tube, will unroll flat. This is a great way to teach concave and convex mirrors and real and virtual images. Many applications, use your imagination!

Funhouse Mirror 135x210 cm²
9983-1003338

Funhouse Mirror 60x130 cm²
9983-1003339



9983-1003338/9983-1003339

www.EngineeringBooksPDF.com

Experiment Topics:

- Adaptation (accommodation) of the eye's lens
- Short-sightedness
- Long-sightedness
- Presbyopia
- Correction by means of spectacles



9983-1005047

Functional Model of the Eye

Model for demonstrating the functions of the human eye, including inverted display of images on the retina. The curvature of the silicone lens can be changed by means of water pressure in order to demonstrate the process of accommodation. A holder serves to position corrective glass lenses in front of the eye's lens. The set is mounted on a wooden base and includes an optical object, glass lenses (-0.5 D, +1.0 D) and English operating instructions.

Dimensions: approx. 320x180 mm²
Weight: approx. 1.5 kg

9983-1005047

6-Piece Model of a Human Eye

Model of a human eye enlarged to 3 to 1 scale. Features sclera (white of the eye) and cornea plus muscle attachments, which can be separated into two halves, plus choroid with retina and iris, which is also separable into two, as well as a lens and a glass body. Mounted on base.

Dimensions: 90x90x150 mm³ approx.
Weight: 100 g approx.

9983-1000259

BEST SELLER



9983-1000259



9983-1010208



9983-1010209

Set of 8 Fibre Optic Cables

Set of 8 fibre optic cables, 70 cm long and 2 mm in diameter.

Fibre Optic Cables, Plain

9983-1010208

Fibre Optic Cables, Sheathed

9983-1010209

Magnifying Glass on Stem

All-purpose magnifying glass with lens in plastic setting and handle.

Magnification: 3.5x
Diameter of lens: 50 mm
Dimensions: 140x60x12 mm³

9983-1003767



9983-1003767

Ergonomic Magnifying Glass on Stem

All-purpose magnifying glass with two lenses in plastic setting and ergonomically shaped handle.

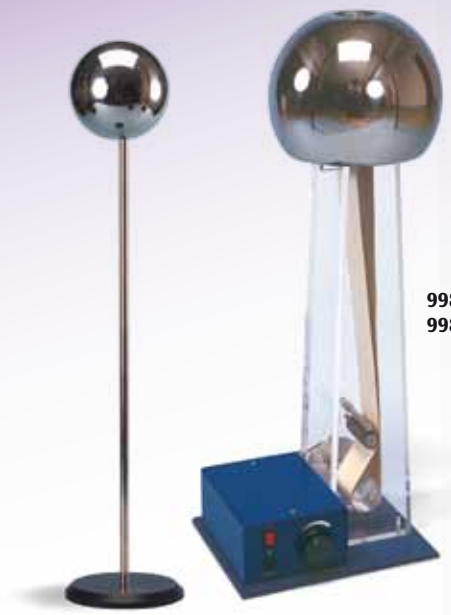
Magnification: 3.5x and 10x
Diameter of lens: 75 mm and 15 mm
Dimensions: 135x90x12 mm³

9983-1003768



9983-1003768

www.EngineeringBooksPDF.com



9983-1002964
9983-1002963

BEST SELLER



9983-1002967

Van de Graaff Generator

Generator for the generation of DC potentials with low current for multiple experiments in electrostatics. Detachable conductor sphere, drive motor with controllable speed, including small discharge sphere on rod.

Voltage:	up to approx. 100 kV
Length of sparks:	up to 5 cm
Conductor sphere:	190 mm diam.
Sphere on rod:	460 mm, diam. 90 mm
Dimensions:	approx. 240x190x620 mm³

Van de Graaff Generator (230 V, 50/60 Hz)

9983-1002964

Van de Graaff Generator (115 V, 50/60 Hz)

9983-1002963

Wimshurst Machine

Historical experiment set-up for the generation of safe, high DC potentials for numerous experiments in the area of electrostatics. Hand crank operation and belt drive, adjustable spark gap, two high-voltage capacitors (Leyden jars).

Diameter:	310 mm
Spark gap:	max. 120 mm
Dimensions:	approx. 360x250x400 mm³
Weight:	approx. 3.4 kg

9983-1002967

Rubber Belt for Van de Graaff Generator (not shown)

Spare rubber belt for Van de Graaff generator (9983-1002964 resp. 9983-1002963).

Length:	930 mm
Width:	50 mm

9983-1002965

Electrostatic Equipment Set

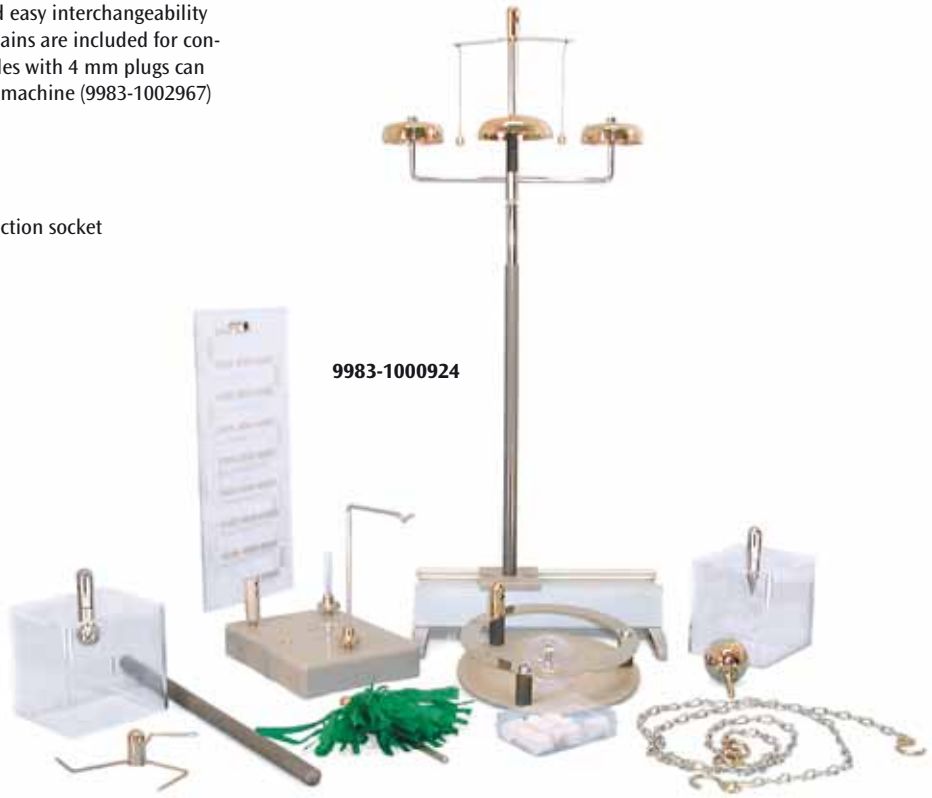
Using this equipment many historical experiments can be performed to investigate electrostatic phenomena. The components are equipped with 4 mm connector pins thus providing for rapid and easy interchangeability of assembly on an insulated stand. Connection chains are included for connection to the charge source, but experiment cables with 4 mm plugs can also be used. We recommend that the Wimshurst machine (9983-1002967) be used as a charge source in these experiments.

Contents:

1 Standbase
1 Stand rod, insulated, with retaining and connection socket
1 Conductor sphere 30 mm diam., with pin
1 Rolling sphere race
1 Elder-pith double pendulum with hook stand
10 Pieces of elder-pith (in box)
1 Box with spherical electrode
1 Box with pointed electrode
1 Triskelion wheel on needle bearing
1 Bundle of tissue paper strips on rod
1 Luminous pane
1 Chimes with bells
1 Friction rod, plastic, with 4 mm socket
2 Connection chains
1 Experiment instructions

9983-1000924

Additionally required:
9983-1002967 Wimshurst Machine



9983-1000924

www.EngineeringBooksPDF.com



9983-1003048

Electroscope
Pointer instrument for the detection of electrical charges and voltages. Shielding ring with 4 mm earthing sleeve. Suitable for shadow projection. Includes sphere, capacitor plate on 4 mm plug and capacitor plate on insulating rod.
Diameter: approx. 130 mm

9983-1003048



9983-1001027

Kolbe's Electroscope
Pointer instrument for the detection of electrical charges and voltages with high sensitivity. Metal housing with 4 mm earthing sleeve, glass front and rear, needle with pivot bearing, scale, suitable for shadow projection. Includes capacitor plate on 4 mm plug.
Measuring range: 0 – 6 kV
Dimensions: approx. 170x110x190 mm³

9983-1001027

NEW



9983-1000923

Piezoelectric Charge Source
Hand-held unit used for the simple generation of safe voltages needed in electrostatic experiments. Featuring the functional principle of a piezoelectric gas lighter. With shortened earthing sleeve and 4 mm cable plug. The colour may deviate from the colour in the image.
Voltage: ±4,5 kV
Dimensions: approx. 250x25x33 mm³
Weight: approx. 130 g

9983-1000923

Electroscope S
Inexpensive instrument with dial for demonstrating electrical charge and voltage potential. Designed in the form of a stand base, frame, aluminium rod with magnet holder and electroscope unit.
Dimensions: 280x80x280 mm³ approx.
Weight: 500 g approx.

9983-1009964



9983-1009964



NEW

9983-1009962

Charge Indicator
Display instrument for showing electric charge and its sign, whereby either a blue or a red LED lights up in the presence of charge. Includes two 1.5-V batteries (AA).
Dimensions: 62x67x20 mm³ approx.
Weight: 85 g approx.

9983-1009962





9983-1009963

Charge Storage Device with Piezo Charger
Storage device for electric charge generated by a piezo charger. The stored charge can be transferred from place to place using a so-called "charge-spoon", for example.
Capacitance: 2x 1 nF
Dimensions of storage device: 62x67x50 mm³ approx.
Dimensions of charger: 230x35x40 mm³ approx.
Total weight: 85 g approx.

9983-1009963

Additionally recommended:
9983-1002707 Charge Spoon, Small

NEW

www.EngineeringBooksPDF.com



9983-1006813

Electrometer Accessories

Set of accessories for carrying out basic experiments on electrostatics, electricity and the photoelectric effect in combination with an electrometer (9983-1001025 resp. 9983-1001024) and 450-V DC power supply (9983-1008535 resp. 9983-1008534).

Contents:
1 Faraday cup
1 Pair of friction rods
1 Metal rod with 4 mm drilled hole
1 Safety adapter socket
1 SK plug-in capacitor 1 nF
1 SK plug-in capacitor 10 nF
1 SK plug-in resistor 100 MΩ
1 SK plug-in resistor 1 GΩ
1 SK plug-in resistor 10 GΩ
1 Zinc electrode
1 Grid electrode

9983-1006813

Conducting Spheres with 4 mm Plugs

Conducting spheres for electrostatics experiments, e.g. for determining the capacity of a sphere or for experiments on the influence of nearby objects.

Conducting Sphere, diam. = 85 mm, with 4 mm Plug

9983-1000938

Conducting Sphere, diam. = 30 mm, with 4 mm Plug

9983-1001026

Additionally recommended:
9983-1002710 Drilled Rod



9983-1000938

9983-1001026



9983-1000972

Faraday Cup

Faraday pail with 4 mm plug, e.g. for mounting on an electroscope (9983-1003048 or 9983-1001027) or electrometer amplifier (9983-1001025 resp. 9983-1001024).
Dimensions: 115 mm x 70 mm diam. approx.

9983-1000972

Friction Rods

Two rods for experiments on frictional electricity, made of PVC and acrylic.
Length: approx. 250 mm
Diameter: approx. 10 mm

9983-1002709

Experiment Topics:

- Measurement of charge and voltage in electrostatics
- Measurement of charge and voltage for a plate capacitor
- Ionisation of air by burning gases or α radiation
- Hallwachs effect (external photoelectric effect)



9983-1001025
9983-1001024

Electrometer

Impedance converter with high-resistance input for measuring extremely small charges and currents. The input signal is converted into a proportional voltage, which can then be measured with an external voltmeter. During the measurement the potentials of the electrometer and the experimenter must be matched by using a metal rod connected to earth. Includes a 12-V AC plug-in power supply.

Electrometer gain factor:	1,00
Input resistance:	$>10^{12}$ Ω
Output resistance:	<1 kΩ
Input current:	<10 pA
Input capacitance:	<50 pF
Max. output voltage:	±8 V
Resistance to excess voltage:	1 kV (from low-resistance sources) 10 kV (from high-resistance sources)
Supply voltage:	12 V AC
Dimensions:	110x170x30 mm³ approx.
Weight:	1 kg approx.

Electrometer (230 V, 50/60 Hz) or

9983-1001025

Electrometer (115 V, 50/60 Hz)

9983-1001024

Additionally recommended:
9983-1006813 Electrometer Accessories
9983-1003073 Analogue Multimeter AM50

9983-1008535 DC Power Supply 450 V (230 V, 50/60 Hz)
or
9983-1008534 DC Power Supply 450 V (115 V, 50/60 Hz)



9983-1002709
9983-1002708
9983-1002707

Charge Spoon

Metal plate on insulating rod for charge transport and for experiments on electrostatic induction.

Art. No.	Designation	Length	Plate	Rod
9983-1002707	Charge Spoon, small	205 mm	40x35 mm²	10 mm diam.
9983-1002708	Charge Spoon, large	265 mm	40x70 mm²	10 mm diam.

www.EngineeringBooksPDF.com







Pair of Capacitor Plates

Pair of capacitor plates consisting of light metal castings with electrically isolated handling rod and 4 mm socket connector for constructing a capacitor. The distance between the plates is determined by the plexiglas spacers that are provided.

Pair of Capacitor Plates 500 cm²

9983-1000932

Pair of Capacitor Plates 250 cm²

9983-1000933

Pair of Capacitor Plates 125 cm²

9983-1000934

Additionally required:
9983-1001045 Barrel Foot, 0.9 kg

Additionally recommended:
9983-1000936 Plastic Dielectric Plate
9983-1000880 Plexiglas Dielectric Plate

Plate Capacitor S

Plate capacitor used to investigate the relationship between charge, voltage and capacitance, as well as determining the dielectric and electric field constants. It consists of a fixed and a movable plate on a guide rail. A centimeter scale is used to read the plate spacing. The device comes with four dielectric sample plates made of acrylic, bakelite, plywood and cardboard.

Plate spacing: 0 – 150 mm
Plate diameter: approx. 149 mm
Plate area: 175 cm²
Connection: via 4 mm safety jacks

9983-1003232



Dielectric Plates

Dielectric plates for experiments with plate capacitors.

Plastic Dielectric Plate

Dimensions: 300x300x2 mm³ approx.

9983-1000936

Plexiglas Dielectric Plate

Dimensions: 300x300x2 mm³ approx.

9983-1000880



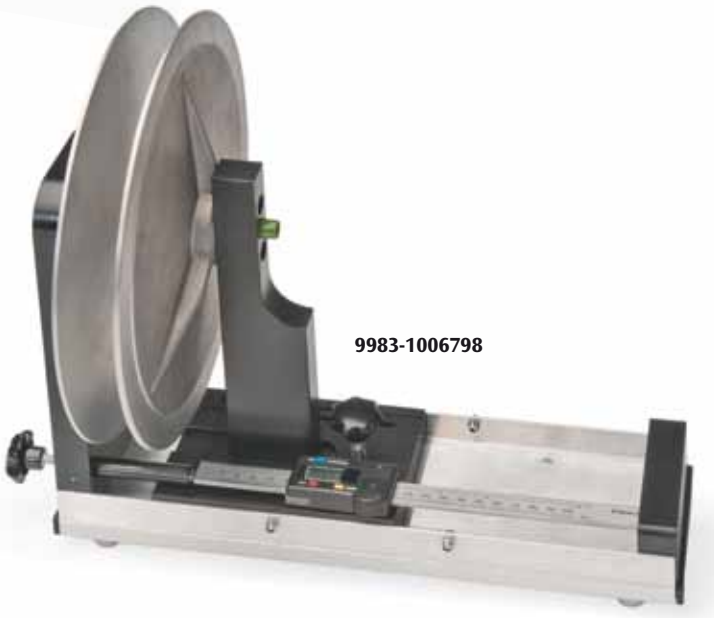
Plate Capacitor D

Plate capacitor used to investigate the relationship between electric charge and voltage, quantify capacitance as a function of plate spacing, measure the dielectric constant ε and precisely determine the electric field constant ε_0. Plate separation can be finely adjusted and read off from a display to an accuracy of 1/10 mm.

Plate spacing: 0 – 160 mm
Plates can be adjusted between 0 and 20 mm via a spindle
Plates: Solid castings
Plate area: 500 cm²
Weight: 4.2 kg approx.

9983-1006798

Additionally recommended:
9983-1000936 Plastic Dielectric Plate
9983-1000880 Plexiglas Dielectric Plate



www.EngineeringBooksPDF.com

BEST SELLER



Experiment Topics:

- Introductory experiments on the functioning of the apparatus
- Electrostatic tests
- Measurement of static electric field strength
- Capacitor tests
- Measurements of potential with an electrostatic meter



9983-1001030
9983-1001029

Electric Field Meter

Instrument for static measurements of electric field strength or electrical potential. A star-shaped modulation vane-wheel connected to earth is mounted a short distance in front of a measurement electrode, also star-shaped. Influenced by the electric field, the charges generate an alternating current proportional to the field strength. This alternating current is measured via a selective amplifier without the electric field experiencing any average energy loss over time. When used in conjunction with voltage measurement plates, the instrument can be used as an electrostatic voltmeter. The device is protected against excess voltage. A standard DC voltmeter can be used for display.

Max. output voltage:	10 V
Measurement ranges:	1 V output can correspond to: 100 V/cm, 300 V/cm, 1000 V/cm 10 V, 30V, 100 V (with 1x voltage measurement plate) 100 V, 300 V, 1000 V (with 10x voltage measurement plate)
Dimensions:	140x110x70 mm³ approx.
Weight:	1 kg approx.

Contents:
1 Electric field meter
1 Voltage measurement plate, measuring range 1x
1 Voltage measurement plate, measuring range 10x
1 Capacitor measurement plate, 250 cm²
Set of plexiglas spacers

Electric Field Meter (230 V, 50/60 Hz)

9983-1001030

Electric Field Meter (115 V, 50/60 Hz)

9983-1001029

Additionally required:
9983-1003073 Analogue Multimeter AM50

Additionally recommended:
9983-1000970 Drip Cup with Basin



Measuring the electric field of a plate capacitor as a function of the capacitor voltage

www.EngineeringBooksPDF.com



9983-1008535
9983-1008534

DC Power Supply, 450 V

Power supply with three outputs for supplying electrical power in experiments using an electrometer (9983-1001025 resp. 9983-1001024).

Output 1:
- Voltage: 0 – 450 V DC
- Max. current: 10 µA

Output 2:
- Voltage: 1.2 – 12 V DC
- Max. current: 100 mA

Output 3:
- Voltage: 0 – 12 V AC
- Max. current: 10 mA

Dimensions: 250x100x160 mm³
Weight: 0.8 kg approx

DC Power Supply, 450 V (230 V, 50/60 Hz)

9983-1008535

DC Power Supply, 450 V (115 V, 50/60 Hz)

9983-1008534

Drip Cup with Basin

Set for experiments involving electrostatic charging of fluids e.g. for charge separation when performing water separation in connection with the E-field meter (9983-1001030 resp. 9983-1001029). Drip cup with side mounted holder and glass stopcock for precise regulation of the drip speed. Basin with 4 mm connector plug.

Dimensions: 70 mmx75 mm diam. approx.
Weight: approx. 150 g

9983-1000970



9983-1000970

Electrolytic Trough

Equipment set for recording equipotential lines of electric fields. Electrodes of different shapes can be used to measure equipotential lines for a plate capacitor, dipole, induced surface charge and a Faraday beaker.

Trough dimensions: 160x105x65 mm³ approx.

Contents:
- 1 Plastic trough
- 1 Stand with measurement electrode
- 2 Bar electrodes
- 2 Round disc electrodes
- 1 Ring electrode

20 Sheets of millimetre-grid paper

9983-1009884

Additionally required:
9983-1003073 Analogue Multimeter AM50
9983-1008535 DC Power Supply, 450 V (230 V, 50/60 Hz)
or
9983-1008534 DC Power Supply, 450 V (115 V, 50/60 Hz)

Pack of Millimetre Paper Sheets (not shown)

20 sheets of millimetre-grid paper for setting up an electrolytic trough (9983-1009884).

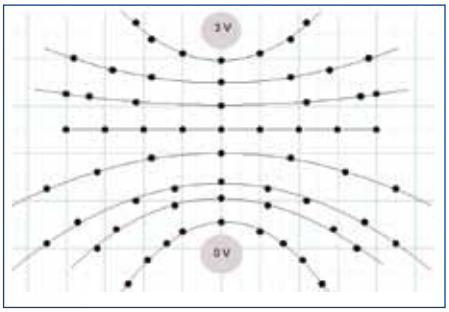
9983-1000691



9983-1009884

9983-1008535
9983-1008534

9983-1003073



Equipotential lines of point charges

...going one step further
www.EngineeringBooksPDF.com



9983-1000949 – 9983-1000953



9983-1000955 – 9983-1000954

Resistance Wires

Metal wires on bobbins, e.g. for experiments to investigate how resistance depends on the material, cross-sectional area and length of the wire.

Art. No.	Material	Length	Diameter
9983-1000949	Copper	100 m	0.3 mm
9983-1000950	Iron	100 m	0.3 mm
9983-1000959	Brass	50 m	0.3 mm
9983-1000951	Nickel	50 m	0.3 mm
9983-1000953	Chrome-Nickel	100 m	0.3 mm
9983-1000954	Chrome-Nickel	50 m	0.5 mm
9983-1000955	Constantan	100 m	0.2 mm
9983-1000956	Constantan	100 m	0.3 mm
9983-1000957	Constantan	50 m	0.4 mm
9983-1000958	Constantan	50 m	0.5 mm

Holder for Components

Holder on an acrylic base with two crocodile clips for connecting loose resistors and other electronic components or samples from the “Conductors and Insulators” set. Sockets for 4 mm safety plugs.

9983-1008524



9983-1008524



9983-1000946

Lamp Socket E10 on Acrylic Base

Lamp socket on transparent acrylic base with screw connection for ordinary commercial filament bulbs for E10 sockets. Sockets for 4 mm safety plugs.

9983-1000946

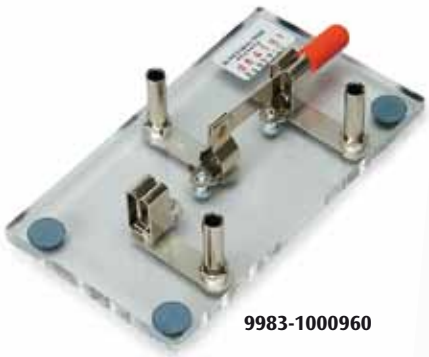


9983-1000947

Lamp Socket E14 on Acrylic Base

Lamp socket on transparent acrylic base with screw connection for ordinary commercial filament bulbs for E14 sockets. Sockets for 4 mm safety plugs.

9983-1000947



9983-1000960



9983-1000962



9983-1000961

Toggle Switch on Acrylic Base

Switch mounted on a transparent acrylic base for the alternate opening and closing of two electric circuits. Sockets for 4 mm safety plugs.

9983-1000960

Momentary Contact Switch on Acrylic Base

Switch mounted on a transparent acrylic base for the momentary closing of circuits. Sockets for 4 mm safety plugs.

9983-1000962

Single-Throw Switch on Acrylic Base

Switch mounted on a transparent acrylic base for the alternate opening and closing of a circuit. Sockets for 4 mm safety plugs.

9983-1000961

www.EngineeringBooksPDF.com

Set of "Conductors and Non-Conductors"
Samples of eight materials for experiments to investigate the electrical conductivities of different materials. In a storage container.

Materials:	Iron, aluminium, copper, steel, wood, glass, plastic, cotton
Sample length:	approx. 200 mm
Weight:	approx. 200 g

9983-1000948

Additionally recommended:
9983-1008524 Holder for Components



9983-1000948



9983-1010137

Set of 10 E10 Lamp Sockets
Set of 10 screw-in sockets for lamps with E10 screw thread. Electrical contact is made via uninsulated wires passing through the connecting eyelets in the base or via crocodile clips.

Base:	28 mm diam.

9983-1010137



9983-1010140 – 9983-1010199

Set of 10 E10 Bulbs
Set of 10 bulbs with E10 screw-in threads. Lamp design A.

Art. No.	Tension	Current
9983-1010142	3.5 V	100 mA
9983-1010143	3.5 V	200 mA
9983-1010195	3.8 V	300 mA
9983-1010196	4 V	40 mA
9983-1010197	6 V	50 mA
9983-1010144	6 V	100 mA
9983-1010145	6 V	350 mA
9983-1010140	12 V	100 mA
9983-1010141	12 V	500 mA

Set of 10 E10 Bulbs, 6 V, 1 A
Set of 10 6 V, 1 A bulbs with E10 screw-in threads. Lamp design C.

9983-1010198

Set of 10 E10 Bulbs, 1.3 V, 60 mA
Set of 10 1.3 V, 60 mA bulbs with E10 screw-in threads. Lamp design B.

9983-1010199

Rod Clamp with Insulator
Clamp for the insulated securing of electrical components with 4mm connectors. A PVC isolator is used to isolate sections from each other. Upper section features two 4 mm cross bore holes and one 6mm hole with clamping screw. Lower section with two 4 mm cross holes.

Total length:	approx. 205 mm
Stem diameter:	approx. 10 mm
Weight:	approx. 135 g

9983-1001054

Contact Stand with Terminal Sockets
Connection rod on insulated base with three 4mm cross holes and one axial 4 mm bore hole used to secure components with 4mm connectors or to plug in 4 mm cables. At the top end spring-loaded terminal socket used as a wire clamp.

Height:	approx. 130 mm
Shaft:	approx. 105x10 mm²
Base:	approx. 25x70 mm²
Weight:	approx. 210 g

9983-1000995



Insulator with Clamp
Metal stem with knurled screw and 4 mm bore hole on acrylic rod, as insulated holder for wires, e.g. when conducting experiments on the optical bench are performed.

Diameter:	approx. 10 mm
Length:	approx. 100 mm

9983-1002970

Insulated Slider
Insulated slider for measuring the electrical resistance as a function of the length, cross section and material. The slider is mounted with two insulated contacts as voltage dividers on riders on the optical bench. Acrylic rod with metal stud and 4 mm bore hole.

Diameter:	approx. 10 mm
Length:	approx. 100 mm

9983-1002969

...going one step further
www.EngineeringBooksPDF.com


9983-1010190


9983-1010192


9983-1012696


9983-1010146


9983-1010158


9983-1010155


9983-1010157


9983-1010138


9983-1010139


9983-1010152

LED on 3B Box
LED in an electrically safe box for assembling simple electric circuits using safety experiment leads. Featuring built-in current limiting resistor and printed circuit symbol.
Maximum voltage: 12 V
Maximum current: 20 mA
Dimensions: 135x85x40 mm³

Red LED on 3B Box
9983-1010190

Green LED on 3B Box (not shown)
9983-1010191

Battery Holder in 3B Box
Battery holder in an electrically safe box for assembling simple electric circuits using safety experiment leads. Printed circuit symbol and battery direction. Batteries not included.
Battery: 4.5 V, 3R12, flat battery
Dimensions: 135x85x40 mm³

9983-1010192

Volta's Pile on 3B Box
Replica of Alessandro Volta's apparatus consisting of series-connected galvanic cells to make up a source of electricity. Zinc and copper plates stacked in alternation on top of each other are separated in each case by a piece of felt soaked in an electrolyte (salt water or acid). The electrolyte makes it possible for electricity to pass between the layers, allowing a voltage to be measured between the plates at the ends.
Connectors: two 4-mm safety sockets
Electrode diameter: 40 mm
Case dimensions: 135x85x40 mm³

9983-1010132

Button on 3B Box
Normally open push-button switch attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol.
Maximum voltage: 12 V
Maximum current: 5 A
Dimensions: 135x85x40 mm³

9983-1010146

Knife-Edge Switch on 3B Box
Knife-edge switch attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol.
Maximum voltage: 12 V
Maximum current: 5 A
Dimensions: 135x85x40 mm³

9983-1010152

Crocodile Clips on 3B Box
Pair of crocodile clips for connecting loose resistors and other electronic components or samples from the "Conductors and Non-Conductors" set. Attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol.
Maximum voltage: 12 V
Maximum current: 2 A
Dimensions: 135x85x40 mm³

9983-1010155

Additionally recommended:
Steel wool
9983-1000948 "Conductors and Non-Conductors" Set

Diode in 3B Box
1N4002 semiconductor in an electrically safe box for assembling simple electric circuits using safety experiment leads. Featuring printed circuit symbol.
Maximum voltage: 12 V
Maximum current: 1 mA
Dimensions: 135x85x40 mm³

9983-1010157

ELV Motor on 3B Box
Low-voltage motor with pulley for simple experiments on mechanical and electrical energy. The relationship between current direction and direction of rotation is immediately obvious. Built onto an electrically safe box for assembling simple electric circuits using safety experiment leads. Printed circuit symbol.
Voltage: 4 – 6 V DC
Box dimensions: 135x85x40 mm³

9983-1010158

E10 Lamp Socket on 3B Box
E10 lamp socket attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol and supplied with 5 E10 bulbs.
Maximum voltage: 12 V
Maximum current: 2 A
Dimensions: 135x85x40 mm³

9983-1010138

Switch on 3B-Box
Switch attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol.
Maximum voltage: 12 V
Maximum current: 2 A
Dimensions: 135x85x40 mm³

9983-1010139

www.EngineeringBooksPDF.com


9983-1011346


9983-1010154


9983-1012694


9983-1010156


9983-1010132


9983-1012695


9983-1012697


9983-1012698


9983-1012699

Coil with 600 Windings on 3B-Box
600-winding coil without core attached to a safe box and featuring safety sockets. For experiments on induction, a bar magnet can be passed through the coil.
Dimensions: 135x85x40 mm³

9983-1011346

Additionally recommended:
9983-1002726 Zero-Point Galvanometer, CA 403
9983-1003112 Bar Magnet

Fuse Holder on 3B Box
Fuse holder attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol.
Fuses: 20 mm x 5 mm diam.
Maximum voltage: 12 V
Maximum current: 5 A
Dimensions: 135x85x40 mm³

9983-1010154

Change-Over Switch (SPDT) on 3B Box
Single-pole double-throw change-over switch attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol.
Maximum voltage: 12 V
Maximum current: 5 A
Dimensions: 135x85x40 mm³

9983-1012694

Universal Holder on 3B Box
Universal holder for two-pole components (resistors, capacitors, diodes, LEDs) attached to a safe box for building simple electric circuits using safety experiment leads. Printed with a circuit symbol.
Dimensions: 135x85x40 mm³

9983-1010156

LED Graetz Bridge in 3B Box
Bridge rectifier circuit consisting of four LEDs connected in Graetz configuration. Inside a safe box for building simple electric circuits using safety experiment leads. Printed with circuit symbols.
Maximum voltage: 12 V
Maximum current: 20 mA
Dimensions: 135x85x40 mm³

9983-1012696

Graetz Bridge in 3B Box
Bridge rectifier circuit consisting of four semiconductor diodes connected in Graetz configuration. Inside a safe box for building simple electric circuits using safety experiment leads. Printed with circuit symbols.
Maximum voltage: 12 V
Maximum current: 20 mA
Dimensions: 135x85x40 mm³

9983-1012695

Current Direction Indicator in 3B Box
Circuit comprised of two LEDs for indicating the direction of current. Inside a safe box with sockets for safety experiment leads. Printed with circuit symbols.
Maximum voltage: 12 V
Maximum current: 20 mA
Dimensions: 135x85x40 mm³

9983-1012697

Ohm's Law Apparatus in 3B Box
Classic set-up for verifying Ohm's law for a two-pole resistor. Inside a safe box with sockets for safety experiment leads. Printed with circuit symbols.
Maximum voltage: 12 V
Maximum current: 2 A
Dimensions: 135x85x40 mm³

9983-1012698

Unknown Resistors in 3B Box
Four unknown resistors which can be connected separately in two series circuits. Inside a safe box with sockets for safety experiment leads. Printed with circuit symbols.
Maximum voltage: 12 V
Maximum current: 200 mA
Dimensions: 135x85x40 mm³

9983-1012699



www.EngineeringBooksPDF.com



9983-1009885

Resistance Bridge

Resistance Bridge used to measure resistances in bridge circuits and investigate voltage drops across wires. The device is only suitable for low voltages. It consists of a rail with a scale mounted at two points and a resistance wire stretched between two connecting sockets. A sliding contact on the resistance wire is used to set the resistance of the resultant two wire sections. A Wheatstone bridge circuit is configured to determine unknown resistances.

Dimensions:	approx. 1300x100x90 mm³
Rail:	approx. 30x30 mm²
Scale:	0 – 1000 mm
Scale divisions:	mm
Resistance wire:	1 m, 0.5 mm diam.
Material:	NiCr
Resistance:	5.3 Ω
Connection:	4 mm safety jacks
Maximum permissible voltage:	8 V
Maximum permissible current:	1.5 A

9983-1009885

Additionally recommended:

9983-1002726 Zero Galvanometer CA 403
9983-1002730 Resistance Decade 1 Ω
9983-1002731 Resistance Decade 10 Ω
9983-1002732 Resistance Decade 100 Ω
9983-1009843 High-Precision Resistor 1 Ω
9983-1009844 High-Precision Resistor 10 Ω
9983-1002776 AC/DC Power Supply Unit 0 – 12 V, 3 A (230 V, 50/60 Hz)
or
9983-1002775 AC/DC Power Supply Unit 0 – 12 V, 3 A (115 V, 50/60 Hz)



9983-1000689

Capacitor 2200 µF

Capacitor in plastic housing with 4mm safety plugs.

Capacitance:	2200 µF
Tolerance:	20%
Max. permissible voltage:	40 V
Dimensions:	approx. 122x70x50 mm³

9983-1000689



9983-1009844

High Precision Resistors

High precision resistors in plastic housing with 4 mm safety plugs.
Dimensions: approx. 122x70x50 mm³

Art. No.	Resistance	Tolerance	Load rating
9983-1009843	1 Ω	1%	4 W
9983-1009844	10 Ω	1%	4 W
9983-1009886	100 Ω	1%	4 W
9983-1009887	1 kΩ	1%	4 W
9983-1000685	10 kΩ	1%	4 W
9983-1000686	100 kΩ	1%	1 W
9983-1000690	300 kΩ	5%	1 W
9983-1000687	1 MΩ	1%	1 W
9983-1000688	10 MΩ	1%	1 W

Resistance Apparatus

Apparatus to investigate the dependency of electrical resistance on conductor length, conductor cross-section and material. Six wires are laid out side by side on a metal base and both ends connect to 4 mm sockets.

Wire specimens:	Constantan 1.0 mm diam., Constantan 0.7 mm diam. (2x), Constantan 0.5 mm diam., Constantan 0.35 mm diam., Brass 0.5 mm diam.
Wire lengths:	1000 mm
Dimensions:	approx. 1085x120x50 mm³
Weight:	approx. 1.35 kg

9983-1009949



www.EngineeringBooksPDF.com



9983-1002735

Resistance Decade, 1 Ω – 10 k Ω

Four resistance decades in a single housing, can be used individually or in combination, e.g. for setting up a Wheatstone bridge. Can be set using control knob, with decade scale.

Output:	via 4 mm safety sockets
Max. current:	700 mA (1 Ω – 10 Ω), 200 mA (10 Ω – 100 Ω), 70 mA (100 Ω – 1 kΩ), 20 mA (1 kΩ – 10 kΩ)
Accuracy:	1%
Dimensions:	approx. 310x90x80 mm³
Weight:	approx. 1 kg

9983-1002735



9983-1003062 – 9983-1003069

Rheostats

Slide-contact resistors of high current-bearing capacity in housings that are safe to touch, for experiments with safety low voltage circuits, to be used as continuously variable resistors or voltage dividers. With built-in earth sockets.

Resistance tolerance:	10% from nominal value
Max. permissible power:	320 W (continuous operation), 640 W (max. 15min)
Max. permissible voltage:	600 V
Terminals:	4 mm safety sockets
Dimensions:	approx. 446x93x150 mm³
Weight:	approx. 2.85 kg to 3.25 kg

Art. No.	Resistance	Max. current rating (continuous)	Max. current rating (15 min)
9983-1003062	1 Ω	18 A	25 A
9983-1003063	3.3 Ω	10 A	12 A
9983-1003064	10 Ω	5.7 A	12 A
9983-1003065	33 Ω	3.1 A	4.4 A
9983-1003066	100 Ω	1.8 A	2.5 A
9983-1003067	330 Ω	1 A	1.4 A
9983-1003068	1000 Ω	0.57 A	0.8 A
9983-1003069	3300 Ω	0.31 A	0.44 A

9983-1002736 – 9983-1002737



Capacitance Decades

Capacitance decades which can be mechanically connected to one another. With colour-coded safety sockets and control knob for setting capacitances in 10 steps. Includes 25 cm safety patch cord.

Nominal voltage:	350 V DC
Connections:	4 mm safety sockets
Dimensions:	approx. 72x72x90 mm³
Weight	approx. 220 g

Art. No.	Measurement range	Step size	Accuracy
9983-1002736	0.01 µF – 0,1 µF	0.01 µF	2%
9983-1002737	0.1 µF – 1 µF	0.1 µF	2%

9983-1002730 – 9983-1002734



Resistance Decades

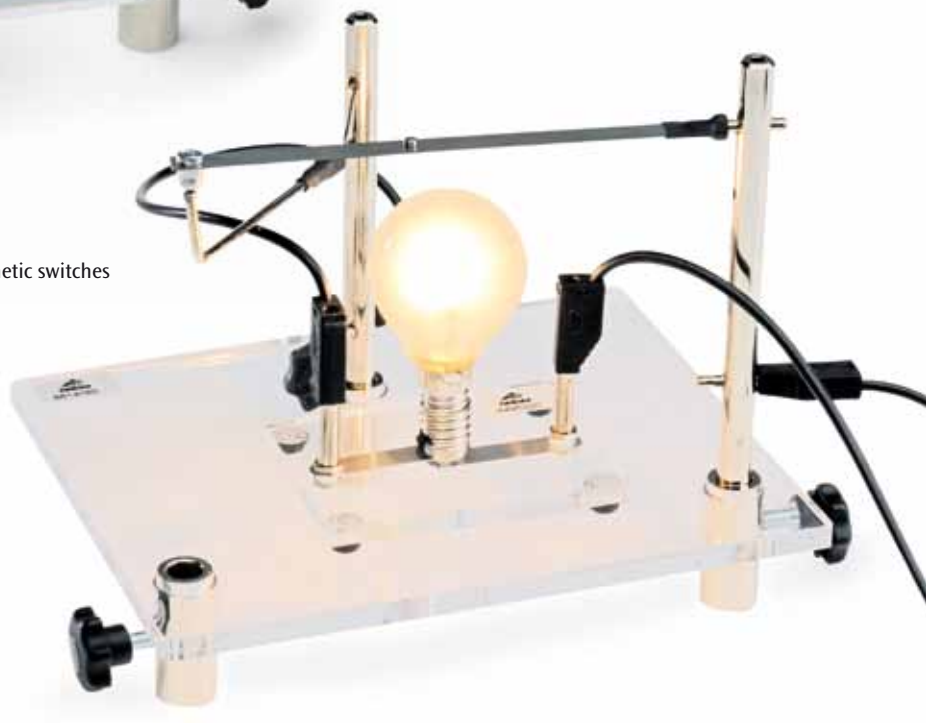
Resistance decades which can be mechanically connected to one another, e.g. in order to assemble a Wheatstone bridge. With colour-coded safety sockets and control knob for setting measurement resistances in 10 steps. Includes 25 cm safety patch cord.

Connections:	4 mm safety sockets
Dimensions:	approx. 72x72x90 mm³
Weight:	approx. 220 g

Art. No.	Measurement range	Step size	Max. current	Accuracy
9983-1002730	0.1 Ω – 1 Ω	0.1 Ω	1 A	1% ±5 mΩ
9983-1002731	1 Ω – 10 Ω	1 Ω	750 mA	1% ±5 mΩ
9983-1002732	10 Ω – 100 Ω	10 Ω	250 mA	0.5%
9983-1002733	100 Ω – 1 kΩ	100 Ω	75 mA	0.5%
9983-1002734	1 kΩ – 10 kΩ	1 kΩ	25 mA	0.5%

...going one step further
www.EngineeringBooksPDF.com





Assembly Kit "Bell, Relay and Bimetallic Switch"
Equipment kit comprising materials to assemble electromagnetic switches and bimetallic switches.

Base plate:	approx. 200x140x40 mm³
Weight:	approx. 1.6 kg

Contents:
1 Stand plate with 3 clamps
1 Bell, 70 mm in diameter
2 Contact rods with three 4 mm cross holes
1 Leaf spring with connector
1 Bimetallic strip with connector
1 Armature with connector
1 Contact pin with connector
1 U-core, 20x20 mm²
1 Coil, 800 turns

9983-1000994

Additionally required:
Bulb, 12 V, 25 W, Type E14, to replace blown components
9983-1000947 Lamp Socket E14
9983-1003316 Transformer with Rectifier (230 V, 50/60 Hz)
or
9983-1003315 Transformer with Rectifier (115 V, 50/60 Hz)



9983-1002796



9983-1002797

Inductance Decade
Variable inductance decade in impact-resistant plastic housing. This series incorporates mechanically stable components, a slide switch for setting measurement ranges and coloured 4 mm sockets with clips for connecting wires.

Measuring range:	10 µH – 111.1 mH
Increment:	10 µH
Accuracy:	5%
Number of decades:	4
Limiting values:	max. 1 V / 10 mA
Dimensions:	approx. 147x117x33 mm³
Weight:	approx. 310 g

9983-1002796

Capacitance Decade
Capacitance decade in impact-resistant plastic housing. This series incorporates mechanically stable components, a slide switch for setting measurement ranges and coloured, 4mm sockets with clips for connecting wires.

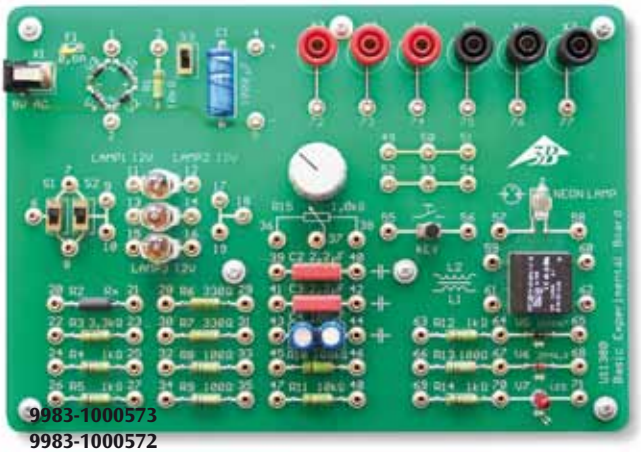
Measuring range:	100 pF – 11.111 µF
Increment:	100 pF
Accuracy:	5%
Number of decades:	5
Limiting values:	max. 50 V DC
Dimensions:	approx. 147x117x33 mm³
Weight:	approx. 310 g

9983-1002797

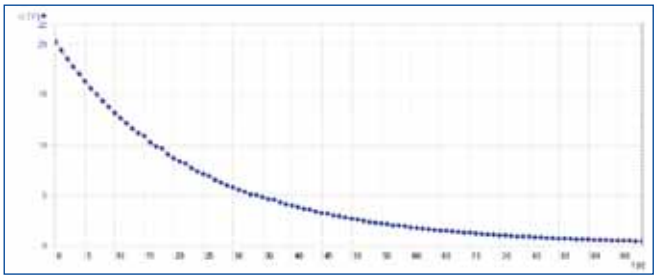
www.EngineeringBooksPDF.com

Experiment Topics:

- Ohm's law
- Parallel resistor circuits
- Series resistor circuits
- Unknown resistance
- Potentiometers
- Voltage dividers with no load
- Voltage dividers with load
- Discharge of a capacitor
- Bridge rectifiers
- Half-wave rectifiers
- Characteristic curve for a lamp
- Characteristic curve for an LED
- Characteristic curve for a silicon diode
- Characteristic curve for a zener diode
- LC parallel resonant circuit
- LC series resonant circuit
- RLC series resonant circuit

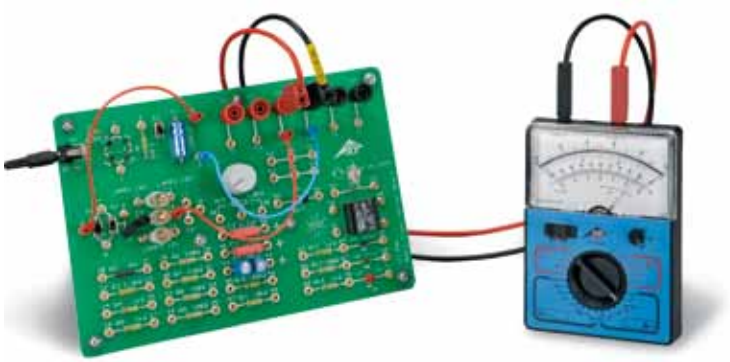


9983-1000573
9983-1000572



Discharge curve of a capacitor

Basic Experiment Board
Experiment board with basic circuits for electricity and electronics: circuit components, Ohm's law, Kirchhoff's laws, rheostat and potentiometer circuits, two way switching, charging and discharging curves of a capacitor, inductive effects in DC and AC circuits. Simple semiconductor circuits for determining diode characteristics, rectifier circuits, filter factors.
The board contains:
13 0.5 W resistors ranging from 100 Ω – 100 kΩ
1 Potentiometer, 1 kΩ
3 Filament lamps, 12 V
2 Slide switches
5 Capacitors (2x 2.2 µF, 1x 100 µF [bipolar], 1x 1000 µF)
5 1 A rectifier diodes
1 Zener diode
1 Red light emitting diode
1 Neon fluorescent light
1 Transformer, 12 V
The components can be interconnected via 2 mm sockets using jumpers and experiment leads. Six 2 mm/4 mm safety socket adapters are provided for connecting 4 mm experiment leads. Includes 10 jumpers and 10 leads (5 red and 5 blue) with 2 mm plugs, 20 cm long, plus 8 V AC/500 mA mains power supply.
Dimensions: approx. 233x160 mm²



Measurement of the discharge of a capacitor

Basic Experiment Board (230 V, 50/60 Hz)
9983-1000573

Basic Experiment Board (115 V, 50/60 Hz)
9983-1000572



Measurement of the discharge of a capacitor

Additionally recommended:
9983-1003073 Analogue Multimeter AM50
or
9983-1000544 3B NET*lab*™
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)

9983-1009957 Function Generator FG 100 (230 V, 50/60 Hz)
or
9983-1009956 Function Generator FG 100 (115 V, 50/60 Hz)



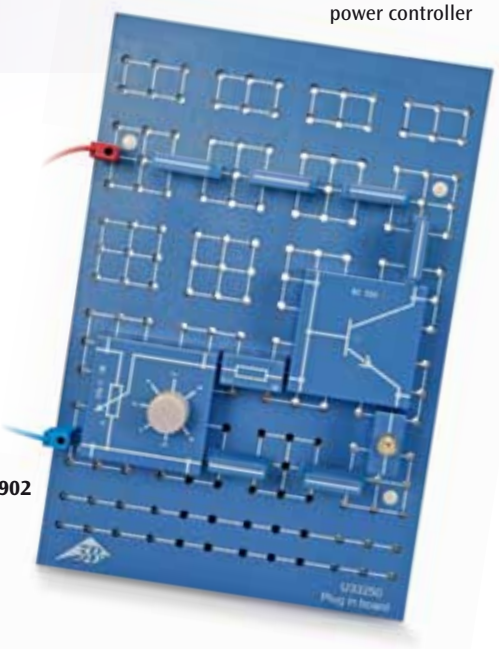
Characteristic curve for a zener diode

www.EngineeringBooksPDF.com

Plug-in Board and Components for Building Electrical and Electronic Circuits in Demonstrations or Students' own Experiments

NEW

Plug-in board with components to build a power controller



9983-1012902

Plug-in Board for Components

Plug-in board for assembling electrical and electronic circuits using components in plug-in housings. Features 4-mm sockets on the front and rear, each internally connected to a square of 9 sockets plus two continuous serial layouts each with 19 sockets. Can be used laid horizontally on a table or vertically in mountings for a whiteboard (9983-1002664 resp. 9983-1002665). Two adjacent plug-in boards can be connected together via plug-in components to make a board that is twice as big.

Connector squares: 16 complete squares and four half-squares
Socket separation: 19 mm from edge to edge of connector squares
50 mm from centre to centre of connector squares
Dimensions: 300x200x24 mm³

9983-1012902

Components in Plug-in Housings with Two Plugs Separated by 19 mm

Capacitors

Art. No.	Capacitance	Tolerance	Max. tension
9983-1012947	100 pF	20 %	160 V
9983-1012948	470 pF	20 %	160 V
9983-1012949	1 nF	20 %	100 V
9983-1012950	2.2 nF	20 %	160 V
9983-1012951	4.7 nF	2.5 %	100 V
9983-1012952	10 nF	20 %	100 V
9983-1012943	22 nF	20 %	100 V
9983-1012944	47 nF	5 %	100 V
9983-1012945	0.22 µF	5 %	250 V
9983-1012946	4.7 µF	5 %	63 V
9983-1012953	0.1 µF	20 %	100 V
9983-1012954	0.47 µF	20 %	100 V
9983-1012955	1 µF	20 %	100 V
9983-1012956	2.2 µF	5 %	63 V



9983-1012910



9983-1012947



9983-1012959

Electrolytic Capacitors

Art. No.	Capacitance	Tolerance	Max. tension
9983-1012957	10 µF	20 %	35 V
9983-1012958	47 µF	20 %	35 V
9983-1012959	100 µF	20 %	35 V
9983-1012960	470 µF	20 %	16 V

Linear Resistors

Art. No.	Resistance	Tolerance	Max. power
9983-1012903	1 Ω	5 %	2 W
9983-1012904	10 Ω	5 %	2 W
9983-1012905	10 Ω	5 %	10 W
9983-1012906	5.1 Ω	5 %	2 W
9983-1012907	22 Ω	5 %	2 W
9983-1012908	47 Ω	5 %	2 W
9983-1012909	68 Ω	5 %	2 W
9983-1012910	100 Ω	5 %	2 W
9983-1012911	150 Ω	5 %	2 W
9983-1012912	220 Ω	5 %	2 W
9983-1012913	330 Ω	5 %	2 W
9983-1012914	470 Ω	5 %	2 W
9983-1012915	680 Ω	1 %	2 W
9983-1012916	1 kΩ	5 %	2 W
9983-1012917	1.5 kΩ	5 %	2 W
9983-1012918	2.2 kΩ	5 %	2 W
9983-1012919	3.3 kΩ	5 %	2 W
9983-1012920	4.7 kΩ	5 %	2 W
9983-1012921	6.8 kΩ	5 %	2 W
9983-1012922	10 kΩ	5 %	0.5 W
9983-1012923	15 kΩ	5 %	0.5 W
9983-1012924	22 kΩ	5 %	0.5 W
9983-1012925	33 kΩ	5 %	0.5 W
9983-1012926	47 kΩ	5 %	0.5 W
9983-1012927	68 kΩ	1 %	0.5 W
9983-1012928	100 kΩ	5 %	0.5 W
9983-1012929	220 kΩ	5 %	0.5 W
9983-1012930	330 kΩ	5 %	0.5 W
9983-1012931	470 kΩ	5 %	0.5 W
9983-1012932	1 MΩ	5 %	0.5 W
9983-1012933	10 MΩ	5 %	0.5 W

www.EngineeringBooksPDF.com



9983-1012972



9983-1012966



9983-1012964



9983-1012988



9983-1012983



9983-1012990

LEDs

Art. No.	Colour	Orientation
9983-1012962	red	upward facing
9983-1012971	green	upward facing
9983-1012972	red	side facing

Zener Diodes

Art. No.	Type	Max. power dissipation
9983-1012965	ZPD 3.3	0.5 W
9983-1012966	ZPD 9.1	0.5 W
9983-1012967	ZPD 6.2	0.5 W
9983-1012968	ZPY 5.6	1.3 W
9983-1012969	ZPY 8.2	1.3 W
9983-1012970	ZPD 18	0.5 W

Semiconductor Diodes

Art. No.	Type	Mate-rial	Cut-off voltage	Max. long-term current
9983-1012964	1N 4007	Si	1000 V	1 A
9983-1012961	BY 255	Si	1300 V	3 A
9983-1012963	AA 118	Ge	90 V	50 mA

Thermistors

Max. temperature:

Art. No.	Type	Resistance (25°C)	Resistance (100°C)
9983-1012941	NTC	2.2 kΩ	120 Ω
9983-1012942	PTC	100 Ω	

LDR 05 Photoresistor

Resistance: 100 Ω (bright light) … 10 MΩ (dark)
Max. power dissipation: 0.2 W

9983-1012940

BR 100 Diac

BR100 diac in a plug-in housing printed with the appropriate circuit symbol.
Breakdown voltage: 32 V approx.
Breakdown current: 50 µA approx.

9983-1012973

Single-Pole Push-Button Switches

Art. No.	Type
9983-1012988	Normally open
9983-1012989	Normally closed

Coils

Art. No.	Type	Inductance
9983-1012983	Coil	10 mH
9983-1012984	High-Frequency Coil	33 mH

Single-Pole Rocker Switch

9983-1012990

Micromotor 1.5 V DC

Miniature motor with gearbox permanently fixed to the side.
Operating voltage: 0.5 – 1.5 V DC
Gear ratio: 40 : 1

9983-1012995



9983-1012995

E 10 Socket

Art. No.	Type
9983-1012986	Socket side facing
9983-1012987	Socket upward facing

Additionally required:
E10 bulb from **9983-1010140, 9983-1010141, 9983-1010142, 9983-1010143, 9983-1010144, 9983-1010145, 9983-1010195, 9983-1010196, 9983-1010197, 9983-1010198** or **9983-1010199**

Set of 10 Jumpers

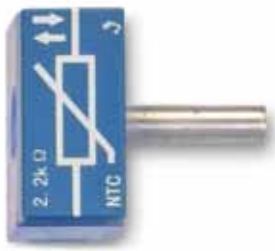
Set of 10 jumpers with printed lines showing the connection between the two plugs, for assembling circuits on the plug-in component board (9983-1012902).
Max. permitted current: 25 A
Plug separation: 19 mm

9983-1012985

Battery Holder

Open housing with connectors for type IEC R 20 1.5-V batteries.
Plugs: 2
Plug separation: 50 mm

9983-1012994



9983-1012941



9983-1012940



9983-1012973



9983-1012987



9983-1012985



9983-1012994

www.EngineeringBooksPDF.com

NEW

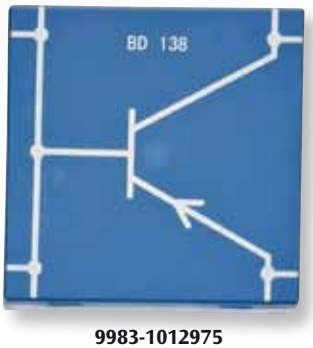
Components in plug-in housings with four plugs separated by 50 mm.



9983-1012939



9983-1012974



9983-1012975

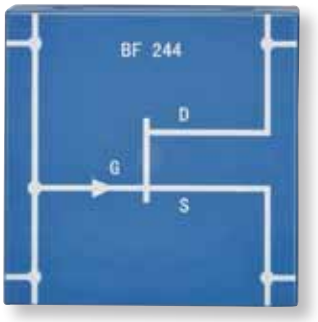
Potentiometers

Art. No.	Resistance	Max. power
9983-1012934	220 Ω	1 W
9983-1012935	470 Ω	1 W
9983-1012936	1 kΩ	1 W
9983-1012937	10 kΩ	1 W
9983-1012938	4.7 kΩ	1 W
9983-1012939	100 kΩ	1 W

Transistors

Art. No.	Type	Current gain	Power dissipation
9983-1012974	NPN BD137	40–250	5 W
9983-1012976	NPN BC550	420–800	0.5 W

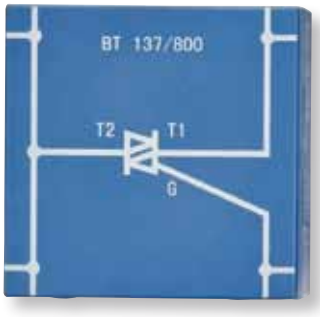
Art. No.	Type	Current gain	Power dissipation
9983-1012975	PNP BD138	40–250	5 W
9983-1012977	PNP BC560	420–800	0.5 W



9983-1012978



9983-1012979



9983-1012980



9983-1012981

BF 244 Field Effect Transistor
Type: BF244, N-channel-FET
Power dissipation: 300 mW
9983-1012978

TYN 1012 Thyristor
Type: TYN 1012, N-channel FET
Cut-off current: 8 A
9983-1012979

BT 137/800 Triac
Type: BT 137/800
Cut-off current: 3 A
9983-1012980

LM 741 Operational Amplifier
Operating voltage: ±15 V DC
Output current: 15 mA
9983-1012981

Double-Pole Change-Over Switch
Mechanical rocker switch with two switch positions on a square plug-in housing printed with the appropriate circuit symbol. Internal mechanical coupling with two change-over switches for each of the three switch positions to be reproduced in two circuits.
Switch functions: 2 x ON-OFF, 2 x OFF-ON, 2 x ON-OFF-ON, 2 x Change-over
9983-1012991

Relay with Change-Over Contacts
Control voltage: 4–16 V DC
Coil resistance: 150 Ω approx.
Maximum switched power: 50 VA
9983-1012992

Low-Frequency Transformer, 1:2
9983-1012982

Single-Pole Change-Over Switch
9983-1012993



9983-1012991



9983-1012992



9983-1012982



9983-1012993

www.EngineeringBooksPDF.com

Experiment Topics:

- Measurement at galvanic voltage sources
- Daniell cell, series and parallel circuits
- Electrochemical potentials (voltage sequence)
- Determination of the standard potentials of different metals and non metals
- How potentials depend on concentration
- How potentials depend on temperature
- Charge and discharge of a steel accumulator
- Leclanché cell
- Measurement of pH values



BEST SELLER

9983-1002719

Electrochemistry Case

A complete equipment set in a case for basic experiments on electrochemistry. A cell block made of tough plastic, which can be unscrewed into two halves for ease of cleaning, allows four galvanic cells to be connected in parallel. A piece of filter paper stretched between the two halves of the cell acts as a diaphragm. Includes a handy, high-resistance meter for measuring potential differences with very little current and measuring pH values with the help of the supplied pH measuring probe.

Measurement device:

7 segment display:	3 digit
Height:	13 mm
Voltage ranges:	2 V DC and 20 V DC
Resolution:	1 mV
Input resistance:	200 MΩ
pH measuring range:	0,0 … 14,0 pH
Power supply:	Plug-in power supply, 12 V/0.5 A (as supplied) or 9-V block battery
Dimensions:	approx. 175x105x55 mm³

Contents:
1 foam lined case
1 measurement device
1 pH combined electrode with BNC plug
1 plug-in power unit 12 V DC / 500 mA for 115/230 V AC mains voltage
1 Cell block, fitted with filter paper
2 Ag-electrodes, 42x28 mm²
1 Pt-electrode, 42x28 mm²
4 Zn-electrodes, 42x28 mm²
2 Fe-electrodes, 42x28 mm²
2 C-electrodes, 42x28 mm²
2 Al-electrodes, 42x28 mm²
2 Ni-electrodes, 42x28 mm²
4 Cu-electrodes, 42x28 mm²
1 Mg-electrode, 42x28 mm²
1 set of filter papers (50 units)
1 Sanding block for cleaning electrodes
3 experiment cables with crocodile clips, 20 cm, red
3 experiment cables with crocodile clips, 20 cm, blue
1 experiment cable with crocodile clip and 2 mm plug, 30 cm, red
1 experiment cable with crocodile clip and 2 mm plug, 30 cm, blue
2 graduated plastic beakers, 25 ml
2 drip pipettes with suction bulbs
1 Storage box with loose insert
1 operating instructions on CD-ROM

9983-1002719

Additionally required:
Chemicals

pH Combined Electrode

pH combined electrode with shaft made of plastic with a BNC plug and highly flexible cable.

Length of cable:	approx. 1 m
Dimensions:	approx. 120 mm x 12 mm diam.

9983-1002720



9983-1002720

www.EngineeringBooksPDF.com



Daniell Cell

Galvanic cell (Daniell cell) named after John Frederic Daniell for studying the properties of an electrochemical cell. The Daniell cell consists of a cylindric zinc and copper electrode, a clay vessel and a battery glass. Filled with cell electrolyte the Daniell cell supplies a voltage of approx. 1.1 volts. The cell is delivered empty.

Connections:	4 mm jacks
Dimensions:	approx. 105 mm x 65 mm diam.
Suitable filling:	Copper sulphate solution ($CuSO_4$), 10% concentration, Zinc sulphate solution ($ZnSO_4$), 10% concentration

9983-1002898

Daniell Cell F

Inexpensive galvanic cell assembled in the layout known after John Frederic Daniell. Assembled from inside to outside using a copper electrode with a connector socket, a clay vessel, a zinc electrode with a connector socket and a glass beaker. The cell is supplied empty and does not include any chemicals. When filled with electrolyte, it can supply a voltage pf approximately 1.1 V.

Electrolyte:	10% copper sulphate solution ($CuSO_4$), 10% zinc sulphate solution ($ZnSO_4$)
Sockets:	4 mm
Dimensions:	140 mm x 75 mm diam. approx.

9983-1010131

Carbon Electrodes

Pair of graphite electrodes for use with the Hofmann's voltameter S (9983-1003507) for the analysis of ammonia solutions, solutions of table salt or other solutions with chloride radicals.

9983-1003508



9983-1003508

Hofmann's Voltameter

Apparatus for electrolysis of water, the quantitative determination of the gases formed and establishing Faraday's laws. Consists of two scaled gas collection tubes connected by flexible plastic hose with levelling bulb for pressure compensation and hence for the exact measurement of gas volumes, on stand with retaining plate. GL threads provide secure mounting for electrodes.

Dimensions:	approx. 800x150 mm²
Baseplate area:	approx. 250x160 mm²
Rod:	750 mmx12 mm diam.
Retaining plate:	approx. 120x110 mm²

See physics experiments catalogue

Contents:

1 gas collection tubes
2 platinum electrodes with 4 mm sockets
1 plastic hose with levelling bulb
1 stand ring for holding levelling bulb
1 universal bosshead
1 stand baseplate with rod and retaining plate

9983-1002899

Additionally recommended:
9983-1003312 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0–20 V, 0 – 5 A (115 V, 50/60 Hz)

9983-1003132 Power and Energy Meter (230 V, 50/60 Hz)
or
9983-1003131 Power and Energy Meter (115 V, 50/60 Hz)

Hofmann's Voltameter S

Hofmann's voltameter is used for determining the chemical composition of water by volume. The apparatus consists of three vertical glass tubes connected to each other at the bottom. Taps at the top ends of the outside tubes are closed whilst the inner cylinder is open at the top to allow the addition of water via a reservoir. Gold sheet electrodes are fitted to the lower ends of the outside tubes and connected to a low-voltage power supply. The proportion of hydrogen and oxygen produced by electrolysis from the water can be read from the graduations on the side tubes. By opening the taps at the top of the tubes, gases can be collected for analysis. Carbon electrodes are also available for analysis of solutions where gold is unsuitable.

Dimensions:	approx. 580x150 mm²
Stand base, A-shaped:	115 mm leg length
Operating voltage:	4 – 12 V DC

9983-1003507

Additionally required:
9983-1003312 DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Additionally recommended:
9983-1003132 Power and Energy Meter (230 V, 50/60 Hz)
or
9983-1003131 Power and Energy Meter (115 V, 50/60 Hz)
9983-1003508 Carbon electrodes

www.EngineeringBooksPDF.com

Equipment Set for Electrochemistry

Set for measuring electrochemical potentials of various metals in experiments intended for students. Includes digital multimeter.

Trough: approx. 85x70x45 mm³
Elecrodes: approx. 76x40 mm²

Contents:

1 flat trough
1 copper plate
1 zinc plate
1 iron plate
2 nickel plates
1 aluminum plate
2 electrolyte-carbon plates
1 digital multimeter with 2 cables with crocodile clamps

9983-1002711



9983-1002711

9983-1002897

Electrode plates

(not shown)
Spare electrodes for the electrochemistry equipment set (9983-1002711).
Dimensions: approx. 76x40 mm²

Art.-No.	Material
9983-1002712	Set of 10 Copper Plates
9983-1002713	Set of 10 Zinc Plates
9983-1002714	Set of 10 Iron Plates
9983-1002715	Set of 5 Nickel Plates
9983-1002716	Set of 10 Aluminum Plates
9983-1002717	Set of 5 Carbon Plates

Leclanché Cell

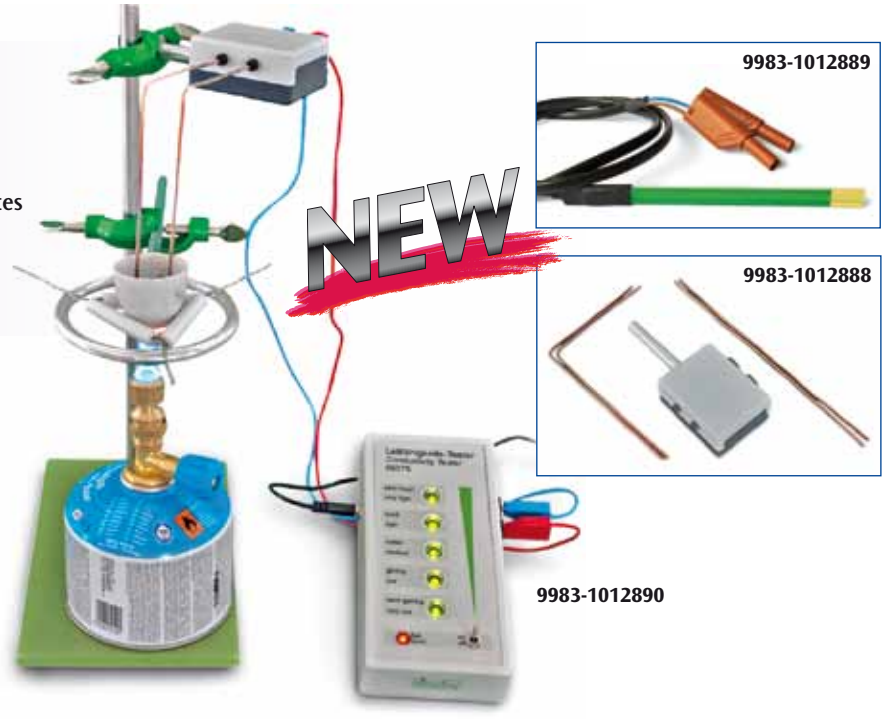
This model of a dry battery was invented by the French chemist Georges Leclanché in the 1860s. It consists of a cylindrical zinc electrode, a rod shaped carbon electrode, a clay vessel and a battery glass. Filled with cell electrolyte, the Leclanché cell supplies a voltage of approximately 1.5 volts. The cell is delivered empty.

Connections: 4 mm jacks
Dimensions: approx. 175 mm x 65 mm diam.
Suitable filling: Ammonium chloride solution (NH_4Cl), approx. 20% concentration

9983-1002897

Experiment Topics:

- Conductors and non-conductors
- Determining electrolytes
- Distinguishing between 5 typical electrolytes
- Conductivity of melted salts



Conductivity Tester

Easy to use meter for determining conductivity of electrolytes (in water courses) and distinguishing between distilled water, rain water, tap water, brine and sea water, as well as between acids and alkalis. The display indicates the levels “very low”, “low”, “medium”, “high” and “very high” and has LED backlighting. Even the very low conductivity of distilled water is displayed. The device is protected against spray and can therefore be used without difficulty in the open air. It can be powered either by a 9-V block battery (not included) or by the supplied 12-V/500-mA plug-in power supply.

Measuring ranges: 2 … 20 µS/cm (very low),
20 … 100 µS/cm (low),
100 … 500 µS/cm (medium),
500 … 3000 µS/cm (high),
> 3000 µS/cm (very high)
Dimensions: 85x35x170 mm
Battery capacity: 10 hours approx.

9983-1012890

Additionally required:
9983-1012889 Conductivity Electrode
or
9983-1012888 Conductivity Electrode for Molten Salts

Conductivity Electrode

Conductivity electrode for use with conductivity tester (9983-1012890). With platinum wires and 0.8 m of cable tipped by two 4-mm plugs.

Cell constant: 1/cm approx.
Dimensions: 130 mm x 15 mm diam.

9983-1012889

Conductivity Electrode for Molten Salts

Conductivity electrode for use with conductivity tester (9983-1012890) to demonstrate the conductivity of molten salts. With 4 interchangeable flexible copper wires for immersion in the molten salts plus 0.8 m of cable tipped by two 4-mm plugs.

Copper wires: 200 mm x 2 mm diam.

9983-1012888

www.EngineeringBooksPDF.com

Magnetic Equipment Set

A selection of various magnets for introducing the subject of magnetism. Complete with a specially molded storage tray.

Contents:
3 AlNiCo round magnets: 12 mm, 19 mm, 24 mm diam.
1 AlNiCo horseshoe magnet, 25 mm long
1 Chromium-steel horseshoe magnet, 100 mm long
2 Chromium-steel bar magnets, 100 mmx6 mm diam.
2 Bar magnets in a protective plastic case, 80 mm long
5 Iron ring magnets, 25 mm diam.
5 Iron magnets, 19x19x5 mm³
1 Natural magnet
4 Coloured magnetic foils, 50x50 mm²
2 Drawing compasses, 19 mm diam.
2 Drawing compasses, 16 mm diam.

9983-1003089

BEST SELLER



9983-1003089



9983-1000943

9983-1003085

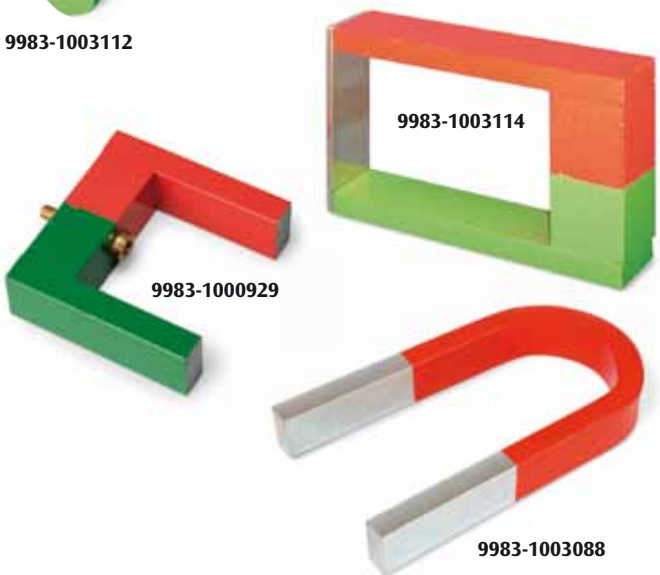


9983-1003554

9983-1003556

9983-1003086

9983-1003112



9983-1003114

9983-1000929

9983-1003088

Pair of Bar Magnets, 80 mm

Pair of bar magnets with poles marked red and blue. In plastic protective cover.
Dimensions: approx. 80x22x10 mm³

9983-1003085

Cylindrical Bar Magnet 50x20

Round bar magnet with poles marked red and green.
Dimensions: approx. 50 mm x 20 mm diam.

9983-1003556

Cylindrical Bar Magnet 200x10

Round bar magnet with poles marked red and green.
Dimensions: approx. 200 mmx10 mm diam.

9983-1003112

Horseshoe Magnet, 70 mm

Horseshoe shaped AlNiCo magnet with screw. Poles marked red and green.
Pole area: approx. 20x10 mm²
Distance between poles: approx. 50 mm
Length of shank: approx. 70 mm
Weight: approx. 400 g

9983-1000929

Horseshoe Magnet 130 mm, with Yoke

Horseshoe shaped magnet with yoke. Poles coloured red/green.
Pull-off force of yoke: 250 N
Pole spacing: approx. 60 mm
Length: approx. 130 mm

9983-1003114

Suspended Magnet

Apparatus for demonstrating repulsion forces between magnets. Two ring magnets facing each other with identical poles are slid on a rod.
Base: approx. 100 mm diam.
Rod: approx. 100 mm x 30 mm diam.
Weight: approx. 410 g

Contents:
1 Rod with Base
2 Ring magnets

9983-1000943

Bar Magnet, AlNiCo, 70 mm

AlNiCo bar magnet with poles marked red and green.
Dimensions: approx 70x20x8 mm³
Weight: approx. 80 g

9983-1003554

Pair of Bar Magnets, AlNiCo, 60 mm, with Two Iron Yokes

Pair of AlNiCo bar magnets, red, with north pole marked. Including two iron yokes.
Dimensions: approx. 60x15x5 mm³

9983-1003086

Horseshoe Magnet 140 mm, with Yoke

Horseshoe shaped chromium steel magnet with yoke, poles coloured red and silver.
Pole area: approx. 20x10 mm²
Distance between poles: approx. 60 mm
Length of shank: approx. 140 mm

9983-1003088

www.EngineeringBooksPDF.com

Equipment Kit “Hysteresis Curve”

Apparatus for recording the magnetic flux density as a function of the magnetic field strength in different iron specimens.

Dimensions of the	
iron samples:	approx. 140 mm x 10 mm diam.
Number of turns:	600
Internal resistance:	1.5 Ω
Inductance without core:	3.5 mH
Dimensions:	approx. 200x145x65 mm³
Total weight:	approx. 950 g

Contents:
Base plate with coil and holder for Hall sensors
3 iron samples as coil cores (stainless steel, hard metal and iron)

9983-1000963



9983-1000963

Additionally recommended:
9983-1001037 Power Function Generator (230 V, 50/60 Hz)
or
9983-1001036 Power Function Generator (115 V, 50/60 Hz)
9983-1000558 Magnetic Field Sensor

9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115 V, 50/60 Hz)
9983-1000544 3B NET*lab*™

Soft-Iron Bars

Set of 5, non-magnetic soft-iron bars for magnetic induction experiments.

Dimensions:	approx. 155 mm x 10 mm diam.

9983-1003090



9983-1003090

Lodestone

Unfinished, walnut-sized stone made of magnetic iron ore (magnetite).

9983-1003091



9983-1003091

NEW

Diamagnetic Levitation Apparatus

The physicist S. Earnshaw proposed the following theorem in 1848: “It is not possible for charges or magnets to be placed in a stable levitated state in a static field obeying an inverse square law.” He further stated, however, that it would be possible to achieve this with the help of diamagnetic materials. The availability of very powerful rare-earth metal magnets has made it possible to design a cheap levitation apparatus such as this using graphite as the diamagnet. Diamagnetic materials are repelled from both magnetic poles. A gold-coated NdFeB magnet is allowed to levitate freely between two graphite plates in a space enclosed by transparent acrylic. The gravitational force acting on the magnet is almost entirely counteracted by the force of attraction from a ring magnet located above the plastic covering. Two diamagnetic graphite plates, one above and one below the NdFeB magnet, compel it into a stable equilibrium since both poles of the magnet are repelled by the graphite plates (diamagnetism).

Dimensions:	
Base plate:	approx. 95x95x135 mm³

Contents:
1 Levitation apparatus
2 Transparent acrylic plates
1 Socket wrench

9983-1003493



9983-1003493

www.EngineeringBooksPDF.com



9983-1013123

Globe with Bar Magnet

Globe of the world with bar magnet along the axis of the poles on acrylic base, for demonstrating the shape of the Earth's magnetic field. A compass (9983-1003093) or a magnetic field indicator (9983-1003555) can be seen to align at the surface of the globe in accordance with a magnetic field parallel to the lines of longitude. The inclination can also be determined using the magnetic field sensor.

Dimensions:	220x160x200 mm³
Diameter (globe):	approx. 150 mm
Weight:	approx. 340 g

9983-1013123

Additionally recommended:
9983-1003555 Magnetic Field Indicator
9983-1003093 Compass

"Oersted's Needle" Device

Compact and easily understood apparatus to demonstrate Oersted's experiment. An electric current passing through a piece of enamelled copper wire creates a magnetic field around the wire, which can deflect a magnetic compass needle from its normal position.

Dimensions of base:	200x80 mm²
Copper wire:	3 mm diam.
Electrical connections:	4-mm safety sockets
Maximum permissible current:	5 A

9983-1009710

Additionally recommended:
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

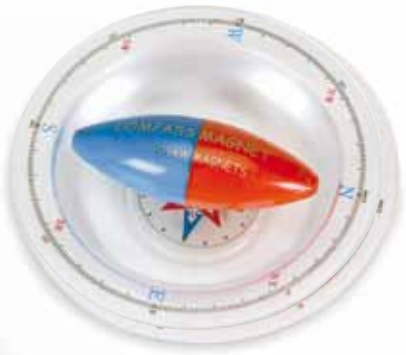
Compass Magnet with Plastic Bowl

Very powerful neodymium magnet covered with a plastic case can float on the surface of water and faces North South when it comes to rest. Complete with translucent plastic bowl marked with compass points.

Dimensions:

Magnet:	80 mm x 30 mm max diam.
Bowl:	approx. 40 mm x 115 mm diam.

9983-1003096



9983-1003096



9983-1009710

NEW

www.EngineeringBooksPDF.com

Compass
Compass in a stable housing, low friction needle bearing, including a compass card and angle scale.
Scale division: 2°
Diameter: approx. 55 mm

9983-1003093

Magnetic Needle, 80 mm
Magnetic needle mounted on base with pivot point.
Length: approx. 80 mm
Height: approx. 110 mm

9983-1000674



9983-1003093

9983-1000674



9983-1003555

Magnetic Field Indicator
Bar magnet, with poles identified by colour and free to turn in space, for three-dimensional mapping of magnetic fields. On agate gimbal bearings pivot allowing free rotation in space, small bar magnet with colour pole coding. Handle and cardanic suspension made of plastic to alleviate any adverse effects on magnetic field.
Magnet: approx. 25x3x3 mm³
Handle length: approx. 95 mm

9983-1003555

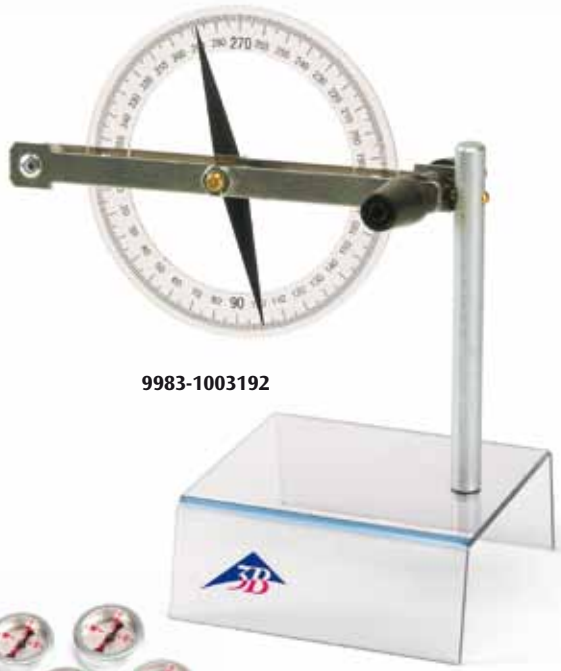


9983-1006799

Inclination Instrument
Instrument for measuring the inclination of the Earth's magnetic field and also for mapping the magnetic field of a current-carrying conductor. An aluminum conductor loop with 4 mm safety sockets, a magnetic needle with a pointed axle rotates on bearings above a full circle in transparent material with an angle scale, rotating about the horizontal axis and mounted on acrylic base.
Diameter of circle: approx. 110 mm
Length of magnetic needle: approx. 100 mm
Strap length: approx. 150 mm
Terminal: 4 mm safety sockets
Base dimensions: approx. 100x90x185 mm³

9983-1003192

Additionally recommended:
9983-1003312 DC-Power-Supply 0–20 V, 0-5 A (230 V, 50/60 Hz)
or
9983-1003311 DC-Power-Supply 0–20 V, 0-5 A (115 V, 50/60 Hz)



9983-1003192

Inclination and Declination Instrument
Instrument for measuring the inclination and declination of the Earth's magnetic field and also for mapping the magnetic field of a current-carrying conductor. The bearings are of agate upon which the magnetic needle is mounted in a frame with reference circle. The frame is equipped with an additional reference circle. There are two 4 mm sockets included for power supply.
Length of magnetic needle: approx. 100 mm
Dimensions: approx. 180x100x220 mm³
Weight: approx. 620 g

9983-1006799

Additionally recommended:
9983-1003312 DC-Power-Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC- Power-Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



9983-1003095

Set of 10 Tracing Compasses
Set of 10 compasses for tracing field lines. Aluminum housing, glazed on both sides. Markings for indicating compass directions.
Diameter: approx. 19 mm

9983-1003095

www.EngineeringBooksPDF.com



9983-1009765



9983-1000580

9983-1000581

9983-1003092



Magnetic Field Lines Device, Three-Dimensional

Instrument for three-dimensional mapping of the magnetic field lines of a cylindrical bar magnet. The plexiglas housing is filled with a special, highly viscous liquid and iron filings. After the magnet has been inserted into the central hole, the iron filings, which had previously been distributed randomly in the liquid, align themselves according to the direction of the field. An enclosed air bubble ensures that a good shake of the device causes the iron shavings to be evenly distributed.

Diameter of the hole: approx. 21 mm
Dimensions: approx. 140x140x120 mm³
Weight: approx. 0.8 kg

9983-1009765

Additionally required:
9983-1003556 Cylindrical Bar Magnet 50x20 mm

Magnetic Field Line Apparatus, Two-Dimensional

Demonstration apparatus for two-dimensional display of magnetic field lines in combination with an overhead projector. It consists of a transparent plastic vessel filled with a liquid containing magnetic powder. Magnets and an experiment manual in English are included.

Dimensions: approx. 220x120x10 mm³

9983-1003092

Additionally required:
9983-1003264 Overhead projector (230 V, 50/60 Hz)
or
9983-1003263 Overhead projector (115 V, 50/60 Hz)

Hexagonal Magnet Model

Demonstration apparatus for the properties of the crystal lattice of ferromagnetic materials, particularly Weiss domains, Barkhausen jumps, saturation, hysteresis and Curie temperature. 117 freely moving magnetic needles are supported in a hexagonal arrangement between two connected transparent acrylic plates. For projection on the overhead projector.

Length of magnetic needles: approx. 17 mm
Dimensions of plate: approx. 150x150 mm²

9983-1002975

Additionally recommended:
9983-1003264 Overhead projector (230 V, 50/60 Hz)
or
9983-1003263 Overhead projector (115 V, 50/60 Hz)
9983-1000942 Pair of Flat Coils

Iron Filings

250 g of iron filings for displaying magnetic field lines. In a storage flask.

9983-1000580

Additionally recommended:
9983-1000581 Shaker

Shaker

Plastic flask with a fine hole for scattering iron filings evenly.

9983-1000581

Magnet Model, Cubic

Like 9983-1002975, but with magnets in a square arrangement.

9983-1002976

Additionally recommended:
9983-1003264 Overhead projector (230 V, 50/60 Hz)
or
9983-1003263 Overhead projector (115 V, 50/60 Hz)
9983-1000942 Pair of Flat Coils

Pair of Flat Coils

Pair of coils for generating a near-uniform magnetic field for the hexagonal and cubic magnet models (9983-1002975 and 9983-1002976). This makes it possible to observe changes in the magnetic flux when the magnetisation is changed.

Number of turns: 125
Resistance: 7 Ω approx.
Permitted current: 1 A
Dimensions: 150x30x18 mm³ approx.
Weight: 85 g approx.

9983-1000942

Additionally recommended:
9983-1003312 DC-Power-Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC-Power-Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



9983-1002976



9983-1002975

9983-1000942



www.EngineeringBooksPDF.com

Experiment Topics:

- Magnetic flux lines of bar and horseshoe magnets
- Magnetic screening
- Magnetic induction
- To display the shapes adopted by magnetic field lines around a straight conductor, a conductor loop, a cylindrical coil, and an electromagnet



9983-1000925

Set of Apparatus for Displaying Magnetic Fields

Equipment set for demonstration experiments designed to make visible the magnetic field distribution of permanent magnets and current carrying conductors. Also compatible for use with a daylight projector. The acrylic glass boxes containing iron filings are equipped with a pouring lip so that the used fillings can easily be refilled into the storage bottle.

Acrylic glass boxes: approx. 185x125x40 mm³
Storage tray: approx. 430x380x25 mm³
Weight: approx. 1.5 kg

Contents:

1 Straight conductor mounted on box made of transparent acrylic
1 Ring-shaped conductor mounted on box made of transparent acrylic
1 Cylindrical coil mounted on box made of transparent acrylic
1 Magnetic overlay with guide studs on acrylic box
1 Acrylic plastic box with smooth surface for scattering materials
2 Soft iron bars
1 Flat soft iron bar
2 Permanent flat bar magnets
1 Soft iron ring
1 Magnetic needle with holder
1 Scattering bottle with iron filings
1 Pre-molded storage tray

9983-1000925

BEST SELLER



Additionally required:
9983-1002771 DC-Power Supply, 0 – 16 V, 0 – 20 A (115 – 230 V, 50/60 Hz)

Additionally recommended:
9983-1003264 Overhead Projector (230 V, 50/60 Hz)
or
9983-1003263 Overhead Projector (115 V, 50/60 Hz)

Current Conductor on Acrylic Base

Current Conductor for demonstrating the magnetic fields of current-carrying conductors. The magnetic field can be made visible with iron powder. Acrylic glass base with two 4 mm safety sockets. For projection on the overhead projector.

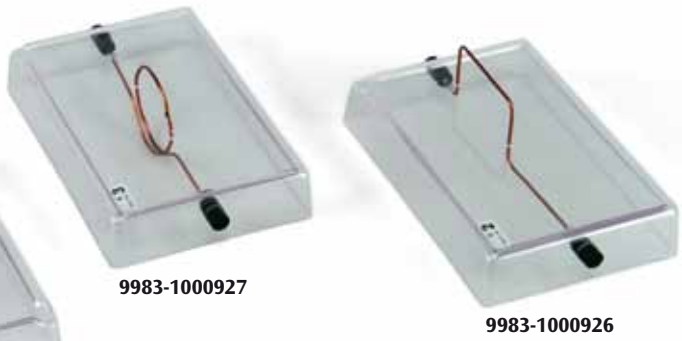
Dimensions of
acrylic glass base: approx. 185x150x30 mm³

Straight Conductor on Acrylic Base

9983-1000926

Loop-Shaped Conductor on Acrylic Base

9983-1000927



9983-1000927

9983-1000926

Coil on Acrylic Base

Number of turns: 7
Coil diameter: approx. 35 mm
Coil length: approx. 65 mm

9983-1000928



9983-1000928

Additionally required:
9983-1002771 DC-Power Supply, 0 – 16 V, 0 – 20 A (115 – 230 V, 50/60 Hz)
9983-1000580 Iron Filings
9983-1000581 Shaker

www.EngineeringBooksPDF.com

Pair of Helmholtz Coils on Mounting Plate

Pair of coils with variable separation for determining the optimum Helmholtz configuration and for quantitative testing of the uniformity of the magnetic field. The apparatus comprises a pair of coils arranged parallel to each other mounted on a robust metal base plate with a holder for a magnetic field meter to measure the magnetic field. One coil and its holder are moveable. There are two scales printed on the base plate to allow coil separation to be read off and to determine how far the measurement probe's position deviates laterally from the coil axis respectively.

Average coil diameter:	125 mm
Number of turns:	100 each
Max. coil separation:	240 mm
Max. permissible current:	5 A
Terminals:	4 mm safety sockets
Base plate:	approx. 400x200 mm²

9983-1003193

Additionally recommended:
9983-1000558 Magnetic Field Sensor



9983-1003193

9983-1003237

Field Coils

Cylindrical coils for experiments investigating magnetic field intensity as a function of the current and the number of turns, for demonstrating that the field intensity is independent of the coil cross section. Coil bobbins made of acrylic.

Number of turns:	120
Coil length:	490 mm
Max. current:	10 A, for short periods 20 A
Terminal:	4 mm safety sockets

Field Coil 100 mm diam.

9983-1000591

Field Coil 120 mm diam.

9983-1000592

Additionally recommended:
9983-1000964 Stand for Cylindrical Coils
9983-1000558 Magnetic Field Sensor

Coil with Variable Number of Turns per Unit Length

Cylindrical coil of variable length for investigating the magnetic field strength as a function of the closeness of the turns.

Coil diameter:	100 mm
Number of turns:	30
Coil length:	490 mm
Max. Current:	10 A, for short periods 20 A
Terminal:	4 mm safety sockets

9983-1000965

Additionally recommended:
9983-1000964 Stand for Cylindrical Coils
9983-1000558 Magnetic Field Sensor



9983-1000965

9983-1000592

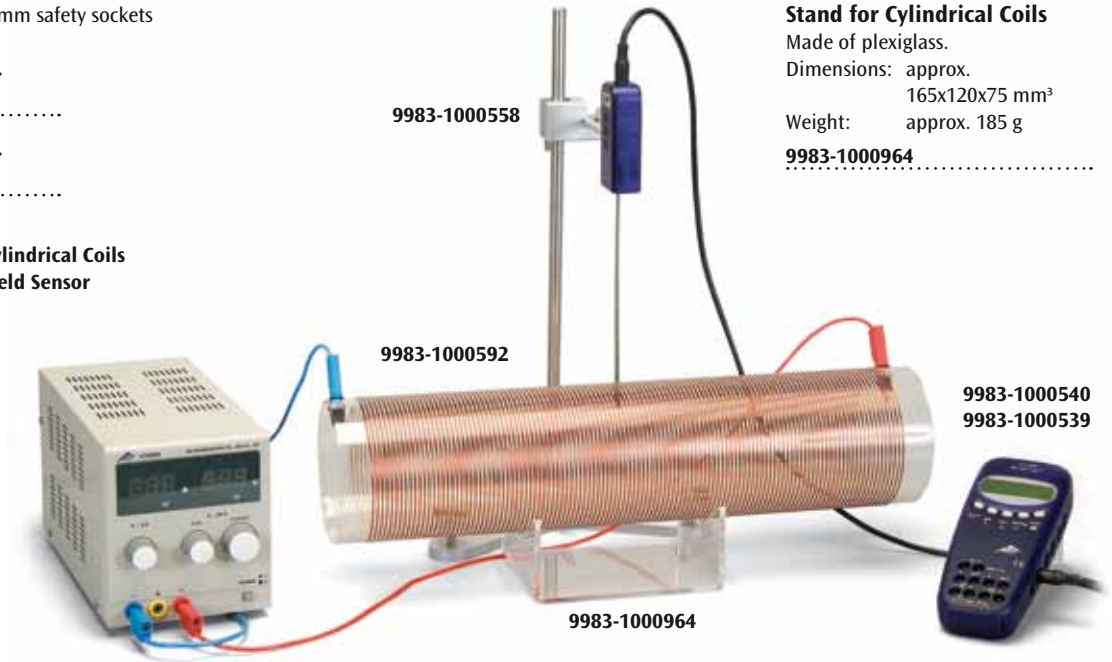
9983-1000591

Magnetizing Coil

This solenoid allows you to magnetize and demagnetize ordinary magnets or iron bars in addition to conducting inductance experiments. The rugged unit consists of insulated copper winding mounted on a base with 4mm sockets and a switch.

Windings:	1000
Coil length:	250 mm
Coil radius:	35 mm internal
Operating Voltage:	max. 12 V DC or 12 V AC
Dimensions:	305x200x100 mm³
Mass:	2 kg

9983-1003237



9983-1000558

9983-1000592

9983-1000540
9983-1000539

9983-1000964

Measurement of the magnetic field around a current carrying coil

Stand for Cylindrical Coils

Made of plexiglass.

Dimensions:	approx. 165x120x75 mm³
Weight:	approx. 185 g

9983-1000964

www.EngineeringBooksPDF.com

Teslameter, 200 mT

This economical digital teslameter will allow students to incorporate quantitative measurements into their magnetism experiments. The unit includes a Hall sensor probe for measuring axial and tangential magnetic fields up to 200 mT. The probe also serves as a ruler as it includes a metric scale. There are two measuring ranges, 0 – ±20 mT and 0 – ±200 mT. The teslameter can be calibrated by the user. In addition to having a digital display, the unit outputs a voltage proportional to the magnetic field which can be measured with a data logger, XY-recorder or analogue multimeter.

Measurement ranges:	0 – ±20 mT, 0 – ±200 mT
Resolution:	0.01 mT, 0.1 mT
Digital Display:	3½ digit LCD
Height of digits:	13 mm
Input:	BNC socket
Output:	4 mm safety sockets
Dimensions of unit:	205x230x85 mm³
Dimensions of probe:	360x15x25 mm³



9983-1003314
9983-1003313

Teslameter, 200 mT (230 V, 50/60 Hz)

9983-1003314

Teslameter, 200 mT (115 V, 50/60 Hz)

9983-1003313

Teslameter E

Hand-held meter for measuring magnetic flux density B or magnetic field strength H in conjunction with an axial-tangential field sensor (9983-1001040) or a flexible magnetic field sensor (9983-1012892). The measurements are shown on a digital display and also converted into equivalent voltage outputs, which can be accessed from the analogue output connection.

LCD display:	3½-digit, 10 mm high
Power supply:	Rechargeable 9-V block battery providing about 20 hours of operation
Sensor connection:	DIN socket
Offset compensation:	±0.150 mT
Measuring modes:	
DC-B	Flux B of uniform fields
AC-B	Flux B of alternating fields (1 Hz … 10 kHz)
AC-H	Field strength H of alternating fields (1 Hz … 10 kHz)
Measuring ranges:	
Flux B:	±2.000/±20.00/±200.0/±2000 mT
Field strength H:	±2.000/±20.00/±200.0/±2000 A/m
Analogue output:	
Connector:	4-mm socket
Range:	0 … ±2 V

9983-1008537

Additionally required:
9983-1001040 Magnetic Field Sensor, Axial/Tangential
or
9983-1012892 Flexible Magnetic Field Sensor

Magnetic Field Sensor, Axial/Tangential

Magnetic field sensor with two built in Hall sensor probes for measuring axial and tangential magnetic fields in conjunction with the teslameter (9983-1008537). A slider switch provides for switching between axial and tangential measuring modes.

Sensitivity:	1 mV/mT
Length of probe (without handle):	approx. 125 mm
Thickness of probe:	4 mm
Hall sensors:	Monocrystalline InAs
Sensor surface:	1 mm²
Connection:	DIN plug

9983-1001040

Flexible Magnetic Field Sensor

Flexible magnetic field sensor with built-in Hall sensor for measuring tangential magnetic fields in connection with the E-model teslameter (9983-1008537).

Sensitivity:	1 mV/mT
Length of probe (without handle):	75 mm
Thickness of probe:	0,6 mm
Hall sensor:	Monocrystalline InAs
Sensor surface:	1 mm²
Connection:	DIN plug

9983-1012892



9983-1001040
9983-1012892
9983-1008537

NEW

www.EngineeringBooksPDF.com

Current Balance According to Langensiepen
Complete equipment set for experiments in electrodynamics and the Lorentz force. Set of equipment for compensation measurement of forces acting on conductor loops in a magnetic field.

Contents:
1 Stand with ball socket made of agate to receive the balance beam
1 Balance beam with pointer and clamp holder for the current conductor
1 Set of 5 current conductor loops (comprising various forms and lengths)
1 Pointer for the zero setting (fastened to the stand)
1 Hydrodynamic frictional brake
250 ml glycerin
1 Set of drive weights
1 Transformer core with yoke and clamp
1 Pole piece set
2 Coils, 600 turns
1 Dynamometer 0.1 N
2 Weights 100 g
1 Weight 200 g
10 Spacer rings

9983-1000975

Additionally required:
9983-1002834 Barrel Foot, 1 kg
9983-1002934 Stainless Steel Rod, 470 mm

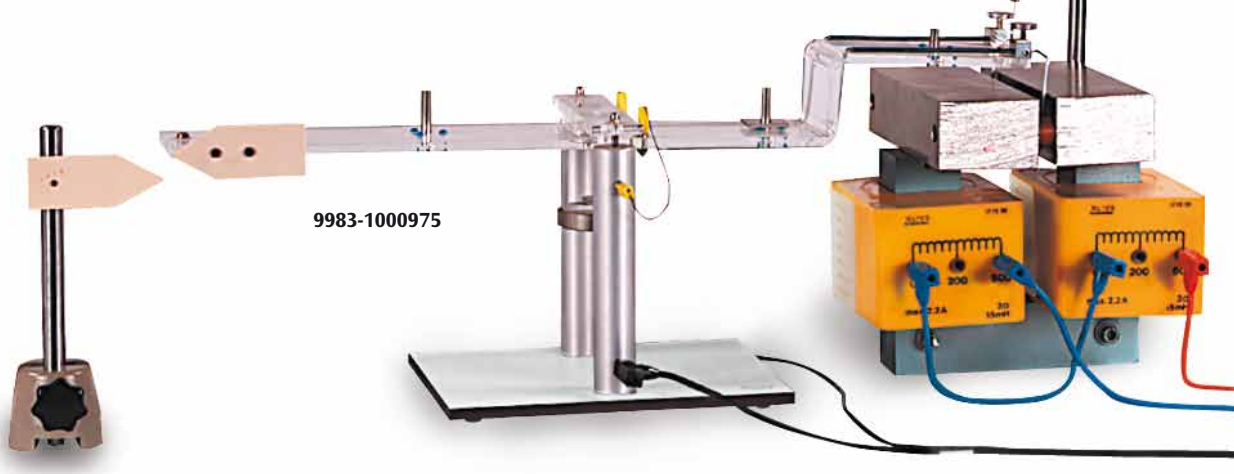
Additionally recommended:
9983-1003312 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Experiment Topics:

- Effect of force acting on a current-carrying conductor in a magnetic field
- Measurement of the magnetic flux density
- Effect of induction acting on a single conductor in the magnetic field
- Force between two parallel linear conductors
- Definition of ampere



9983-1000975



9983-1000975



9983-1003251

Lorentz Force Apparatus
The apparatus consists of a powerful U shaped magnet, a pair of brass rails complete with 4mm sockets and a brass axle. A power supply unit is connected to the rails. When the axle is placed on the rails the electric circuit is completed and the axle is repelled along the rails in a direction either towards or away from the magnetic field. Reversing the current will have the opposite effect.
Dimensions: 175x65x70 mm³

9983-1003251

Additionally required:
9983-1003312 DC Power Supply 0–20 V, 0–5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0–20 V, 0–5 A (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

Experiment Topics

- Diamagnetism and paramagnetism
- Waltenhofen's pendulum
- Force on a conductor in a magnetic field in parallel and transverse configurations
- Measuring currents with a current balance



Equipment Set Electromagnetism

This equipment consists of a stable, firm, anodized-aluminum tripod with pre-defined magnet positions and accessory mountings. The deflection of the conductor swing can be adjusted in steps of 0, 15, 30 and 45 mm for current balance experiments.

Contents:
1 Aluminum tripod, anodized
1 Conductor swing with 4 mm safety jacks
2 Waltenhofen pendulums (solid and slotted)
1 Glass rod and polyester thread with hook
1 Aluminum rod and polyester thread with hook
1 Knurled screw

9983-1002661

Additionally required:
9983-1002660 Permanent Magnet with Adjustable Pole Spacing
9983-1003312 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Lorentz Motor

Comprising a motor armature without an iron core, this device is intended for installation inside the permanent magnet with adjustable pole spacing (9983-1002660). The coil is rotated purely by the Lorentz force, its direction of rotation depending on the direction of the current.

9983-1002662

Additionally required:
9983-1002660 Permanent Magnet with Adjustable Pole Spacing
9983-1003312 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Permanent Magnet with Adjustable Pole Spacing

This permanent magnet has an adjustable pole spacing and a high field strength arising from the use of two neodymium magnet elements. It comes with a black-finished iron yoke, knurled handles made of high-grade steel and attachable pole shoes. This magnet system can be installed horizontally or vertically.

Magnet:	20x10 mm²
Pole shoes:	20x50 mm²
Pole spacing:	2–80 mm
Field strength at centre of gap:	20 mT–1000 mT

9983-1002660





www.EngineeringBooksPDF.com

Demonstration Dynamo

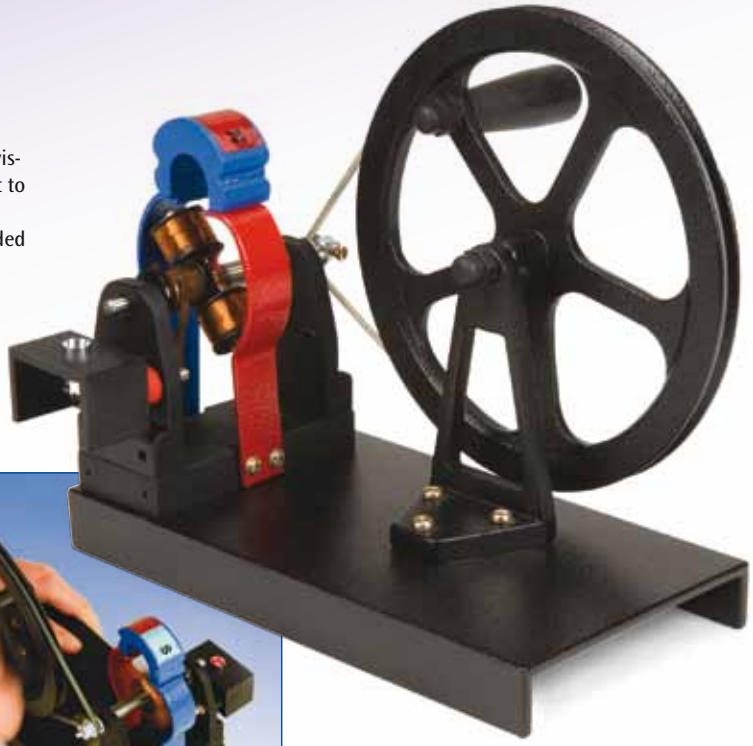
This model dynamo demonstrates the conversion of mechanical energy into electrical energy. All working parts of the electric motor are clearly visible. The motor is mounted on a base plate and coupled by a rubber belt to a hand-drive pulley. External connection is via 4 mm sockets with a light emitting diode acting as an output indicator. The magnetic field is provided by a permanent magnet.

Base plate:	200x100x20 mm³
Hand-drive pulley:	150 mm diam.
Height:	180 mm

Contents:
1 Apparatus on base plate
1 Removable magnet
1 Stackable light emitting diode
1 Small dynamo pulley

9983-1003252





9983-1003252

Induction Apparatus

Apparatus for demonstrating the induced voltage in a frame coil that is moved through the magnetic field produced by a magnet plate of limited area or by the rotation of a current-carrying conductor in the magnetic field of the magnet plate. By varying the speed of motion of the frame coil, the direction of motion and the number of turns in the coil, the induction law can be derived experimentally and quantitatively. The transparent design of the magnetic plate and coils means that they can be demonstrated on the overhead projector. An unfoldable support permits inclined set-up.

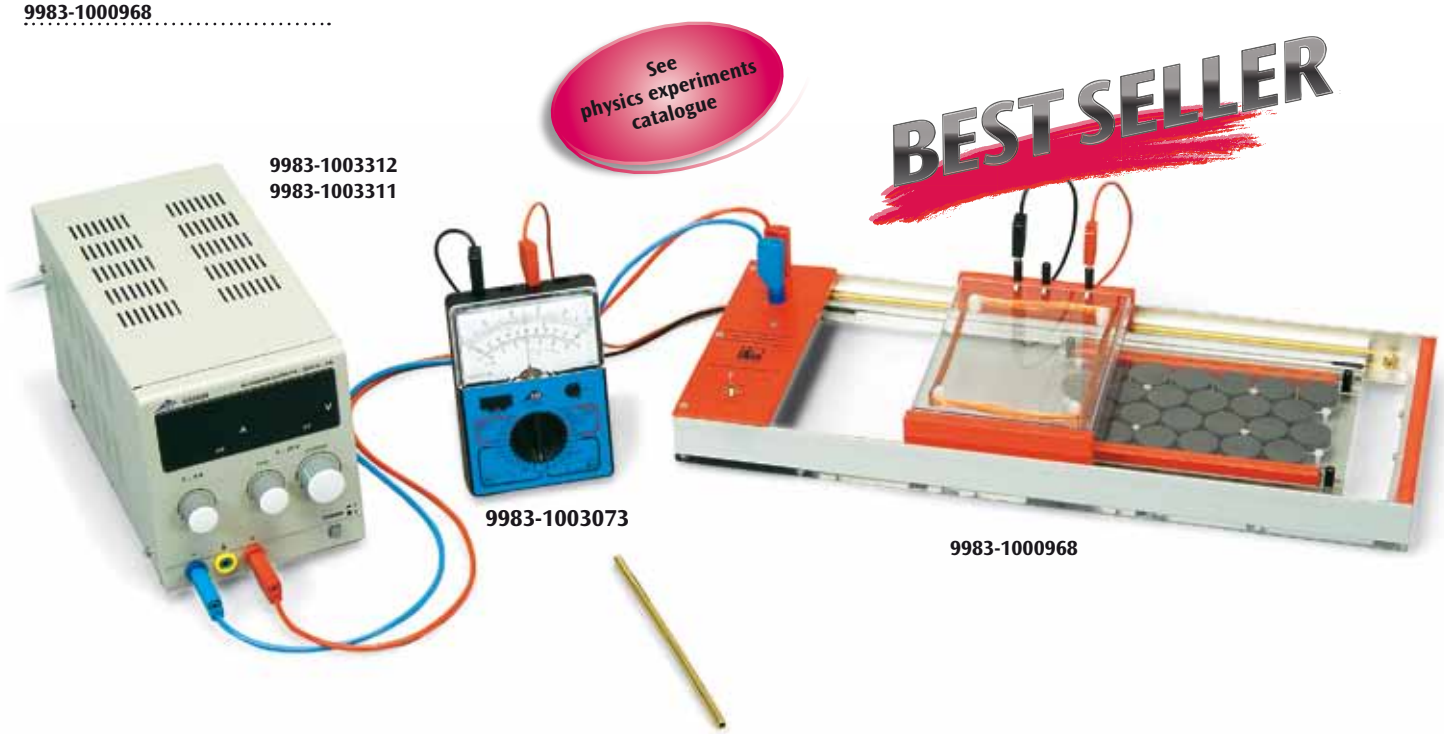
Operating voltage:	2–12 V DC
Frame coil:	approx. 185x125 mm²
Total dimensions:	approx. 585x200x55 mm³
Weight:	approx. 3 kg

Additionally required:
9983-1003312 **DC-Power Supply Unit 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)**
or
9983-1003311 **DC-Power Supply Unit 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)**
9983-1003073 **Analogue Multimeter AM50**

Additionally recommended:
9983-1003264 **Overhead Projector (230 V, 50/60 Hz)**
or
9983-1003263 **Overhead Projector (115 V, 50/60 Hz)**

Contents:
1 Induction apparatus with retractable magnetic plate
1 Frame coil
1 Rolling conductor loop

9983-1000968



www.EngineeringBooksPDF.com

Flat Coil in a Rotatable Frame

Flat coil in a plexiglas frame, mounted so that it can be rotated, for use in combination with 300 mm Helmholtz coils (9983-1000906). When the flat coil is rotated in the magnetic field of the Helmholtz coils, an alternating voltage is induced. The electrical connection to the coil is established via sliding contacts. A hand crank and pulley on the rotary frame's axle are used to drive the coil.

Number of turns:	4000
Effective area:	42 cm²
Dimensions:	approx. 110x80x11 mm³
Weight:	approx. 360 g

9983-1013131

Additionally required:
9983-1000906 Helmholtz Coils, 300 mm
9983-1003073 Analogue Multimeter AM50
9983-1003312 DC-Power Supply Unit 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC-Power Supply Unit 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

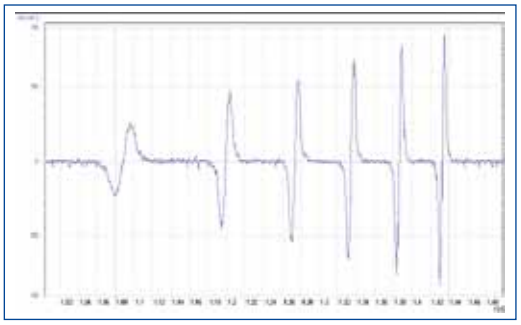


Tube with Six Induction Coils

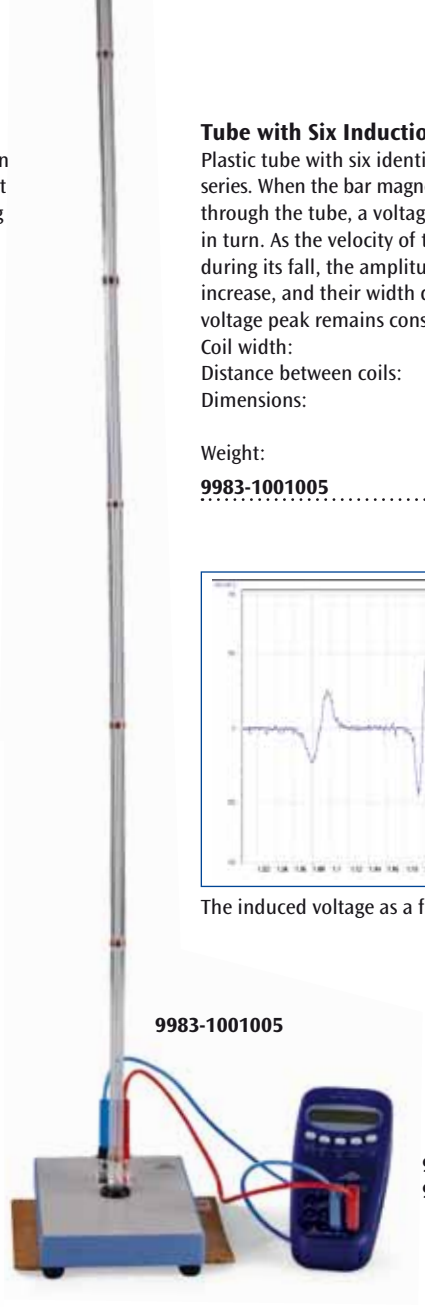
Plastic tube with six identical induction coils connected in series. When the bar magnet provided is allowed to fall through the tube, a voltage is induced in each of the coils in turn. As the velocity of the magnet increases with time during its fall, the amplitudes of the voltage peaks also increase, and their width decreases. The area under each voltage peak remains constant.

Coil width:	10 mm
Distance between coils:	190 mm
Dimensions:	approx. 1500 mm x 20 mm diam.
Weight:	approx. 500 g

9983-1001005



The induced voltage as a function of time.



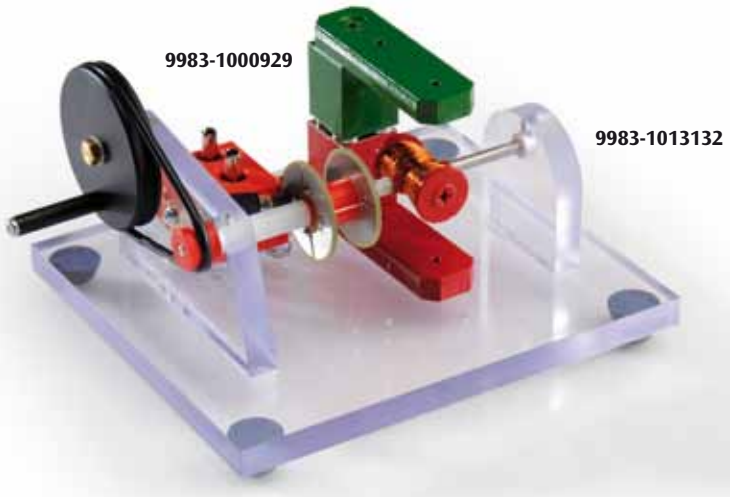
Electromotor and Generator

Functioning model to demonstrate how a direct current motor and direct current generator alternating current generator respectively operates. The model is equipped with a commutator and slip-rings and mounted on an acrylic plate with connection sockets, drive pulley and rubber belt.

Dimensions:	approx. 200x140x60 mm³
Weight:	approx. 370 g

9983-1013132

Additionally required:
9983-1000929 Horseshoe Magnet 70 mm



Helmholtz Coils 300 mm

Pair of coils with large diameter in Helmholtz configuration used to produce a homogeneous magnetic field. The coils can be switched in parallel or in series. A spring clip on the top crossbar is used to mount the Hall sensor during measurements of the magnetic field.

Coil diameter:	approx. 300 mm
Number of turns per coil:	124 each
DC resistance:	1.2 Ω each
Maximum coil current:	5 A each
Terminals:	4 mm safety sockets
Weight:	4.1 kg approx.
Max. field:	3.8 mT

9983-1000906

Additionally recommended:
9983-1000558 Magnetic Field Sensor

www.EngineeringBooksPDF.com



Waltenhofen's Pendulum

Equipment set for the demonstration of the effects of eddy currents and braking. A pendulum object composed of a solid steel plate swings back and forth between the poles of an electromagnet with the power switched off. When the magnet is switched on, the pendulum motion of the object comes to an almost immediate halt. If the plate contains slots more time elapses before the plate stops moving, i.e. the braking effect is severely reduced. The equipment set consists of a pendulum rod and four aluminium pendulum plates with various shapes: rectangle, rectangle with slits, circular disk, ring and ring with slits.

Rectangular:	approx. 100x60 mm²
Ring:	approx. 30 mm diam. (interior), approx. 60 mm diam. (exterior)

9983-1000993

Additionally required:

9983-1000976 Transformer Core D
9983-1000978 Pair of Pole Pieces
9983-1000989 Coil with 1200 Turns (2x)
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)

or

9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

See physics experiments catalogue



Set of 3 Induction Coils

Coils for experiments on induction in combination with the 120 mm diameter field coil (9983-1000592) and for experiments on resonant electric circuits. The coils are only designed for safety extra low voltage (SELV). The spools are made of transparent acrylic plastic.

Connection:	4 mm safety sockets
Coil length:	170 mm
Coil 1	
Number of turns:	300 with taps at 100 and 200 turns
Coil cross section:	50x50 mm²
Coil 2	
Number of turns:	300
Coil cross section:	50x30 mm²
Coil 3	
Number of turns:	300
Coil cross section:	50x20 mm²

9983-1000590

Additionally recommended:

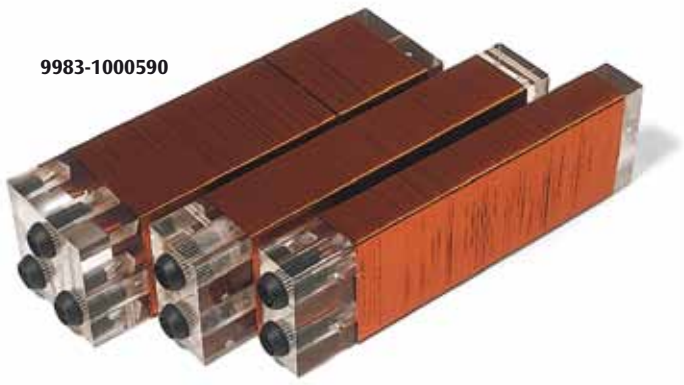
9983-1000592 Field Coil 120 mm diam.

Variable Inductance Coil

Coils for measuring inductance and self-inductance of a current-carrying coil depending on the insertion of an iron core and for investigating AC circuits. Coil of copper wire in a shock-resistant plastic casing with lifting handles. A coated iron core is mounted on a worm screw for moving in and out of the coil. With printed scale in cm for reading the length of core inserted into the coil.

Number of windings:	3000
Max. permissible voltage:	30 V AC, 60 V DC
Max. permissible current:	2 A
Inductance at 1 A:	approx. 0.15 –1.4 H, continuously adjustable
Resistance:	12.5 Ω
Terminals:	4 mm safety plugs
Dimensions:	approx. 265x145x130 mm³
Weight:	approx. 6.2 kg

9983-1003194





www.EngineeringBooksPDF.com

Induction Torch

No batteries, a simple shake is enough.

Tough torch with bright LED. Shaking the torch causes a magnet to move back and forth inside a coil, thus generating a current in accordance with Faraday's laws of induction. The current charges a built-in storage cell. One minute of shaking is enough to provide about five minutes of light.

Dimensions: 175 mm x 40 mm diam.
Weight: 125 g

9983-1010207



9983-1010207

Lenz's Law Copper Tube

Handy demonstration apparatus for illustrating Lenz's law and induction of eddy currents. A small steel cylinder and a magnet of the same dimensions fall at different speeds through a copper tube because the motion of the magnet causes eddy currents to be induced, resulting in a magnetic field which slows the fall of the magnet. Includes 2 plastic caps so that the tube can be used as a container.

Length: 320 mm approx.
Diameter: 15 mm approx.

9983-1009716



9983-1009716

Lenz's Law Apparatus

Instrument for demonstrating Lenz's Law qualitatively by bringing a magnet close to it. One closed and one open conductor loop, with point bearing on base.

Length: approx. 195 mm
Height: approx. 110 mm

9983-1009959

Additionally required:
9983-1003112 Cylindrical Bar Magnet 200x10



9983-1009959



9983-1010164

Bicycle Dynamo, Transparent

Bicycle dynamo in transparent housing. It is possible to observe the movement of the generator components while the dynamo is in operation.

Generated voltage: ca. 6 V
Generated power: 3 W
Dimensions: 95x34x25 mm³ approx.

9983-1010164

Experiment Motor with Gearbox

Experiment motor for universal use in experiments on rotational motion, e.g. for experiments using the rings demonstrating flattening of the earth (9983-1000750) or Watt's governor (9983-1009695). Can also be used as a generator in conjunction with the included hand crank. Robust clockwise and counter-clockwise rotating IDC motor with epicyclic gearbox and quick-action chuck in a tough anodized aluminum casing with removable and adjustable stainless steel stand rod. Can also be mounted on the clamp for the projectile launcher (9983-1002655). Speed of rotation is adjusted by altering the supply voltage. Adjustable torque. Includes 3 belt pulleys of different diameters on a mounting axle.

Speed without load: approx. 480 rpm at 12 V
Speed sensitivity: approx. 40 rpm per V
Span of chuck: 0.8 to 10 mm
Stand rod: 12 mm diam.
Pulleys: 10 mm diam., 20 mm diam., 40 mm diam.
Axle: 10 mm diam.
Drive belt: 130 mm diam. x 4 mm
Nominal voltage: 12 V DC, 5A
Connection: via 4-mm safety sockets
Dimensions: 210x95x60 mm³
Mass: 1.2 kg

9983-1002663



9983-1002663

Contents:

Experiment motor	Hand crank
Stand rod with knurled screws	Pulleys
	Drive belt

Additionally required:
9983-1003312 DC Power Supply 0 – 20 V, 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0 – 20 V, 5 A (115 V, 50/60 Hz)

Additionally recommended:
9983-1003331 Digital Stroboscope (230 V, 50/60 Hz)
or
9983-1003330 Digital Stroboscope (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

Experiment topics:

- Voltage transformation
- Transformer under load
- Current transformation
- Autotransformer
- Leakage field experiments
- Induction oven
- Point welding
- Fusing experiments
- High voltage experiments



9983-1000976,
9983-1000987/9983-1000986,
9983-1000985



9983-1000991

9983-1000988

9983-1000990

9983-1000989

Primary or Secondary Coils for Transformer Core D

Coils, covered with impact resistant plastic so that they are safe to touch, for use as primary or secondary coils in combination with transformer core D (9983-1000976). With safety connection sockets. As secondary coils these can output either low or high voltage, depending on the primary voltage, and therefore they cannot be used in student experiments.

	9983-1000988	9983-1000989	9983-1000990
Number of turns	600	1200	6000
Taps	200/600	400/1200	2000/6000
Resistance	3 Ω	12 Ω	300 Ω
Max. current	2.2 A	1.2 A	0.2 A
Inductance	15 mH	60 mH	1,5 H

Transformer Core D

U shaped core made of high grade laminated transformer plates, with removable yoke. Provided with two clips for securing the yoke or attaching special pole shoes with drilled holes (9983-1000978).

Cross-section of core: 40x40 mm²
U-core: approx. 150x130 mm²
Length of yoke: approx. 150 mm
Weight: approx. 6 kg

9983-1000976

High Voltage Coil Including 2 Horn Shaped Electrodes

Secondary coil for transformer core D (9983-1000976), generating high voltages which can cause spark discharges between two shielded horn electrodes. Covered with impact resistant plastic, safe to touch.

Number of turns: 24000
Open-circuit voltage: approx. 9200 V
Resistance: 10 kΩ
Max. current: 0.02 A
Inductance: 28 H

9983-1000991

Additionally required:
9983-1000976 Transformer Core D
9983-1000987 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
9983-1000986 Mains Coil with Connecting Lead (115 V, 50/60 Hz)

Low Voltage Coil D

Secondary coil for use with a transformer core D (9983-1000976) to generate low voltages up to 28 V. With five tapping points. Covered by impact resistant plastic, safe to touch.

Terminals: Safety sockets
Number of turns: 72
Taps: 6/ 30/ 54/ 66/ 72
Resistance: 0.1 Ω
Max. current: 12 A
Inductance: 0.23 mH

9983-1000985

Additionally required:
9983-1000976 Transformer Core D
9983-1000987 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
9983-1000986 Mains Coil with Connecting Lead (115 V, 50/60 Hz)

High Current Coil for Nail Fusing Experiment

Secondary coil for use with the transformer core D (9983-1000976) to generate a large current sufficient to melt nails. Covered by impact resistant plastic.

Number of turns: 6
Resistance: 3 mΩ
Max. current: 60 A
Inductance: 0.25 mH

9983-1000984



9983-1000986 9983-1000985 9983-1000984

9983-1000987

	9983-1000987	9983-1000986
Description	Mains Coil with Connecting Lead (230 V, 50/60 Hz)	Mains Coil with Connecting Lead (115 V, 50/60 Hz)
Number of turns	600	300
Resistance	3 Ω	0.75 Ω
Max. current	2.2 A	4.4 A
Inductance	15 mH	7.5 mH

Mains Coil with Connecting Lead

Coil that is safe to touch with mains connecting lead for use as primary coil in combination with the transformer core D (9983-1000976). Covered by impact resistant plastic, safe to touch.

www.EngineeringBooksPDF.com

NEW



9983-1012859

Coil D, 900 Turns

Coil with 900 turns and thermal overload protection. For generating powerful magnetic fields in conjunction with the U-core (9983-1000979).

Number of turns:	900
Inductance:	approx. 34 mH
Resistance:	approx. 4.8 Ω (at room temperature) approx. 6.0 Ω (at maximum amperage)
Maximum permissible amperage:	5 A (for approx. 7 minutes)
Waiting time for reactivation after thermal overload:	approx. 10 minutes
Weight:	approx. 1.6 kg

9983-1012859







9983-1000983



9983-1000992

Metal Ring

Metal ring for performing Thomson's ring experiment in conjunction with the mains coil (9983-1000987 resp. 9983-1000986) and the transformer core D (9983-1000976). First the metal ring is fitted around one stem of a U core and allowed to rest on the mains coil. The stem of the U core is extended by the yoke positioned vertically on top of it. When the mains coil is switched on the ring jumps into the air.

Diameter: 55 mm

9983-1000992

Additionally required:
9983-1000976 Transformer Core D
9983-1000987 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
9983-1000986 Mains Coil with Connecting Lead (115 V, 50/60 Hz)

High Current Coil with Five Turns

Secondary coil for transformer core D (9983-1000976), generating high voltages which can be used for spot-welding of metal sheets up to 2 mm thick.

Number of turns:	5
Short-circuit current:	approx. 260 A
Coil diameter:	57 mm
Weight:	approx. 650 g

9983-1000981

Additionally required:
9983-1000982 Set of Metal Strips
9983-1000976 Transformer Core D
9983-1000987 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
9983-1000986 Mains Coil with Connecting Lead (115 V, 50/60 Hz)



9983-1000981

Set of Metal Strips

Five metal strips used to demonstrate spot welding techniques in conjunction with a coil with 5 turns (9983-1000981).

Dimensions: 120x10 mm²

9983-1000982



9983-1000982

Set of 20 Nails for Nail Fusing Experiment

20 nails for experiments involving fusing using high current coil (9983-1000984).

9983-1000983



9983-1000980

Fusion Ring

Circular aluminium channel with insulated handle for demonstrating the principle of induction melting, when used as a secondary coil with the transformer core D (9983-1000976).

Max. current:	approx 1300 A
Internal diameter:	approx. 57 mm
Weight:	approx. 80 g

Suitable melting materials:
Wood's Alloy, Tin

9983-1000980

Additionally required:
9983-1000976 Transformer Core D
9983-1000987 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
9983-1000986 Mains Coil with Connecting Lead (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com



9983-1008525





9983-1000978

Pair of Pole Shoes

Pair of pole shoes with conical ends for generating a highly non uniform magnetic field when fitted onto the U core (9983-1000979). Provided with holes for optical experiments in a magnetic field.

Pole shoe: approx. 40x40 mm²
Weight: approx. 1.7 kg

9983-1000978





9983-1000977

Pole Shoe Fitting

Pole shoe fitting with adjustable separation for generating a uniform magnetic field on a U-shaped core (9983-1000979). Includes two 20-mm spacers, four 10 mm spacers and four 5 mm spacers.

Dimensions: 150x120x40 mm
Weight: 5.7 kg

9983-1008525



9983-1000979

U Core

U shaped transformer core D (9983-1000976).

9983-1000979

Pair of Clamps

Pair of clamps from the transformer core D (9983-1000976).

9983-1000977



9983-1009935



9983-1001004



Pair of Pole Shoes and Clamping Brackets for Hall Effect

Pair of pole pieces for experiments on the semiconductor Hall effect. Including clamping brackets for mounting on the U-core (9983-1000979).

Pole shoe dimensions: 40x40x75 mm³
Total weight: approx. 2 kg

9983-1009935



9983-1001003, 9983-1001000

Transformer Core S

U-core with removable yoke made of high quality transformer laminate.

Core cross section: 20x20 mm approx.
U-core: 70x70 mm approx.
Length of yoke: 70 mm approx.

9983-1001004









9983-1001000–9983-1001003



9983-1000999

High Current Coil S

Secondary coil for transformer core S (9983-1001004) for generating high current output.

No. of windings: 22
Max. Current: 10 A

9983-1000999

Transformer Coils S

Impact resistant plastic covered coils, safe to touch, for assembling a transformer in conjunction with the transformer core S (9983-1001004).

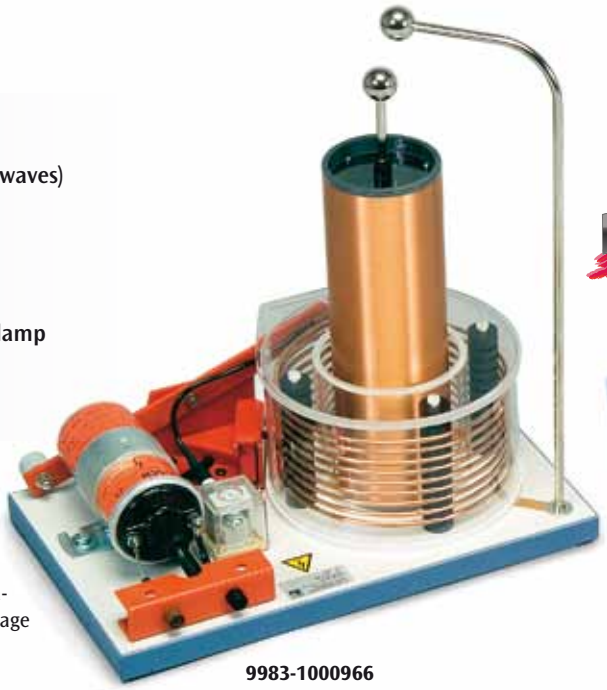
Maximum voltage: 50 V (safety extra-low voltage)
Terminals: 4 mm safety sockets
Opening for iron cores: approx. 20x20 mm²

Art. No.	Number of turns	Taps	Inductance
9983-1001000	600	200/400/600	approx. 6 mH
9983-1001001	800	400/800	approx. 10 mH
9983-1001002	1200	400/800/1200	approx. 25 mH
9983-1001003	2400	800/1600/2400	approx. 100 mH

www.EngineeringBooksPDF.com

Experiment Topics:

- Hertzian waves (high frequency electromagnetic waves)
- Absorption and transmission
- Corona discharge
- Spark discharge
- Wireless transmission of energy to a fluorescent lamp
- Standing waves on a Tesla coil



BEST SELLER

9983-1000966



Tesla Transformer

Classic Tesla transformer for the generation of a safe high frequency high voltage starting from approx. 100 kV. The well-conceived, open configuration of all components facilitating demonstration of both design and function. The apparatus is rendered shock proof on account of its extra low voltage operation.

No. of turns in the primary coil:	2–10
No. of turns in the secondary coils:	1150
Primary voltage:	20 V AC
Secondary voltage:	>100 kV
Transformer:	approx. 330x200x120 mm³
Secondary coils:	approx. 240 mm x 75 mm diam.
Weight:	approx. 3 kg

Contents:

1 Tesla transformer, basic apparatus
1 Hand coil
1 Secondary coil
1 Spherical electrode, short
1 Spherical electrode, long
1 Needle electrode with spray wheel
1 Fluorescent tube
1 Reflector

9983-1000966

Additionally required:
9983-1003593 AC/DC Power Supply 0 – 30 V, 6 A (230 V, 50/60 Hz) or
9983-1008692 AC/DC Power Supply 0 – 30 V, 6 A (115 V, 50/60 Hz)

Additionally recommended:
9983-1000967 Additional Coil for Tesla Transformer

AC/DC Power Supply, 0–30 V, 0–6 A

Combined power supply with separate AC and DC outputs plus separate displays of output voltage and current. The DC output can be used as a voltage source or current source and can be set to any value within its range. The AC output features current limiting and is electronically protected against overload.

DC voltage:	0…30 V
DC current:	0…6 A
AC voltage:	0…30 V
AC current:	max. 6 A
Dimensions:	380x140x300 mm³ approx.
Weight:	12 kg approx.

AC/DC Power Supply, 0 – 30 V, 0 – 6 A (230 V, 50/60 Hz)

9983-1003593

AC/DC Power Supply, 0 – 30 V, 0 – 6 A (115 V, 50/60 Hz)

9983-1008692

Additional Coil for Tesla Transformer

Additional secondary coil for Tesla transformer (9983-1000966).

Dimensions: approx. 240 mm x 75 mm diam.

9983-1000967



9983-1000967

NEW



9983-1003593
9983-1008692

www.EngineeringBooksPDF.com

Experiment topics:

- Thermionic emission of electrons
- Linear propagation of electrons in field free spaces
- Deflection in magnetic and electric fields
- Determination of the polarity of electron charges
- Determination of specific charge e/m
- Inelastic electron collisions
- Luminescence
- Wave and particle nature of electrons



9983-1000651

9983-1000655

TELTRON® Electron Tubes D

Electron tubes with thermionic cathodes for experimental investigations of the properties of electrons and various topics in atomic physics as well as for applications in standard cathode ray tube technology. Some electron tubes are operated at voltages up to 500 V, others at high voltages. During operation at high voltages of up to 5 kV, no ionizing radiation occurs outside the tubes, thus eliminating the need for radiation protection measures. All the tubes in the D series can be inserted into the tube holder D (9983-1008507, to which it is possible to add the pair of Helmholtz coils D (9983-1000644) necessary to generate a uniform magnetic field.

Electron Diffraction Tube D

Highly evacuated electron tube for demonstrating the wave nature of electrons through the observation of interference caused by passage of electrons through a polycrystalline graphite lattice (Debye-Scherrer diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelength as a function of the anode voltage from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Focussing voltage:	0 – 50 V
Lattice constant of graphite:	d_{10} = 0.213 nm, d_{11} = 0.123 nm

9983-1000655

Additionally required:

9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz) or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)

Additionally recommended:

9983-1009960 Three-Pole Protective Adapter

Electron Deflection Tube D

Highly evacuated electron tube with focusing electron gun and fluorescent screen inclined relative to the beam axis, so that the path of the beam can be seen and the effects of electric and magnetic fields can be studied. The electron beam can be deflected electrically in the electric field of the built-in plate capacitor, and magnetically by using the Helmholtz pair of coils D (9983-1000644). By adjusting the electric field so that it cancels the magnetic deflection, it is possible to determine the specific charge e/m and the velocity of the electrons.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Max. capacitor voltage:	5000 V
Fluorescent screen:	approx. 90x60 mm²
Glass bulb:	approx. 130 mm diam.
Total length:	approx. 260 mm

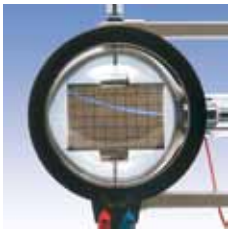
9983-1000651

Additionally required:

9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1000644 Helmholtz Pair of Coils D
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz) (2x)
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz) or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz) (2x)
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Additionally recommended:

9983-1009961 Two-Pole Protective Adapter



Note:
When using just one high-voltage power supply, the anode voltage and capacitor voltage cannot be selected independently of one another.

www.EngineeringBooksPDF.com



9983-1000650

9983-1000649

Perrin Tube D

Highly evacuated electron tube with focusing electron gun, fluorescent screen, and Faraday cage positioned on one side. For demonstrating the negative polarity of electrons and estimating the specific electron charge (charge-to-mass ratio) e/m by magnetic deflection into the Faraday cage, which is connected to an electroscope (9983-1003048). It is also possible to investigate the deflection of electrons by two magnetic fields at right-angles to each other and to demonstrate the effects, for example by generating Lissajou figures.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Beam current:	4 µA at 4000V
Glass bulb:	approx. 130 mm diam.
Luminescent screen:	85 mm diam.
Total length:	approx. 250 mm

9983-1000650

Additionally required:
9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1000644 Helmholtz Pair of Coils D
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz) or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Additionally recommended:
9983-1003048 Electroscope
9983-1000645 Auxiliary Coil
9983-1009961 Two-Pole Protective Adapter

Maltese-Cross Tube D

Highly evacuated electron tube with divergent electron gun, fluorescent screen and Maltese cross. For demonstrating the straight line propagation of electrons in the absence of any electric or magnetic field by projecting the shadow of a Maltese cross onto the fluorescent screen and for introducing students to electron optics.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Glass bulb:	approx. 130 mm diam.
Luminescent screen:	85 mm diam.
Total length:	approx. 260 mm

9983-1000649

Additionally required:
9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz) or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)

Additionally recommended:
9983-1009961 Two-Pole Protective Adapter
9983-1000644 Helmholtz Pair of Coils D
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz) or
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Luminescence Tube D

Highly evacuated electron tube with divergent electron gun and three fluorescent strips in red, green and blue. For demonstrating stimulated light emission during and after electron bombardment.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Glass bulb:	approx. 130 mm diam.
Total length:	approx. 260 mm

9983-1000648

Additionally required:
9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz) or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)

Additionally recommended:
9983-1009961 Two-Pole Protective Adapter



9983-1000648

www.EngineeringBooksPDF.com



9983-1000646

9983-1000647



9983-1000653

Triode D

Highly evacuated electron tube with thermionic cathode, control grid and anode for quantitative investigation of controllable high vacuum tubes, plotting the characteristics of a triode, demonstrating the negative polarity of the electron charge, studying the practical applications of a triode as an amplifier and generating undamped oscillations in LC circuits.

Max. heater voltage: 7.5 V AC/DC
Max. anode voltage: 500 V
Anode current: approx. 2 mA at 200 V anode voltage
Glass bulb: approx. 130 mm diam.
Total length: approx. 260 mm

9983-1000647

Additionally required:
9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1003073 Analogue Multimeter AM50
9983-1003308 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
9983-1003307 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

Additionally recommended:
9983-1009961 Two-Pole Protective Adapter

Gas Triode D

Electron tube filled with low pressure helium gas, with thermionic cathode, control grid, and anode for quantitative investigations of the typical properties of a gas-filled triode, recording the $I_A - U_A$ characteristics of a thyratron, observing independent and dependent discharges as well as discontinuous energy release of He atoms during inelastic collisions with free electrons.

Max. heater voltage: 7.5 V AC/DC
Max. anode voltage: 500 V
Anode current: approx. 10 mA at 200 V anode voltage
Glass bulb: approx. 130 mm diam.
Total length: approx. 260 mm

9983-1000653

Additionally required:
9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1003073 Analogue Multimeter AM50
9983-1003308 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
9983-1003307 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

Additionally recommended:
9983-1009961 Two-Pole Protective Adapter

Known throughout the world
TELTRON®

Diode D

Highly evacuated electron tube with thermionic cathode and anode for investigating the thermoelectric effect (Edison effect) and measuring the emission current as a function of the heating power applied to the cathode. Also for plotting diode characteristics and for demonstrating the rectifying effect of a diode.

Max. heater voltage: 7.5 V AC/DC
Max. anode voltage: 500 V
Anode current: approx. 2 mA at 200 V Anode voltage
Glass bulb: approx. 130 mm diam.
Total length: approx. 260 mm

9983-1000646

Additionally required:
9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1003073 Analogue Multimeter AM50
9983-1003308 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
9983-1003307 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

Additionally recommended:
9983-1009961 Two-Pole Protective Adapter

		9983-1000646	9983-1000647	9983-1000653
		Diode D	**Triode D**	**Gas Triode D**
9983-1008507	**Tube Holder D**	required	required	required
9983-1002847	**Set of Leads for Electron Tube Experiments**	required	required	required
9983-1003308 or **9983-1003307**	**Power Supply, 500 V DC**	required	required	required
9983-1003310 or **9983-1003309**	**High Voltage Power Supply, 5 kV**	–	–	–
9983-1000644	**Helmholtz Pair of Coils D**	–	–	–
9983-1003312 or **9983-1003311**	**DC-Power Supply 20 V**	–	–	–
9983-1003073	**Analogue Multimeter AM50**	required	required	required
9983-1009961	**Two-Pole Protective Adapter**	recommended	recommended	recommended
9983-1009960	**Three-Pole Protective Adapter**	–	–	–
9983-1000645	**Auxiliary Coil**	–	–	–
9983-1003048	**Electroscope**	–	–	–

www.EngineeringBooksPDF.com

Dual Beam Tube D

Part evacuated electron tube, filled with helium at low pressure, with tangential and axial electron gun. For determining specific charge e/m from the diameter of the filament beam in the case of tangential bombardment and a perpendicularly aligned magnetic field, and observing spiral paths of electrons in the case of axial bombardment and a co-axial magnetic field. The electron paths are rendered visible in the form of fine luminescent beams through impact excitation of the helium atoms.

Max. filament voltage:	7.5 V
Max. anode voltage:	100 V DC
Anode current:	approx. 30 mA
Max. deflection voltage:	50 V DC
Glass bulb:	approx. 130 mm diam.
Total length:	approx. 260 mm

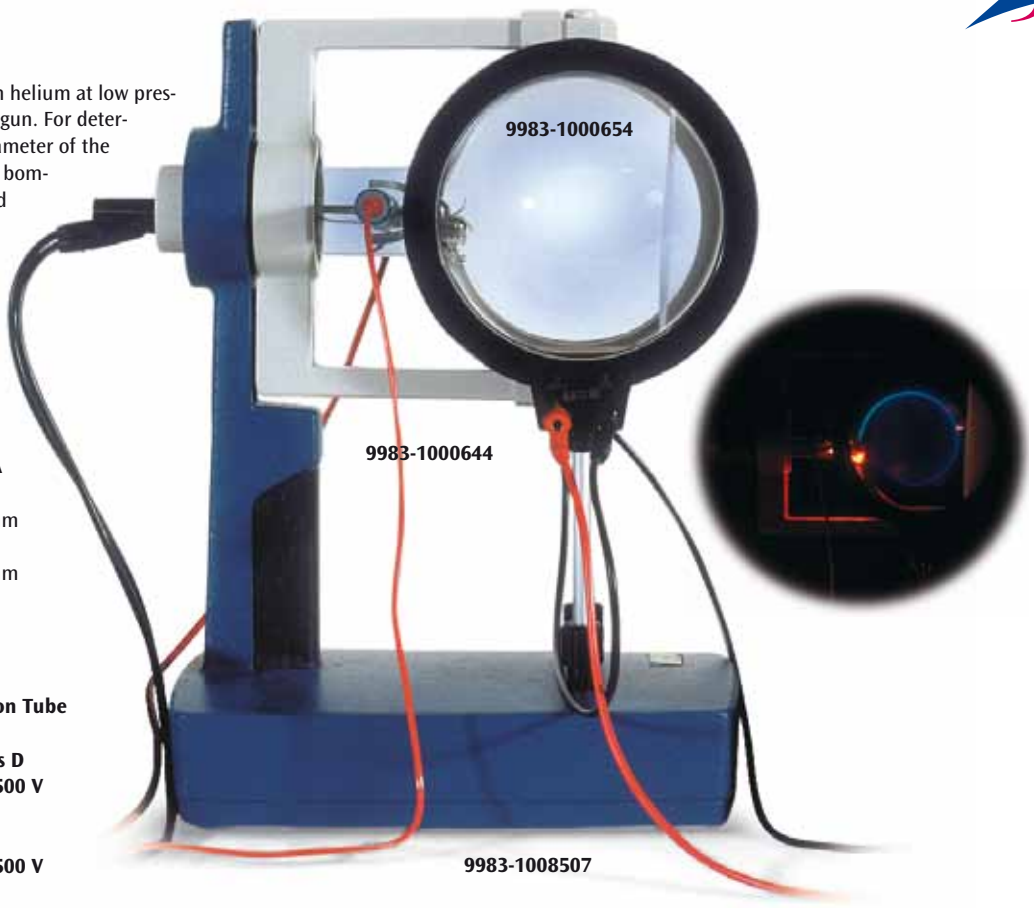
9983-1000654

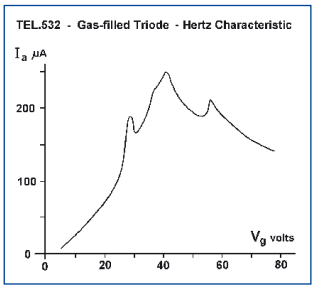
Additionally required:

9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1000644 Helmholtz Pair of Coils D
9983-1003308 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)

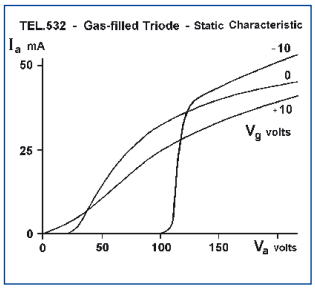
or

9983-1003307 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

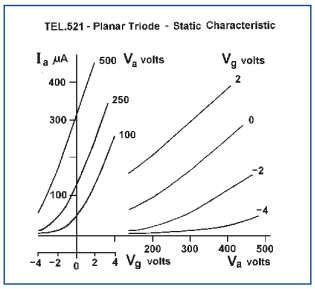




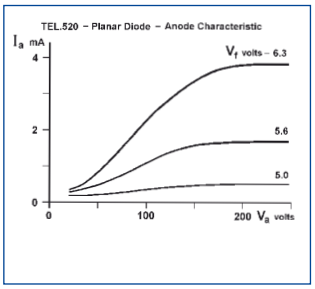
9983-1000653:
Anode current I_A as a function of the anode voltage U_A at different grid voltages U_G



9983-1000653:
Electron collision excitation in Helium as a function of the acceleration voltage U_G



9983-1000647:
Anode current I_A as a function of the grid voltage U_G and as a function of the anode voltage U_A at different grid voltage U_G



9983-1000646:
Anode current I_A as a function of the anode voltage U_A

9983-1000654	9983-1000648	9983-1000649	9983-1000650	9983-1000651	9983-1000655
Dual Beam Tube D	**Luminescence Tube D**	**Maltese Cross Tube D**	**Perrin Tube D**	**Electron Deflection Tube D**	**Electron Diffraction Tube D**
required	required	required	required	required	required
required	required	required	required	required	required
required	–	–	–	–	–
–	required	required	required	2x required	required
required	–	recommended	required	required	–
–	–	recommended	required	required	–
–	–	–	–	–	–
–	recommended	recommended	recommended	recommended	–
–	–	–	–	–	recommended
–	–	–	recommended	–	–
–	–	–	recommended	–	–

www.EngineeringBooksPDF.com





9983-1009960



9983-1009961



9983-1008507

Protective Adapter, 3-Pole
Adapter for electron refraction tube D (9983-1000655) for connection of the heater voltage via safety experiment leads. Includes internal protective circuitry to protect the heating filament against excess voltage. Dimensions match the three-pole connector for the tube.

9983-1009960

Protective Adapter, 2-Pole
Adapter for electron tubes D for connection of the heater voltage via safety experiment leads. Includes internal protective circuitry to protect the heating filament against excess voltage. Dimensions match the two-pole connector for the tubes.

9983-1009961

Tube Holder D
Tube holder made of robust plastic for holding electron tubes of the D series and the optical equivalent (9983-1000656). With 360° rotating clamp made of heat-resistant plastic and two holes for fixing the Helmholtz coil pair D (9983-1000644). On rubber feet to prevent slipping.

Dimensions:	approx. 230x175x320 mm³
Weight:	approx. 1.5 kg

9983-1008507

Auxiliary Coil
Extra coil for generating an additional magnetic field in a Perrin tube, for example, to demonstrate the principle of an oscilloscope and for generating Lissajou's figures.

Number of turns:	1000
DC resistance:	approx. 7 Ω
Load rating:	max. 2 A
Connections:	4 mm jacks
Dimensions:	approx. 33 mm x 80 mm diam.

9983-1000645



9983-1000645



9983-1000644

Helmholtz Pair of Coils D
Pair of coils for generating a uniform magnetic field perpendicular to the axis of a tube when using the tube holder D (9983-1008507). In plastic sleeve on an insulated stand rod.

Coil diameter:	136 mm
Number of turns:	320 each
Effective resistance:	approx. 6.5 Ω each
Load rating:	1.5 A each
Terminals:	4 mm sockets
Rod:	approx. 145 mm x 8 mm diam.

9983-1000644

Additionally recommended:
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

Experiment topics:

- Thermionic emission of electrons
- Linear propagation of electrons in field free spaces
- Deflection in magnetic and electric fields
- Determination of the polarity of electron charges
- Determination of specific charge e/m
- Luminescence
- Excitation spectra of noble gases
- Inelastic electron collisions
- Resolution of primary and secondary quantum numbers of atomic excitation levels
- Wave and particle nature of electrons



9983-1000617

Thomson Tube S

Highly evacuated electron tube with focusing electron gun and fluorescent screen inclined relative to the beam axis, so that the path of the beam can be seen and the effects of electric and magnetic fields can be studied. The electron beam can be deflected electrically in the electric field of the built-in plate capacitor, and magnetically by using the Helmholtz coil pair S (9983-1000611). By adjusting the electric field so that it cancels the magnetic deflection, it is possible to determine the specific charge e/m and the velocity of the electrons.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Max. Capacitor voltage:	500 V
Glass bulb:	approx. 130 mm diam.
Total length:	approx. 250 mm

9983-1000617

Additionally required:

9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Experiment Leads, 75 cm
9983-1000611 Helmholtz Pair of Coils S

9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
9983-1003310 Power Supply, 500 V DC (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)
9983-1003307 Power Supply, 500 V DC (115 V, 50/60 Hz)

TELTRON® Electron Tubes S

Electron tubes with thermionic cathodes for experimental investigations of the properties of electrons and various topics in atomic physics as well as for applications in standard cathode ray tube technology. Some electron tubes are operated at voltages up to 500 V, others at high voltages. During operation at high voltages of up to 5 kV, no ionizing radiation occurs outside the tubes, thus eliminating the need for radiation protection measures. All the tubes in the S series can be inserted into the tube holder S (9983-1000610), to which it is possible to add the pair of Helmholtz coils S (9983-1000611) necessary to generate a uniform magnetic field.

BEST SELLER

See physics experiments catalogue



www.EngineeringBooksPDF.com



Maltese Cross Tube S

Highly evacuated electron tube with divergent electron gun, fluorescent screen and Maltese cross. For demonstrating the straight line propagation of electrons in the absence of any electric or magnetic field by projecting the shadow of a Maltese cross onto the fluorescent screen and for introducing students to electron optics.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Glass bulb:	approx. 130 mm diam.
Luminescent screen:	approx. 85 mm diam.
Total length:	approx. 250 mm

9983-1000011

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Patch Cords, 75 cm
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)

Additionally recommended:
9983-1000611 Helmholtz Pair of Coils S
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

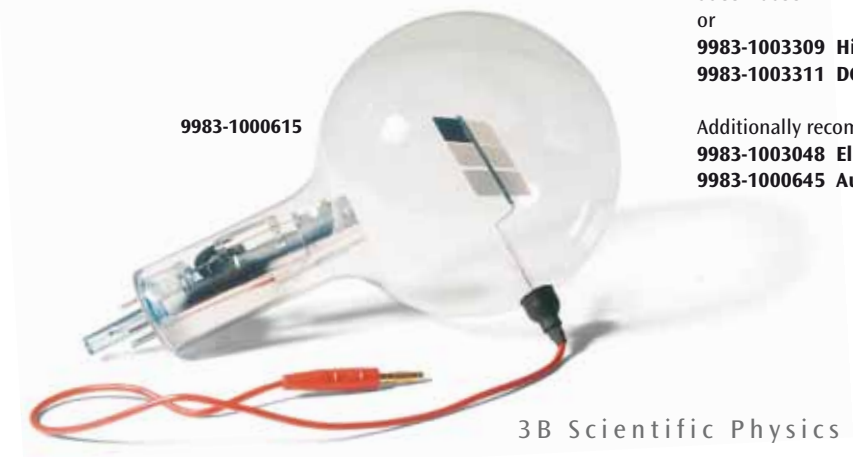
Luminescence Tube S

Highly evacuated electron tube with divergent electron gun and three fluorescent strips in red, green and blue. For demonstrating stimulated light emission during and after electron bombardment.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0,1 mA at 4000 V
Glass bulb:	approx. 130 mm diam.
Total length:	approx. 250 mm

9983-1000615

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Patch Cords, 75 cm
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)



Electron Diffraction Tube S

Highly evacuated electron tube for demonstrating the wave nature of electrons through the observation of interference caused by passage of electrons through a polycrystalline graphite lattice (Debye-Scherrer diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelength as a function of the anode voltage from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Lattice constant of graphite:	d_{10} = 0.213 nm, d_{11} = 0.123 nm

9983-1000623

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Experiment Leads, 75 cm
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)

Perrin Tube S

Highly evacuated electron tube with focusing electron gun, fluorescent screen, and Faraday cage positioned on one side. For demonstrating the negative polarity of electrons and estimating the specific electron charge (charge to mass ratio) e/m by magnetic deflection into the Faraday cage, which is connected to an electroscope (9983-1003048). It is also possible to investigate the deflection of electrons by two alternatingmagnetic fields at right-angles to each other or by parallel electric and magnetic fields and to demonstrate the effects, for example by generating Lissajous figures.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Beam current:	4 µA at 4000V
Glass bulb:	approx. 130 mm diam.
Luminescent screen:	approx. 85 mm diam.
Total length:	approx. 250 mm

9983-1000616

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Patch Cords, 75 cm
9983-1000611 Helmholtz Pair of Coils S
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Additionally recommended:
9983-1003048 Electroscope
9983-1000645 Auxiliary Coil

www.EngineeringBooksPDF.com



Diode S

Highly evacuated electron tube with thermionic cathode and anode for investigating the thermoelectric effect (Edison effect) and measuring the emission current as a function of the heating power applied to the cathode. Also for plotting diode characteristics and for demonstrating the rectifying effect of a diode.

Max. heater voltage: 7.5 V AC/DC
Max. anode voltage: 500 V
Anode current: approx. 2 mA at 200 V Anode voltage
Glass bulb: approx. 130 mm diam.
Total length: approx. 250 mm

9983-1000613

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Patch Cords, 75 cm
9983-1003073 Analogue Multimeter AM50
9983-1003308 Power Supply, 500 V DC (230 V, 50/60 Hz)
or
9983-1003307 Power Supply, 500 V DC (115 V, 50/60 Hz)



Triode S

Highly evacuated electron tube with thermionic cathode, control grid and anode for quantitative investigation of controllable high vacuum tubes, plotting the characteristics of a triode, demonstrating the negative polarity of the electron charge, studying the practical applications of a triode as an amplifier and generating undamped oscillations in LC circuits

Max. heater voltage: 7.5 V AC/DC
Max. anode voltage: 500 V
Anode current: approx. 2 mA at 200 V anode voltage
Glass bulb: approx. 130 mm diam.
Total length: approx. 250 mm

9983-1000614

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Patch Cords, 75 cm
9983-1003073 Analogue Multimeter AM50
9983-1003308 Power Supply, 500 V DC (230 V, 50/60 Hz)
or
9983-1003307 Power Supply, 500 V DC (115 V, 50/60 Hz)

Gas Triode S

Electron tube filled with low pressure helium gas resp. neon gas, with thermionic cathode, control grid, and anode for quantitative investigations of the typical properties of a gas-filled triode, recording the $I_A - U_A$ characteristics of a thyratron, observing independent and dependent discharges as well as discontinuous energy release of He or Ne atoms during inelastic collisions with free electrons.

Max. heater voltage: 7.5 V AC/DC
Max. anode voltage: 500 V
Anode current: approx. 10 mA at 200 V anode voltage
Glass bulb: approx. 130 mm diam.
Total length: approx. 250 mm

Gas Triode S with He Filling

9983-1000618

Gas Triode S with Ne Filling

9983-1000619

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Patch Cords, 75 cm
9983-1003073 Analogue Multimeter AM50
9983-1003308 Power Supply, 500 V DC (230 V, 50/60 Hz)
or
9983-1003307 Power Supply, 500 V DC (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com



9983-1000622

Dual Beam Tube S

Partly evacuated electron tube, filled with helium at low pressure, with tangential and axial electron gun. For determining specific charge e/m from the diameter of the filament beam in the case of tangential bombardment and a perpendicularly aligned magnetic field, and observing spiral paths of electrons in the case of axial bombardment and a co-axial magnetic field. The electron paths are rendered visible in the form of fine luminescent beams through impact excitation of the helium atoms.

Max. filament voltage:	7.5 V AC/DC
Max. anode voltage:	100 V DC
Anode current:	approx. 30 mA
Max. deflection voltage:	50 V DC
Glass bulb:	approx. 130 mm diam.
Total length:	approx. 250 mm

9983-1000622

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Patch Cords, 75 cm
9983-1000611 Helmholtz Pair of Coils S
9983-1003308 Power Supply, 500 V DC (230 V, 50/60 Hz)
or
9983-1003307 Power Supply, 500 V DC (115 V, 50/60 Hz)

Helmholtz Pair of Coils S

Pair of coils for generating a uniform magnetic field perpendicular to the axis of a tube when using the tube holder S (9983-1000610).

Number of turns:	320 each
Coil diameter:	138 mm each
Load rating:	1.0 A (Continuous operation) each 1.5 A (Short-term operation)
Effective Resistance:	approx. 6,5 Ω each
Terminals:	4 mm safety sockets

9983-1000611

Additionally recommended:
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



9983-1000611

		9983-1000613	9983-1000614	9983-1000618	9983-1000619
		Diode S	**Triode S**	**Gas Triode S with He Filling**	**Gas Triode S with Ne Filling**
9983-1000610	Tube Holder S	required	required	required	required
9983-1002843	Set of 15 Safety Patch Cords, 75 cm	required	required	required	required
9983-1002839	Experiment Lead, Safety Plug and Socket	–	–	–	–
9983-1003308 or **9983-1003307**	Power Supply, 500 V DC	required	required	required	required
9983-1003310 or **9983-1003309**	High Voltage Power Supply, 5 kV	–	–	–	–
9983-1000611	Helmholtz Pair of Coils S	–	–	–	–
9983-1003312 or **9983-1003311**	DC-Power Supply, 20 V	–	–	–	–
9983-1003073	Analogue Multimeter AM50	required	required	required	required
9983-1000645	Auxiliary Coil	–	–	–	–
9983-1003048	Electroscope	–	–	–	–

www.EngineeringBooksPDF.com



9983-1000624

Gas Discharge Tube S

Evacuable glass tube with fluorescent screens at both ends for observation of electrical discharges in gases under reduced pressure as well as for investigation of cathode beams and canal rays, which appear at low pressure outside the discharge path. Demountable design, installation in tube holder (9983-1000610). Includes a needle ventilation valve and vacuum hoses.

Length: approx. 280 mm
Polarization voltage: ≤5 kV
Discharge current: approx. 1.2 mA
Connections: 4 mm contact pins

9983-1000624

Additionally required:
9983-1000610 Tube Holder S
9983-1002839 Experiment Lead, Safety Plug and Socket (2x)
9983-1003317 Rotary-Vane Vacuum Pump, Two-Stage
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)



9983-1000610

Tube Holder S

Tube holder to support all S series electron tubes for easy and safe operation. The five pin sockets for the tube are concealed inside the tube holder. A cathode protection switch is integrated into the tube holder, to protect the heated cathode from excessive voltage. The base plate has a slot for attaching the Helmholtz pair of coils S (9983-1000611).

Terminals : 4 mm safety sockets
Dimensions: approx. 130x190x250 mm³
Weight: approx. 570 g

9983-1000610

9983-1000622	9983-1000615	9983-1000011	9983-1000616	9983-1000617	9983-1000623	9983-1000624
Dual Beam Tube S	**Luminescence Tube S**	**Maltese Cross Tube S**	**Perrin Tube S**	**Thomson Tube S**	**Electron Deflection Tube S**	**Gas Discharge Tube S**
required	required	required	required	required	required	required
required	required	required	required	required	required	–
–	–	–	–	–	–	2x required
required	–	–	–	required	–	–
–	required	required	required	required	required	required
required	–	recommended	required	required	–	–
–	–	recommended	required	–	–	–
–	–	–	–	–	–	–
–	–	–	recommended	–	–	–
–	–	–	recommended	–	–	–

...going one step further
www.EngineeringBooksPDF.com



Dual Pole Tube

Evacuated electron tube with hot thermionic cathode made of tungsten wire and a cylindrical anode for verification of the Edison effect, demonstration of Richardson's equation and recording the current-voltage characteristic of a vacuum diode. Mounted on connector base with safety sockets.

Cathode surface:	32 mm²
Max. anode voltage:	400 V
Heating voltage:	1.5 – 5.9 V
Heating current:	2 – 5 A
Dimensions of the tube:	approx. 120x45 mm²
Dimensions:	approx. 155x100x160 mm³
Weight:	approx. 440 g

9983-1008521

Additionally required:
9983-1003308 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
9983-1003307 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

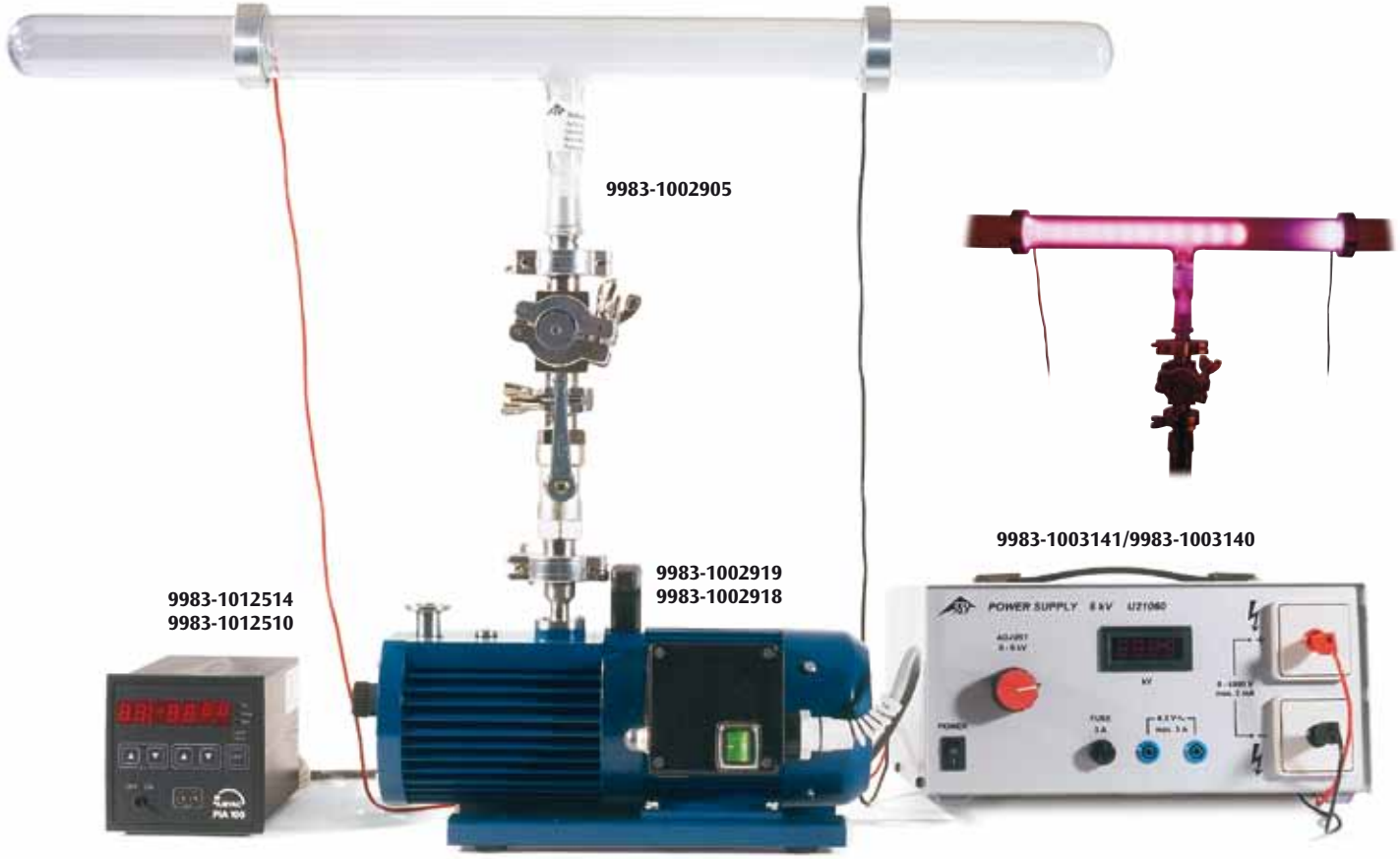
Gas Discharge Tube

Evacuable glass tube for observation of luminous effects of electrical discharges in gases under reduced pressure. Glass tube with graded seal, disc shaped, perforated electrodes and 4 mm jacks for connecting the voltage supply.

Material:	glass
Dimensions:	approx. 700 mmx40 mm diam.
Vacuum connection:	graded seal NS 19/26

9983-1002905

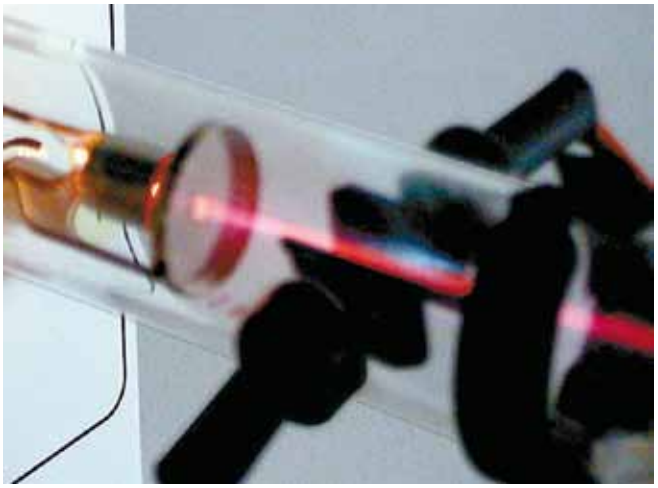
Additionally recommended:
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
9983-1002919 Rotary Vane Pump PK 4D (230 V, 50/60 Hz)
9983-1012514 Pirani Vacuum Gauge (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)
9983-1002918 Rotary Vane Pump PK 4D (115 V, 50/60 Hz
9983-1012510 Pirani Vacuum Gauge (115 V, 50/60 Hz)
9983-1002923 2-Way Ball Valve DN 16 KF
9983-1002924 Crosspiece DN 16 KF
9983-1002929 Adapter Flange DN 16 – Core NS 19/26



www.EngineeringBooksPDF.com

Experiment topics:

- Linear propagation of electrons in a zero-field space
- Deflection of electron beams in an electrical field
- Deflection of electron beams in a magnetic field
- Magnetic lens
- Phase displacement, superimposition of magnetic fields, Lissajous figures
- Determination of an electron's specific charge
- Determination of an electron's speed



Training Oscilloscope

Electron tube mounted on a terminal base for investigating the design and operation of a cathode ray tube. The electron beam can be deflected by an electric field produced by the deflection plates integrated into the tube, and by a magnetic field from three external coils mounted on a ring. A Wehnelt cylinder is used to focus the beam. The gas filling and the fluorescent screen make it possible to observe the beam in the tube. A continuously adjustable saw-tooth generator can be used to analyse and visualize time dependent processes. The device comes with a socket and printed wiring diagram.

Anode voltage:	250 – 400 V DC
Anode current:	1 mA
Filament voltage:	6 – 8 V AC/DC
Filament current:	0.3 A
Wehnelt voltage:	0 – 50 V DC
Deflection plate dimensions:	approx. 12x20 mm²
Plate spacing:	approx. 12 mm
Electric deflection sensitivity:	0,2 mm/V
Screen diameter:	approx. 100 mm
Tube length:	approx. 260 mm
Residual gas:	Neon
Gas pressure:	10^{-4} hPa
Sweep frequency:	10 – 200 Hz, continuously adjustable
3 deflection coils:	600 turns each, with a centre pick up
Weight:	approx.1.6 kg

9983-1000902

Additionally recommended:
9983-1003308 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
9983-1009957 Function Generator FG100 (230 V, 50/60 Hz)
or
9983-1003307 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)
9983-1009956 Function Generator FG100 (115 V, 50/60 Hz)

BEST SELLER

See physics experiments catalogue



9983-1000902

Cathode Ray Tube (not shown)
Spare tube for the training oscilloscope (9983-1000902).

9983-1000901

www.EngineeringBooksPDF.com

Experiment topics:

- Deflection of electrons in a closed circular path inside a magnetic field
- Determination of specific charge of an electron e/m

BEST SELLER



9983-1000904

9983-1000906

Fine Beam Tube on Connection Base

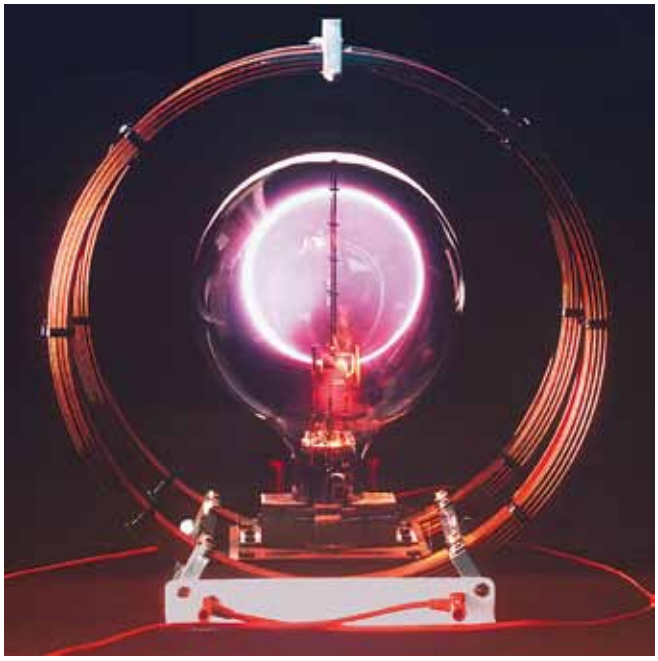
For examining the deflection of electron beams in a uniform magnetic field using a pair of Helmholtz coils (9983-1000906) and for the quantitative determination of the specific charge of the electron e/m. Glass vessel with integrated electron beam system, consisting of an indirectly heated oxide cathode, a Wehnelt cylinder and a perforated anode, in neon residual gas atmosphere with precisely set gas pressure and with integrated measurement marks for parallax-free determination of the diameter of the fine beam. Gas atoms are ionized along the electron path and produce a sharply defined, visible fluorescent beam. Tube mounted on base with colour coded connectors.

Gas filling:	Neon
Gas pressure:	1.3×10^{-5} hPa
Filament voltage:	4 – 10 V AC/DC
Filament current:	300 – 450 mA
Wehnelt voltage:	0 – -50 V
Anode voltage:	200 – 300 V
Anode current:	<0.3 mA
Circular path diameter:	20 – 120 mm
Division spacing:	approx. 20 mm
Tube diameter:	approx. 160 mm
Dimensions:	approx. 260x115x35 mm³
Weight:	approx. 820 g

9983-1000904

Additionally required:
9983-1000906 Helmholtz Coils, 300 mm

Additionally recommended:
9983-1003308 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
9983-1003307 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)





www.EngineeringBooksPDF.com

Experiment topics:

- Electron deflection in a uniform magnetic field
- Closed orbit or spiral path
- Determining an electron's specific charge e/m

Complete Fine Beam Tube System

This complete experimental system is used to determine an electron's specific charge and investigate the deflection of electron beams in a uniform magnetic field. The system comes complete with a fine-beam tube, Helmholtz coil pair for generating a uniform magnetic field, and operating unit for power supply. The fine beam tube and Helmholtz coil pair are mounted on the operating unit, the fine beam tube being rotatable around its vertical axis. The tube and coil pair are both connected internally to the operating unit without a need for external wiring. All supply voltages for the tube and the current through the Helmholtz coils are adjustable. The anode voltage and coil current are displayed digitally and can be tapped additionally as equivalent voltage values. Inside the fine beam tube, a sharply delimited electron beam is generated by a system comprising an indirectly heated oxide cathode, perforated anode and Wehnelt cylinder. Impact ionization of helium atoms creates a very bright, also sharply delimited trace of the electron path in the tube. If the tube is aligned optimally and an appropriate current flows through the Helmholtz coils, the electrons are deflected into a circular orbit, whose diameter can be easily determined when the electrons strike one of the equidistant measurement marks, causing its end to light up. Diameter, anode voltage and magnetic field are the parameters used to determine the electron's specific charge. The magnetic field can be calculated from the coil current, the geometry of the Helmholtz coil pair being known.

Fine-beam tube:

Gas filling:	Helium
Gas pressure:	0.13 hPa
Bulb diameter:	165 mm
Orbit diameter:	20…120 mm
Measurement markspacing:	20 mm

Helmholtz coil pair:

Coil diameter:	approx. 300 mm
Winding count:	124
Magnetic field:	0…3.4 mT (0.75 mT/A)

Operating unit:

Coil current:	0…4.5 A, 3-figure digital display
Measurement output:	1 V*I_B / A
Anode voltage:	15…300 V, 3-figure digital display
Measurement output:	0.01*U_A
Heating voltage:	5…7 V
Wehnelt voltage:	0…-50 V

General data:

Tube's rotary angle:	-10°…270°
Supply voltage:	100–240 V, 50/60 Hz
Power supply cable:	EU, UK and US
Dimensions:	approx. 310x275x410 mm³
Weight:	approx. 7.5 kg

The complete fine-beam tube system consists of the following parts:

Fine Beam Tube T

9983-1008505

Operating Unit for Fine-Beam Tube

9983-1009948

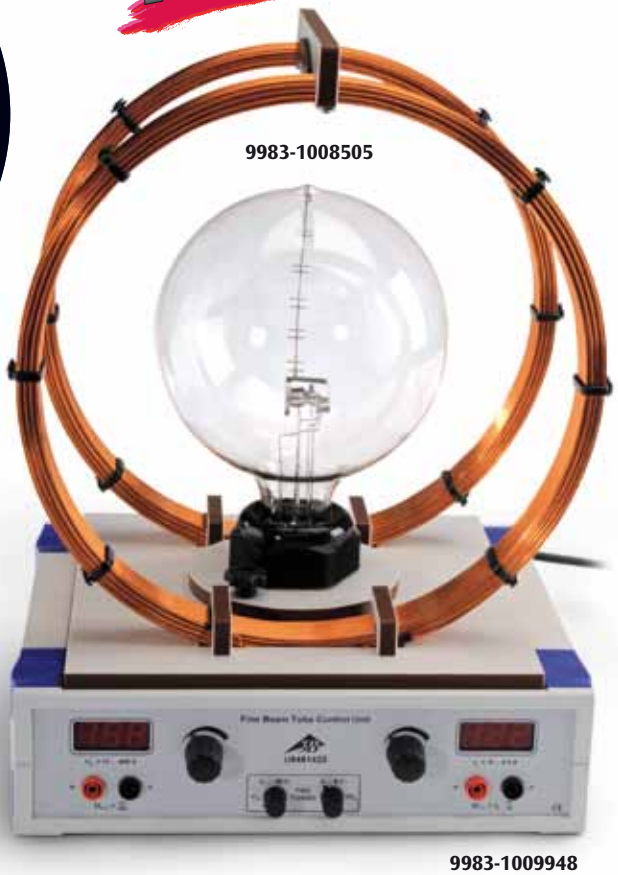


Circular path



Spiral path

NEW



9983-1008505

9983-1009948

www.EngineeringBooksPDF.com

Periodic Table of the Elements, with Electron Configurations

Chart of the periodic table of the elements showing the configurations of electron shells. On strong plasticized material with rods and hanging cord. Bilingual.

Dimensions: 1950x1380 mm² approx.

Languages: English and German

9983-1003097

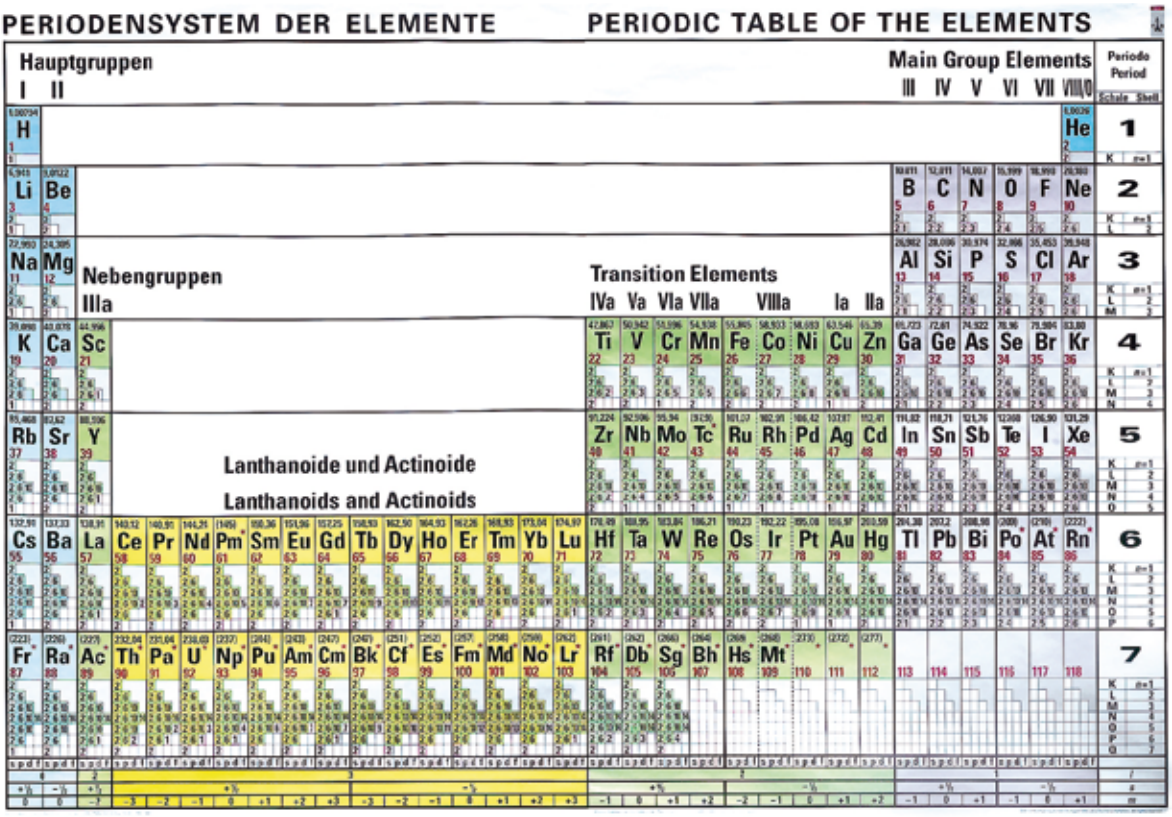
Periodic Table of the Elements, with Pictures

Chart of the periodic table of the elements with pictures of the elements. On strong plasticized material with rods and hanging cord. In four languages.

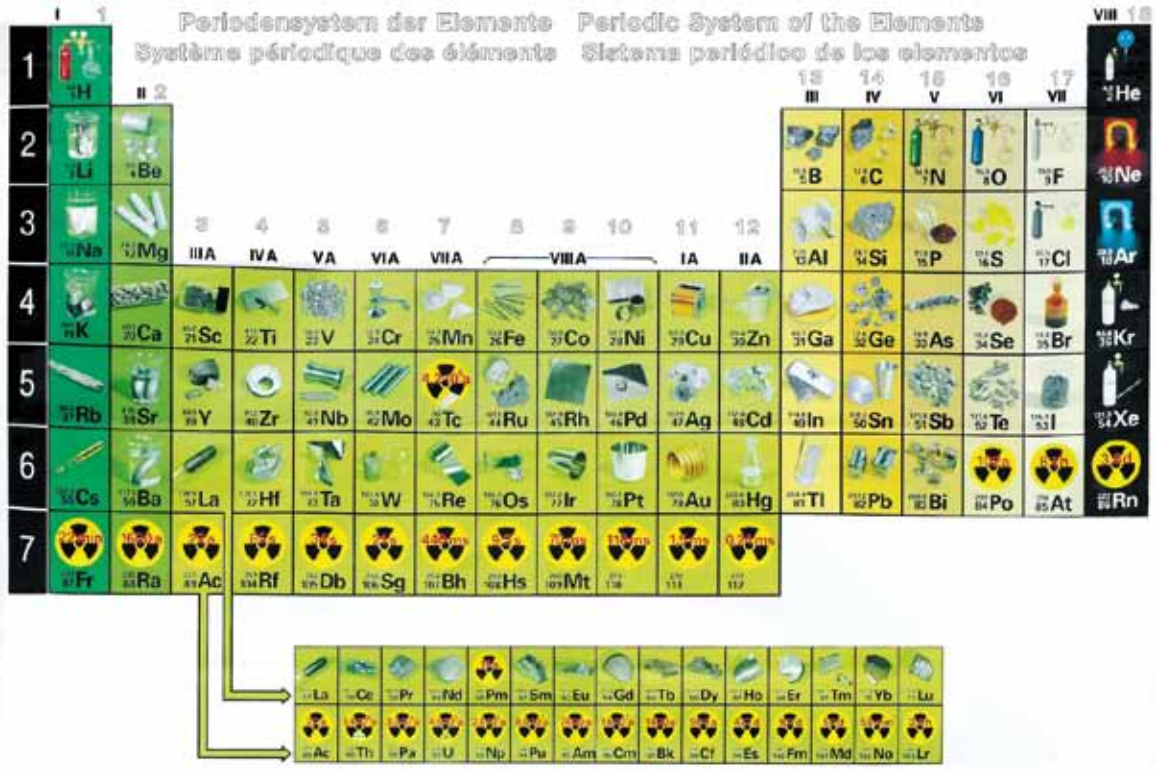
Dimensions: 1950x1380 mm² approx.

Languages: English, German, French, Spanish

9983-1003098



9983-1003097



9983-1003098

www.EngineeringBooksPDF.com



9983-1012782

Insight into the World of Atoms

Experiment topics:

- Tunnel effect
- Representation of individual atoms
- Representation of lattice defects and dislocations
- Representation of charge density waves
- Dependence of tunnel current on distance between measuring tip and sample
- PID control of tunnel current

NEW

Scanning Tunnelling Microscope
Meant to resolve atomic structures at the surface of electrically conductive materials, this easy-to-use and compact, scanning tunnelling microscope is particularly suitable for training purposes. The complete system includes a probe for row-by-row scanning of sample surfaces with the measuring tip, vibration-absorbing pad, controller with computer interface, as well as graphite and gold samples.

System requirements:	Windows 2000 or higher
XYZ grid:	500x500x200 nm³
Minimum increment XY:	7.6 pm
Minimum increment Z:	3 pm
Tunnel current:	0.100…100.000 nA (0.025 nA increment)
Voltage:	±10.000 V (0.005 V increment)
Maximum sample size:	10 mm diam.
Supply voltage:	90 – 240 V, 50/60 Hz
Connection:	USB

Contents:
Controller
Installation CD with measurement and control software
Scanning probe with connection cable
Cover with lens
Experiment plate with vibration damping
Tool kit for manufacturing the probe tip (side cutters, flat-nose pliers, pointed and rounded tweezers)
Platinum-iridium wire, 0.25 mm diam., 300 mm
Graphite (HOPG) sample on a carrier
Gold (1.1.1) sample on a carrier
Set of 4 sample carriers

9983-1012782

MoS_2 Sample (not shown)
Molybdenum-sulphide sample on a carrier for observing defects in crystal lattices with the scanning tunnelling microscope.

9983-1012877

TaS_2 Sample (not shown)
Tantalum-disulfide sample on a carrier for observing the distribution of surface charge density (stationary charge-density waves) with a scanning tunnelling microscope.

9983-1012876

WSe_2 Sample (not shown)
Tungsten-diselenide sample on a carrier for observing surface defects with a scanning tunnelling microscope.

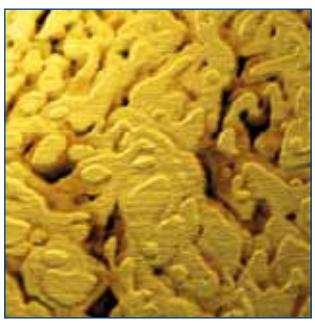
9983-1012874

$TaSe_2$ Sample (not shown)
Tantalum-diselenide sample on a carrier for observing the distribution of surface charge density (stationary charge-density waves) with a scanning tunnelling microscope.

9983-1012875

Platinum-Iridium Wire (not shown)
Platinum-iridium wire, 0.25 mm Ø, 300 mm as spare wire for manufacturing measuring tips for the scanning tunnelling microscope.

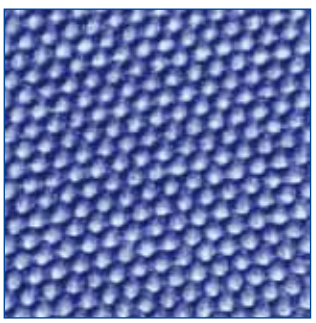
9983-1012878



Representation of a gold surface



Representation of the hexagonal structure of a graphite surface



Representation of a TaS_2 surface by means of stationary charge-density waves

www.EngineeringBooksPDF.com



9983-1005279

Organic/Inorganic Molecule Set D

Molecule building set for assembling three-dimensional models of organic and inorganic molecules and for clarification of their spatial configurations. Many chemical compounds can be represented clearly. These include simple molecules such as hydrogen, oxygen and water, organic compounds such as ethane, ethene, ethyne, benzene, alanine, glucose, and cyclohexane and also more complex structures such as the tetrammino zinc ion or tetraphosphorous decoxide.

9983-1005279

Contents:

Atoms					
14	C	black	4 wholes	tetrahedral	109°
6	C	dark blue	5 wholes	tribipyramidal	90°, 120°
12	H	white	1 whole	one sided	
2	H	white	1 whole	linear	180°
16	O	red	2 wholes	angular	105°
6	O	red	4 wholes	tetrahedral	109°
6	N	blue	4 wholes	tetrahedral	109°
4	N	blue	3 wholes	pyramidal	107°
4	S	yellow	4 wholes	tetrahedral	109°
1	S	yellow	6 wholes	octahedral	90°
8	S	yellow	2 wholes	angular	105°
8	Cl, (F)	green	1 wholes	one sided	
4	P	purple	4 wholes	tetrahedral	109°
1	P	purple	5 wholes	tribipyramidal	90°, 120°
2	P	purple	3 wholes	pyramidal	107°
4	Na	grey	1 whole	one sided	
3	Ca, Mg	grey	2 wholes	angular	105°
2	Al	grey	3 wholes	trigonal	120°
4	Si, Cu	grey	4 wholes	tetrahedral	109°
1	metal atom	grey	6 wholes	octahedral	90°

Electron clouds		
6	lone pair	light beige
6	unhybridised p-lobe	purple
6	unhybridised p-lobe	pink

Links		
38	medium	light grey
12	medium	purple
36	long, flexible	grey





9983-1005290

Organic Molecule Set S

Molecule building set for assembling three-dimensional models of organic molecules and for clarification of their spatial configurations. Many chemical compounds can be represented clearly and phenomena such as structural isomerism, optical isomerism and geometric isomerism can be illustrated. The spectrum ranges from simple molecules such as alkanes, alkenes and alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, ethers, halogenated compounds, amines, amides, cycloalkanes to biochemical molecules, amino acids, aromatic molecules and polymers.

9983-1005290

Contents:

Atoms					
12	C	black	4 wholes	tetrahedral	109°
20	H	white	1 whole	one sided	
6	O	red	2 wholes	angular	105°
2	N	blue	4 wholes	tetrahedral	109°
2	N	blue	3 wholes	pyramidal	107°
1	S	yellow	4 wholes	tetrahedral	109°
1	S	yellow	6 wholes	octahedral	90°
4	Cl, (F)	green	1 whole	one sided	
1	P	purple	4 wholes	tetrahedral	109°
1	Na	grey	1 whole	one sided	

Links		
26	short	white
6	medium	light grey
12	long, flexible	grey



9983-1012836

Set of 3 Carbon Configurations

Set of 3 easy-to-use models of various carbon crystal structures: diamond, graphite and fullerene, for demonstrating the fundamental differences between the structures.

Ball diameter: 25 mm approx.
Lengths of sides: 150 mm approx.

9983-1012836

www.EngineeringBooksPDF.com



9983-1005291



9983-1005278

Organic/Inorganic Molecule Set S

Molecule building set for assembling three-dimensional models of organic and inorganic molecules and for clarification of their spatial configurations. Many chemical compounds can be represented clearly. These include inorganic molecules such as hydrogen, oxygen, water, acids, salts, metal oxides, and non metal oxides and also organic compounds such as ethane, ethene, ethyne, benzene, alanine, glucose, and cyclohexane.

9983-1005291

Contents:

Atoms					
6	C	black	4 wholes	tetrahedral	109°
14	H	white	1 whole	one sided	
6	O	red	2 wholes	angular	105°
1	O	red	4 wholes	tetrahedral	109°
2	N	blue	4 wholes	tetrahedral	109°
1	N	blue	3 wholes	pyramidal	107°
1	S	yellow	4 wholes	tetrahedral	109°
1	S	yellow	6 wholes	octahedral	90°
6	Cl, (F)	green	1 wholes	one sided	
1	P	purple	5 wholes	tribipyramidal	90°, 120°
1	P	purple	3 wholes	pyramidal	107°
2	Na	grey	1 wholes	one sided	
2	Ca, Mg	grey	2 wholes	angular	105°
1	Be	grey	2 wholes	linear	180°
1	Al	grey	3 wholes	trigonal	120°
1	Si, Cu	grey	4 wholes	tetrahedral	109°
1	metal atom	grey	6 wholes	octahedral	90°
1	B	light beige	3 wholes	trigonal	120°
1	atom	beige	4 wholes	tetrahedral	109°
1	atom	beige	5 wholes	tribipyramidal	90°, 120°
1	atom	beige	6 wholes	octahedral	90°

Electron clouds		
3	lone pair	light beige

Links		
20	medium	light grey
5	medium	purple
12	lang flexibel	grey

Set 14 Bravais Lattices

Set of easy to handle models of the 14 fundamental lattice types (Bravais lattices), from which Auguste Bravais postulated that practically all naturally occurring crystal lattices can be derived by shifting along the axes. Made of wooden balls in six different colours connected via metal rods. The six colours distinguish the six different systems into which the lattice types are categorised.

Diameter of balls: 25 mm approx.
Length of sides: 150 mm approx.

9983-1012837

Organic Molecule Set D

Molecule building set for assembling three-dimensional models of organic molecules and for clarification of their spatial configurations. Many chemical compounds can be represented clearly and phenomena such as structural isomerism, optical isomerism and geometric isomerism can be illustrated. The spectrum ranges from simple molecules such as alkanes, alkenes and alkynes, alcohols, aldehydes, ketones, carboxylic acids, esters, ethers, halogenated compounds, amines, amides, cycloalkanes to biochemical molecules, amino acids, aromatic molecules and polymers.

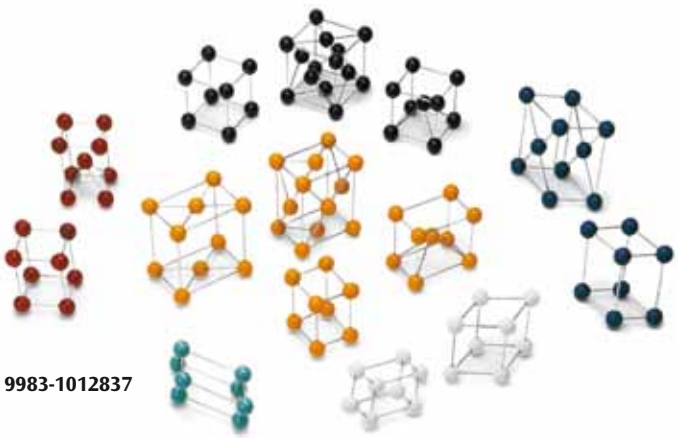
9983-1005278

Contents:

Atoms					
24	C	black	4 wholes	tetrahedral	109°
6	C	dark grey	3 wholes	trigonal	120°
2	C	dark grey	2 wholes	linear	180°
6	C	dark blue	5 wholes	tribipyramidal	90°, 120°
40	H	white	1 whole	one sided	
12	O	red	2 wholes	angular	105°
4	N	blue	4 wholes	tetrahedral	109°
1	S	yellow	4 wholes	tetrahedral	109°
1	S	yellow	2 wholes	angular	105°
8	Cl, (F)	green	1 whole	one sided	
4	P	purple	4 wholes	tetrahedral	109°
2	Na	grey	1 whole	one sided	
1	Ca, Mg	grey	2 wholes	angular	105°

Electron clouds		
6	lone pair	light beige
6	unhybridised p-lobe	purple
6	unhybridised p-lobe	pink

Links		
60	short	white
55	medium	light grey
25	long, flexible	grey



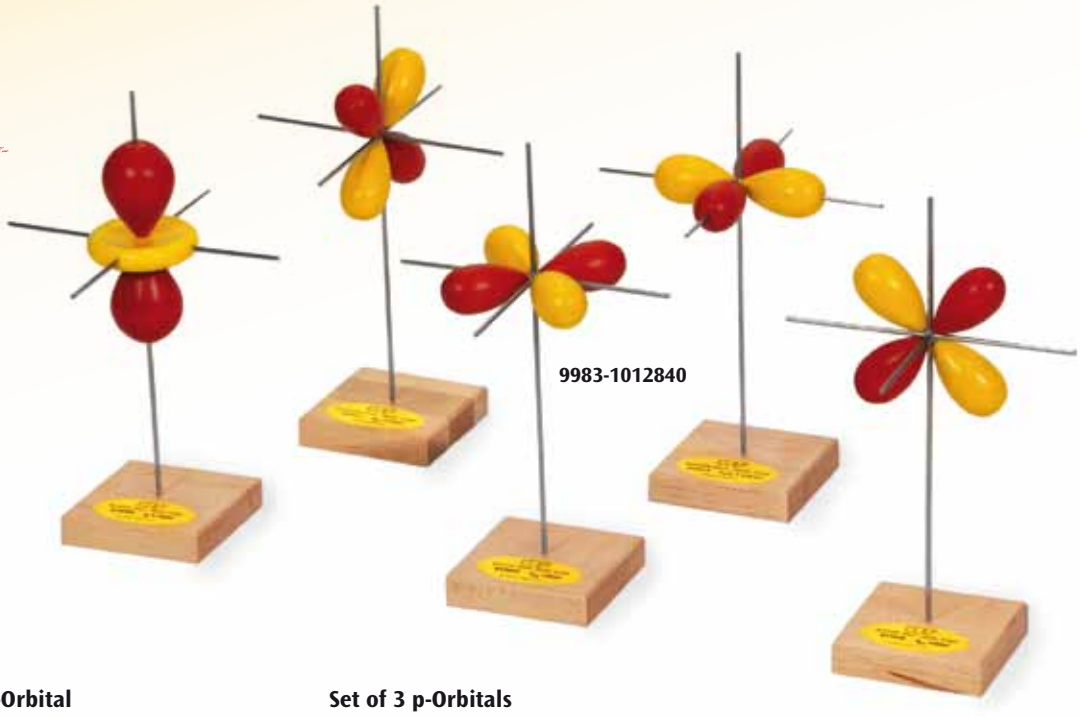
9983-1012837

www.EngineeringBooksPDF.com

NEW



9983-1012842



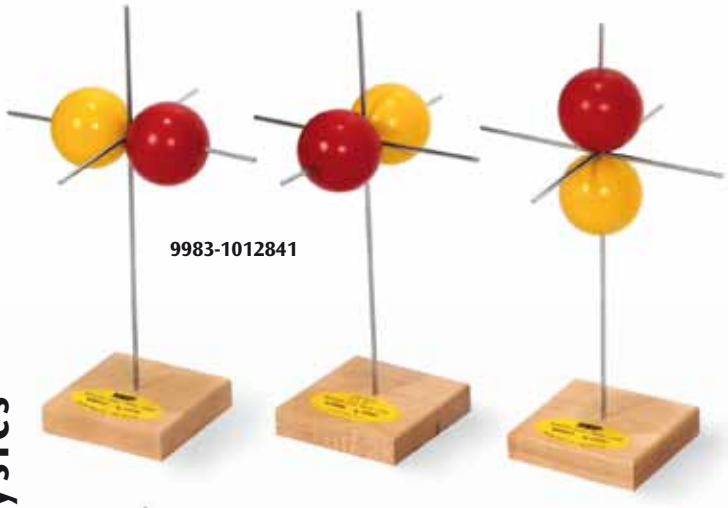
9983-1012840

s-Orbital
Three-dimensional model of the s-orbital in the wave functions of hydrogen. With base. Made of hard wood mounted on a nickel coated steel axle.
Height: 250 mm approx.

9983-1012842

Set of 3 p-Orbitals
Set of three-dimensional models of the three p-orbitals in the wave functions of hydrogen. With base. Made of hard wood mounted on a nickel coated steel axle. Two colours to indicate the change in sign in the wave functions.
Height: 250 mm approx.

9983-1012841



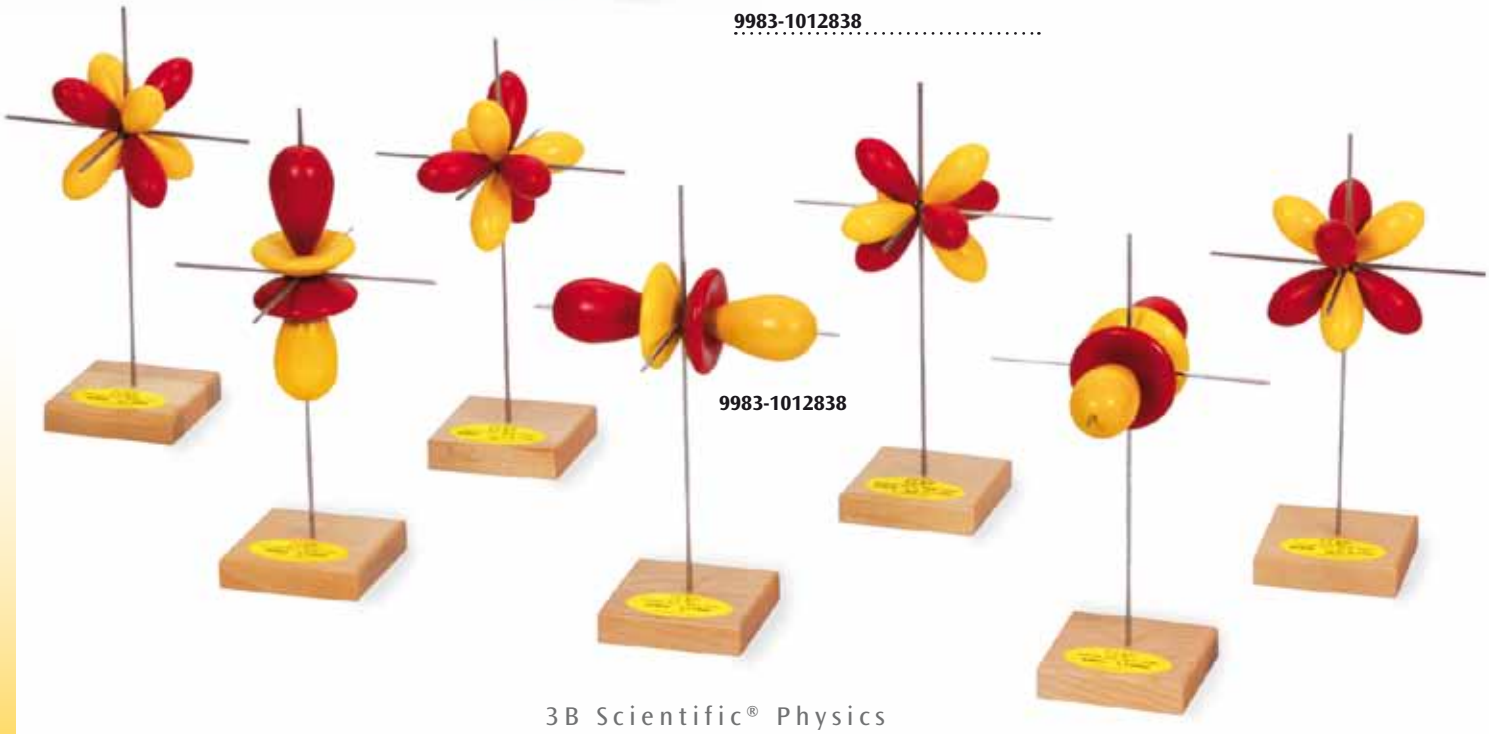
9983-1012841

Set of 5 d-Orbitals
Set of three-dimensional models of the five d-orbitals in the wave functions of hydrogen. With base. Made of hard wood mounted on a nickel coated steel axle. Two colours to indicate the change in sign in the wave functions.
Height: 250 mm approx.

9983-1012841

Set of 7 f-Orbitals
Set of three-dimensional models of the seven f-orbitals in the wave functions of hydrogen. With base. Made of hard wood mounted on a nickel coated steel axle. Two colours to indicate the change in sign in the wave functions.
Height: 250 mm approx.

9983-1012838



9983-1012838

www.EngineeringBooksPDF.com

Experiment topics:

- Millikan's experiment
- Elementary electric charge
- Charged oil droplets in an electric field
- Stokes viscous drag, weight, buoyancy
- Measurements of the equilibrium voltage and the velocity of fall
- Measurements of the velocity of fall, the velocity of rise, and the associated plate voltages



9983-1002819

Millikan's Apparatus

Compact apparatus for demonstrating the discrete nature (quantisation) of electric charge and for determining the elementary charge of an electron. The experiment is set up on a height-adjustable tripod and consists of a plate capacitor under a plastic cover, measuring microscope, lighting apparatus and an oil atomiser. Includes a plastic bottle containing oil.

Distance between plates:	6 mm
Plate diameter:	80 mm
Halogen lamp:	12 V / 10 W
Objective magnification:	2x
Eyepiece magnification:	10x
Micrometer range:	10 mm
Scale divisions:	0.1 mm
Connections:	4 mm sockets
Dimensions:	250x300x450 mm³ approx.
Weight:	4.0 kg approx.

9983-1002819

Additionally required:
9983-1002821 Power Supply for Millikan's Apparatus (230 V, 50/60 Hz)
or
9983-1002820 Power Supply for Millikan's Apparatus (115 V, 50/60 Hz)

Power Supply for Millikan's Apparatus

Operating equipment supplying voltages for the plate capacitor and the halogen lamp used in Millikan's apparatus (9983-1002819). With digital voltage read-out, rotary potentiometer for adjusting voltage, a switch for enabling the two stopwatch outputs for measurements with one stopwatch (falling from equilibrium method) or with two stopwatches (rising and falling method) and a switch for turning the capacitor voltage on and off with simultaneous switching between the two stopwatch outputs. Includes mains-powered supply unit.

Output connections:	4 mm safety sockets
Plate capacitor:	0 – 600 V
Halogen lamp:	12 V / 10 W
Voltage readout:	3-digit, height of numerals: 14 mm
Operating voltage:	12 V, 20 W, from the mains-powered unit that is provided
Dimensions:	190x150x110 mm³ approx.
Weight:	1 kg approx.



9983-1002821

Power Supply for Millikan's Apparatus (230 V, 50/60 Hz)

9983-1002821

Power Supply for Millikan's Apparatus (115 V, 50/60 Hz)

9983-1002820

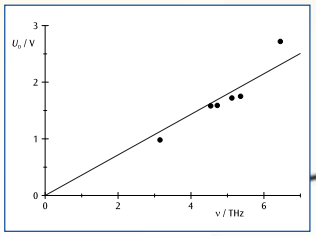
Additionally recommended:
9983-1001033 Digital Counter (230 V, 50/60 Hz)
or
9983-1001032 Digital Counter (115 V, 50/60 Hz)

www.EngineeringBooksPDF.com

Light Emitting Diodes for Determination of *h*

Mounting plate with six coloured light-emitting diodes with different emission wavelengths for determining Planck's constant *h* by measuring the cut-off voltage as a function of the frequency of the emitted light. Light-emitting diodes with series resistors mounted on a base plate with a stem.

Cut-off voltage as a function of frequency



Wavelengths:	465 nm, 560 nm, 585 nm, 635 nm, 660 nm, 950 nm
Series resistor:	100 Ω
Max. voltage:	6 V
Dimensions:	115x115 mm² approx.
Weight:	120 g approx.

9983-1000917

Additionally required:

9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)

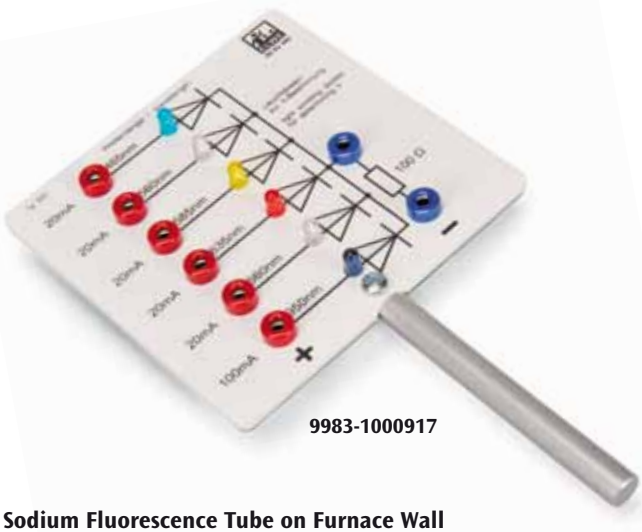
or

9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

9983-1006810 Multimeter, Escola 10

9983-1001046 Stand base

Experiment leads



9983-1000917

Sodium Fluorescence Tube on Furnace Wall

Highly evacuated glass tube containing several times distilled sodium for demonstrating the resonance fluorescence of sodium vapour. Filled with argon. The entire tube emits yellow light at the wavelength of the sodium D line when it is brought to the heated state and illuminated with sodium spectral light. If it is instead illuminated with white incandescent filament light, the transmitted light exhibits a dark absorption line at the position of the sodium D line.

Dimensions of tube:	170 mm x 42 mm diam.
Dimensions of hotplate:	230x160 mm² approx.
Weight:	550 g approx.

9983-1000913

Additionally required:

9983-1012820 Heating Chamber (230 V, 50/60 Hz)

or

9983-1006796 Heating Chamber (115 V, 50/60 Hz)

Additionally recommended:

9983-1002793 Digital Thermometer, Single Channel

9983-1002804 Immersible Temperature Sensor, NiCr-Ni, Type K, -65°C to 550°C

9983-1003531 Hand Held Spectroscope with Amici Prism

9983-1003541 Sodium Vapour Spectrum Lamp

9983-1003196 Choke for Spectrum Lamps (230 V, 50/60 Hz)

or

9983-1003195 Choke for Spectrum Lamps (115 V, 50/60 Hz)

Simple, safe and fast
Accuracy < 5%



9983-1000537
9983-1000536

Planck's Constant Apparatus

Simple, safe and quick-to-operate, compact apparatus with integrated photocell as well as a voltmeter and nano-ammeter for determining Planck's constant and the work done in emitting an electron using the stopping potential method. Five light emitting diodes (LEDs) of known mean wavelengths act as light sources of differing frequencies. The intensity of the light emitted by them can be varied from 0 to 100%.

Wavelengths:	472 nm, 505 nm, 525 nm, 588 nm, 611 nm
Dimensions:	280x150x130 mm³
Weight:	1.3 kg approx.

Contents:

1 Basic apparatus with photocell, voltmeter, nano-ammeter and power supply for light sources
5 LEDs in casings with connector leads
1 Plug-in power supply 12 V AC

Planck's Constant Apparatus (230 V, 50/60 Hz)

9983-1000537

Planck's Constant Apparatus (115 V, 50/60 Hz)

9983-1000536

Heating Chamber

Electric heating chamber with continuous temperature control and digital temperature display showing actual and set-point temperatures. In lacquered metal housing with two viewing windows, opening with spring-clip for thermometer and thermally insulated carrying handle. Temperature measurement and control is handled by an integrated microcontroller and a Pt100 thermocouple.

Dimensions of front opening:	230x160 mm² approx.
Heating power:	400 W
Maximum temperature:	300°C (230 V, 50/60 Hz) 250°C (115 V, 50/60 Hz)
Temperature constancy:	±1°C approx.
Dimensions:	335x180x165 mm³ approx.
Weight:	5.6 kg approx.

Heating chamber (230 V, 50/60 Hz)

9983-1012820

Heating chamber (115 V, 50/60 Hz)

9983-1006796



9983-1000913

9983-1012820
9983-1006796

www.EngineeringBooksPDF.com

9983-1000915



Vacuum Photocell

Evacuated photocell for demonstrating the photoelectric effect and showing that the emission of electrons increases with increasing light intensity. Mounted ready for use on a base plate with electrical wiring and clamping bar.

Cathode:	Caesium on oxidized silver
Cathode area:	2.4 cm²
Operating voltage:	50 V, max. 200 V
Working resistance:	1 MΩ
Dark current:	<0.05 µA
Sensitivity:	20 µA/lumen
Photoelectric current density:	max. 3.0 µA/cm²

9983-1000915

9983-1000916



Gas Filled Photocell

Gas-filled photocell for demonstrating the photoelectric effect with simple measuring instruments for use by students that also shows how the emission of electrons increases with increasing light intensity. Mounted ready for use on a base plate with electrical wiring and clamping bar.

Cathode:	Caesium on oxidized silver
Cathode area:	2.4 cm²
Operating voltage:	50 V, max. 90 V
Working resistance:	1 MΩ
Dark current:	<0.1 µA
Sensitivity:	125 µA/Lumen
Photoelectric current density:	max. 0.7 µA/cm²

9983-1000916

External Photoelectric Effect (Hallwachs Effect)

Equipment:

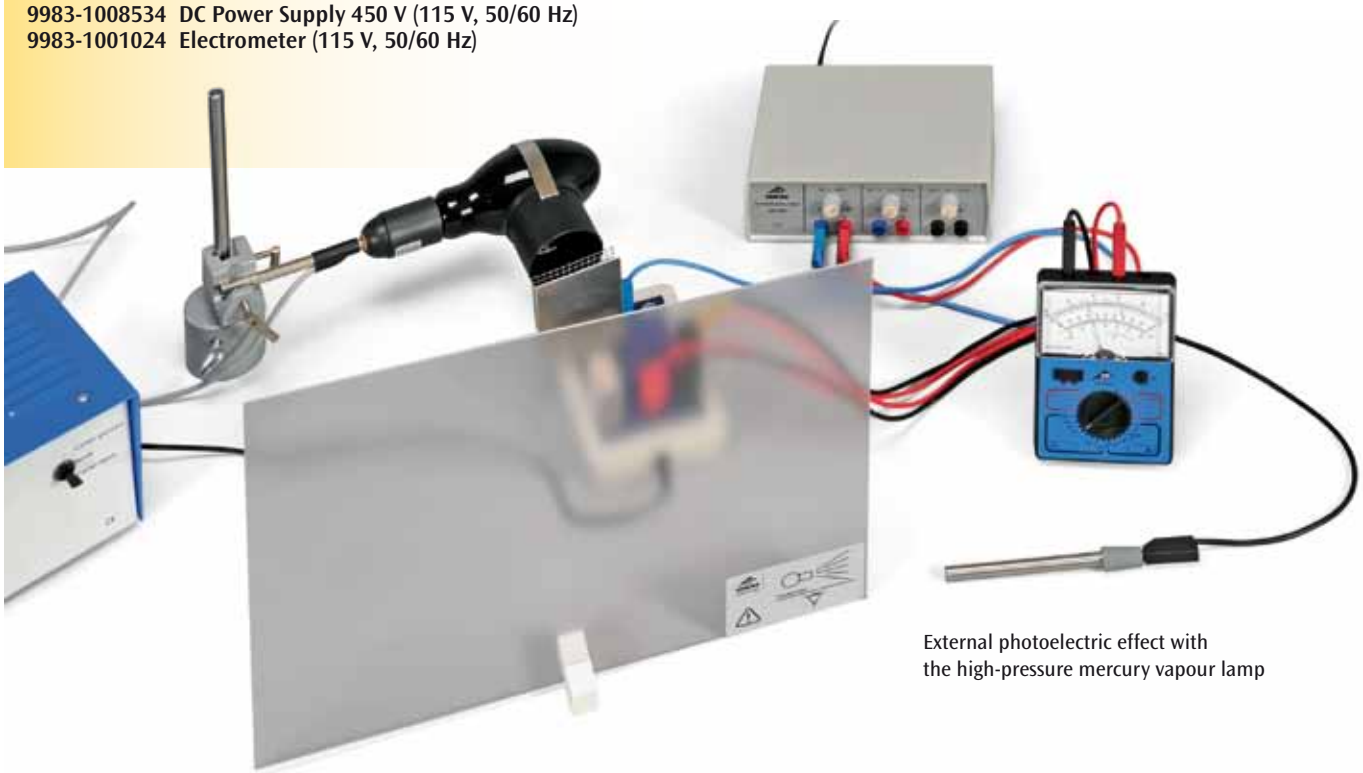
9983-1000852 High-Pressure Mercury Vapour Lamp
9983-1006813 Electrometer Accessories
9983-1002835 Tripod Stand, 150 mm
9983-1002933 Stainless Steel Rod, 250 mm
9983-1002830 Universal Clamp
9983-1003073 Analogue Multimeter AM50
9983-1003196 Control Unit for Spectrum Lamps (230 V, 50/60 Hz)
9983-1008535 DC Power Supply 450 V (230 V, 50/60 Hz)
9983-1001025 Electrometer (230 V, 50/60 Hz)
or
9983-1003195 Control Unit for Spectrum Lamps (115 V, 50/60 Hz)
9983-1008534 DC Power Supply 450 V (115 V, 50/60 Hz)
9983-1001024 Electrometer (115 V, 50/60 Hz)

High-Pressure Mercury Vapour Lamp

High-pressure mercury vapour lamp in hardened glass bulb made of blackened borosilicate glass, with tube-shaped hole allowing emission of unfiltered ultra-violet radiation. Includes E27 lamp holder on stem and see-through screen to protect users from UV radiation.

Wavelength ranges:	UV-A, UV-B, UV-C
Power consumption:	125 W

9983-1000852



External photoelectric effect with the high-pressure mercury vapour lamp

www.EngineeringBooksPDF.com



Franck-Hertz experiment with neon

Franck-Hertz Experiment

The quantization of energy and the generation, recording and evaluation of spectra, along with the experimental verification thereof, is included in most of the curricula used around the world. The well known experiment first performed by James Franck and Gustav Hertz in 1913 is critically important in terms of demonstrating discrete energy states in atoms.



9983-1012819
9983-1012818

Power Supply Unit for Franck-Hertz Experiment

Power supply unit for operating the mercury filled Franck-Hertz tube (9983-1006795 resp. 9983-1006794), the neon filled Franck-Hertz tube (9983-1000912) or the critical potential tubes (9983-1000620 and 9983-1000621). The equipment provides all the voltages needed to power the tubes and includes a sensitive built-in DC amplifier for measuring collector current. The voltages can simultaneously be read off a display. The accelerating voltage can be set-up manually on the apparatus or set to a saw-tooth wave form. Additional measuring inputs are also available for the anode current and accelerating voltage.

Filament voltage U_F:	4 – 12 V, continuously adjustable
Control voltage U_G:	0 – 12 V, continuously adjustable
Accelerating voltage U_A:	0 – 80 V
Modes of operation:	manually adjusted / saw-tooth
Countervoltage U_E:	0 – ±12 V, continuously adjustable, switchable polarity
Output U_E for collector current I_E:	$I_E = U_A$ * 7 nA/V (0 – 12 V)
Output U_Y for accelerating voltage U_A:	$U_X = U_A$ / 10
Outputs:	4 mm safety sockets
Input:	BNC socket
Dimensions:	160x132x210 mm³ approx.
Weight:	3.4 kg approx.

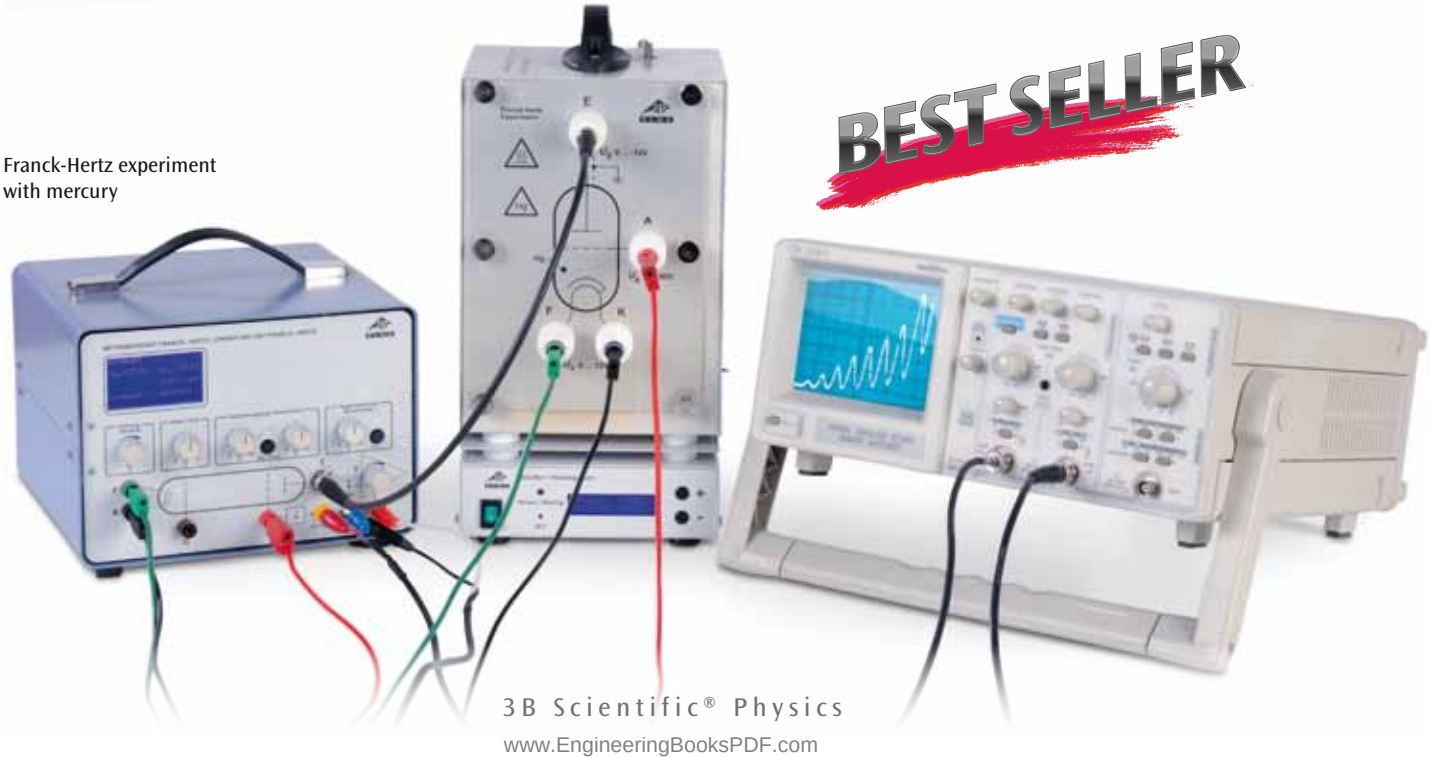
Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)

9983-1012819

Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)

9983-1012818

Franck-Hertz experiment with mercury



www.EngineeringBooksPDF.com

Franck-Hertz Tube with Neon Filling

Highly evacuated electron tube containing neon, mounted on a base with socket connection for demonstrating that free electrons colliding with neon atoms emit energy in quantized packets and for determining the excitation energy of the $^3P_0$ or $^3S_1$ states at about 19 eV. When excited, these states emit visible light due to the energy drop from intermediate levels to a ground state at an excitation energy of about 16.7 eV. The light so emitted is in the red-yellow region of the spectrum. Parallel bands of light are formed between the control grid and the accelerator grid and can be observed through a window. The Franck-Hertz neon tube can be operated at room temperature. Tetrode with indirectly heated cathode, mesh control grid, mesh accelerating grid and collector (counter) electrode. Mounted on a base with colour coded connection sockets.

Filament voltage:	4 – 8 V
Control voltage:	9 V
Accelerating voltage:	max. 80 V
Counter voltage:	1.2 – 10 V
Tube:	130 mm x 26 mm diam. approx
Base with connector sockets:	190x115x115 mm³ approx.
Weight:	450 g approx.

9983-1000912

Additionally required:

9983-1012819 Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)

or

9983-1012818 Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)

9983-1002727 Analogue Oscilloscope 2x30 MHz



9983-1000912

Franck-Hertz Tube with Mercury Filling and Heating Chamber

Highly evacuated electron tube containing mercury in a heating chamber for demonstrating the discrete nature (quantization) of the energy released by free electrons in collisions with mercury atoms, and for determining the excitation energy of the mercury resonance line ($6^1S_0 – 6^3P_1$), which is 4.9 eV. The electron tube must be heated in the chamber to generate the necessary mercury vapour pressure to achieve a sufficiently high probability of collisions between electrons and mercury atoms. Electron tube with a plane parallel electrode system consisting of an indirectly heated oxide cathode with aperture, a grid and a collecting electrode. Front plate with printed tube symbol visible from a distance. Electric heating chamber with continuous temperature control and digital temperature display showing actual and set-point temperatures. In lacquered metal housing with two observation windows, opening with spring clip for thermometer, and thermally insulated carrying handle. Temperature measurement and control is handled by an integrated microcontroller and a Pt100 thermocouple.

Heater voltage:	4 – 12 V
Grid voltage:	0 – 70 V
Suppressor voltage:	1.5 V approx.
Tube dimensions:	130 mm x 26 mm diam. approx.
Heater output:	400 W
Temperature range:	160° C – 240° C
Temperature constancy:	±1°C approx.
Overall dimensions:	335x180x165 mm³ approx.
Weight:	5.6 kg approx.

Franck-Hertz Tube with Mercury Filling and Heating Chamber (230 V, 50/60 Hz)

9983-1006795

Franck-Hertz Tube with Mercury Filling and Heating Chamber (115 V, 50/60 Hz)

9983-1006794

Additionally required:

9983-1012819 Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)

or

9983-1012818 Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)

9983-1002727 Analogue Oscilloscope 2x30 MHz



9983-1003550



9983-1003549

9983-1006795
9983-1006794



Replacement Tubes for Frank-Hertz Experiment

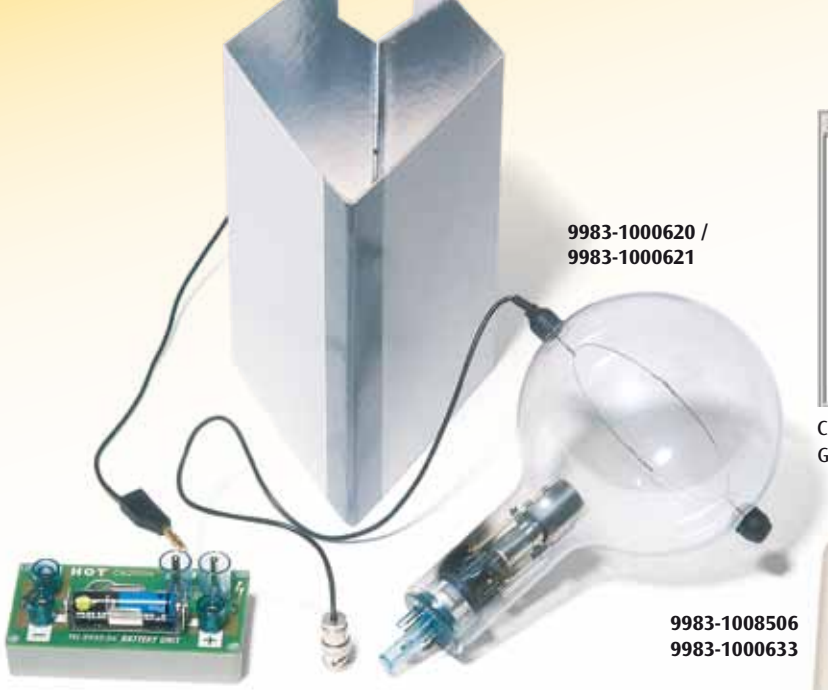
Franck-Hertz Tube with Hg

9983-1003549

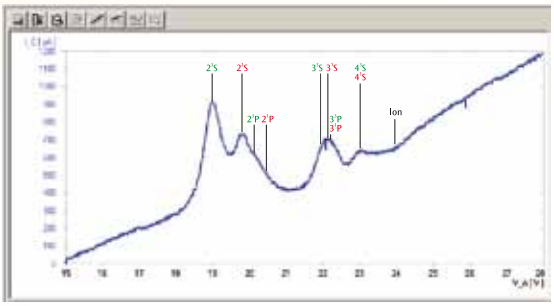
Franck-Hertz Tube with Ne

9983-1003550

www.EngineeringBooksPDF.com



9983-1000620 /
9983-1000621



Collector current I_R as a function of accelerating voltage U_A.
Gas filling: He



9983-1008506
9983-1000633

Critical Potential Tube S

Hertz electron tube for quantitative investigations of inelastic collisions of electrons with inert gas atoms, determination of ionization energy and excitation energies of helium resp. neon, resolution of the energy states of various primary and orbital angular-momentum quantum numbers, as well as demonstrating meta stable states. Includes shielding as well as a discharge tube and battery unit (battery included) for the collector voltage.

Cathode filament voltage: $U_F \leq 3$ V, $I_F \leq 1{,}3$ A
Anode voltage: $U_A \leq 60$ V
Anode current: $I_A \leq 10$ mA
Collector voltage: $U_c = 1{,}5$ V
Collector current: $I_c \leq 200$ pA

Critical Potential Tube S with He Filling

9983-1000620

Critical Potential Tube S with Ne Filling

9983-1000621

Additionally required:
9983-1000610 Tube Holder S
9983-1008506 Control Unit for Critical Potential Tubes (230 V, 50/60 Hz)
9983-1003312 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
9983-1012819 Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)
or
9983-1000633 Control Unit for Critical Potential Tubes (115 V, 50/60 Hz)
9983-1003311 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)
or
9983-1012818 Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)

Control Unit for Critical Potential Tubes

Control unit for operating the critical potential tubes. Equipped with an output for sawtooth acceleration voltages; adjustable upper and lower limits of the acceleration voltage. Integrated pico-ammeter amplifier for anode current measurement. Allows recording of the acceleration voltage as a function of the anode current. A slow sawtooth voltage (approx. 6 seconds per cycle) is available with an interface or XY-recorder; a sawtooth voltage with a repetition rate of 20 Hz is available for oscilloscopic observations.

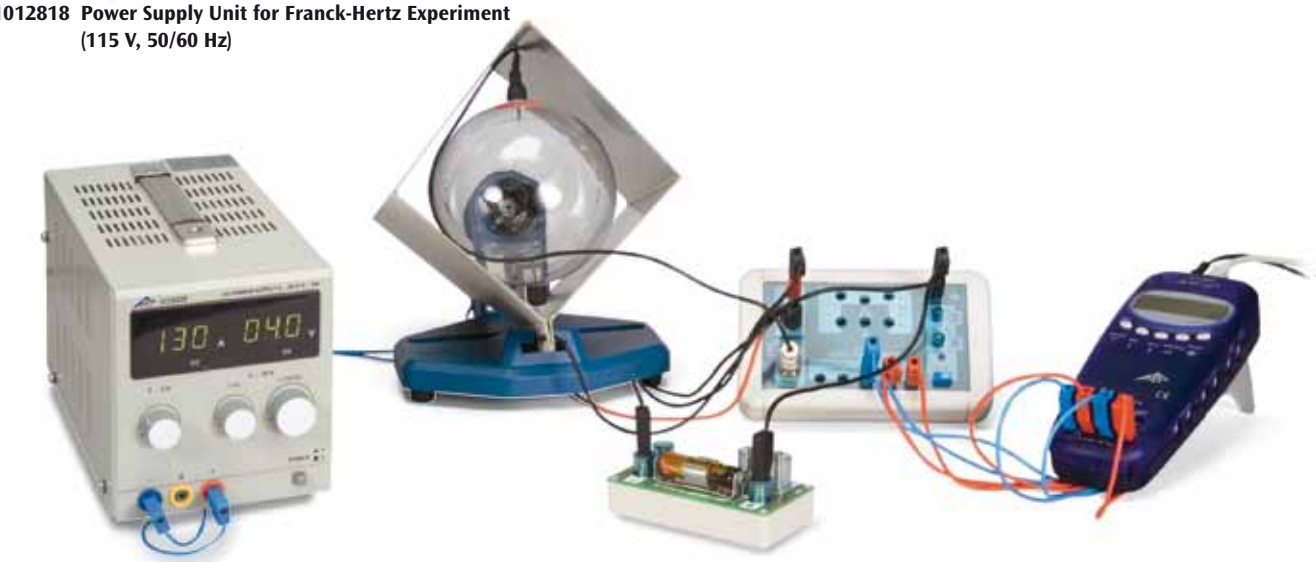
Input:	Anode current measurement via a BNC jack
Outputs:	
Tube	Sawtooth acceleration voltage of 0 – 60 V, 20 Hz
Fast	Voltage signal of 0 – 1 V, proportional to the acceleration voltage, for oscilloscopic observations
Slow	Voltage signal of 0 – 1 V, proportional to the acceleration voltage, for recording data with an XY-recorder or interface
Anode current	Voltage signal of 0 – 1 V, proportional to the anode current (1 V/nA)
Supply voltage:	12 V DC
Dimensions:	approx. 170x105x45 mm³

Control Unit for Critical Potential Tubes (230 V, 50/60 Hz)

9983-1008506

Control Unit for Critical Potential Tubes (115 V, 50/60 Hz)

9983-1000633



www.EngineeringBooksPDF.com

Electron Diffraction Tube D

Highly evacuated electron tube for demonstrating the wave nature of electrons through the observation of interference caused by passage of electrons through a polycrystalline graphite lattice (Debye-Scherrer diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelength as a function of the anode voltage from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Focussing voltage:	0 – 50 V
Lattice constant of graphite:	d_{10} = 0,213 nm, d_{11} = 0.123 nm

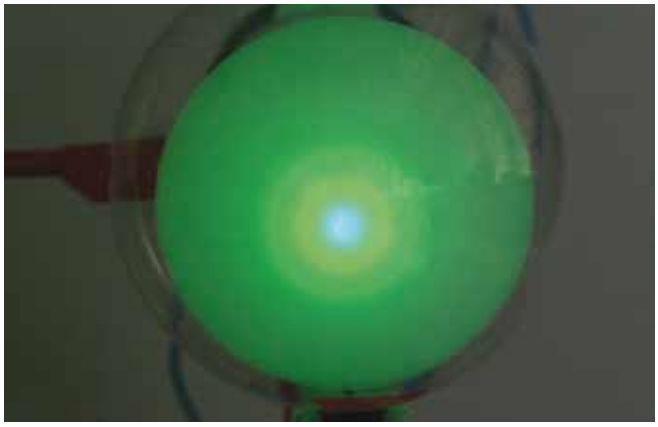
9983-1000655



9983-1000655

Additionally required:
9983-1008507 Tube Holder D
9983-1002847 Set of Leads for Electron Tube Experiments
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)

Additionally recommended:
9983-1009960 Three- Pole Protective Adapter



Electron Diffraction Tube S

Highly evacuated electron tube for demonstrating the wave nature of electrons through the observation of interference caused by passage of electrons through a polycrystalline graphite lattice (Debye-Scherrer diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelength as a function of the anode voltage from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Lattice constant of graphite:	d_{10} = 0,213 nm, d_{11} = 0,123 nm

9983-1000623



9983-1000623

Additionally required:
9983-1000610 Tube Holder S
9983-1002843 Set of 15 Safety Experiment Leads, 75 cm
9983-1003310 High Voltage Power Supply, 5 kV (230 V, 50/60 Hz)
or
9983-1003309 High Voltage Power Supply, 5 kV (115 V, 50/60 Hz)



9983-1000656

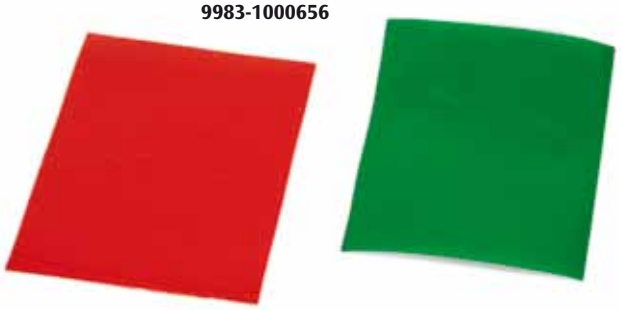
Optical Equivalent to Debye-Scherrer Interference

Aluminium disc with ball bearing mounted optical lattice grating for illustrating the principle of Debye-Scherrer interference using visible light. The rotating lattice grating serves as a model for the polycrystalline graphite lattice in the electron diffraction tube. Includes an aperture and red and green colour filters.

Cross lattice:	20 grid points/mm, 3 mm diam.
Flywheel:	100 mm diam.
Pinhole aperture:	1 mm diam.
Aperture frame:	approx. 50x50 mm²
Filter:	approx. 80x100 mm²

9983-1000656

Additionally recommended:
9983-1008507 Tube Holder D
9983-1003188 Optical Lamp
9983-1000593 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
9983-1006780 Transformer 12 V, 60 VA (115 V, 50/60 Hz)
9983-1003023 Convex Lens, f = 100 mm



9983-1000855 Object Holder, on Stem
9983-1000608 Projection Screen
9983-1002835 Tripod Base
9983-1001046 Barrel Foot (3x)

www.EngineeringBooksPDF.com



NMR Supplementary Set

Supplementary set for ESR/NMR basic set (9983-1000638/9983-1000637) for experiments on nuclear magnetic resonance using three different samples. Consists of an NMR probe-head with radio frequency coil, a permanent magnet giving a highly uniform field, a sample of glycerine, a sample of polystyrene, a sample of Teflon, an empty sample tube for comparison and two mounting discs.
Connection to the probe-head: Four-pin Lemo plug
Magnetic flux density of permanent magnet: 300 mT approx.

9983-1000642

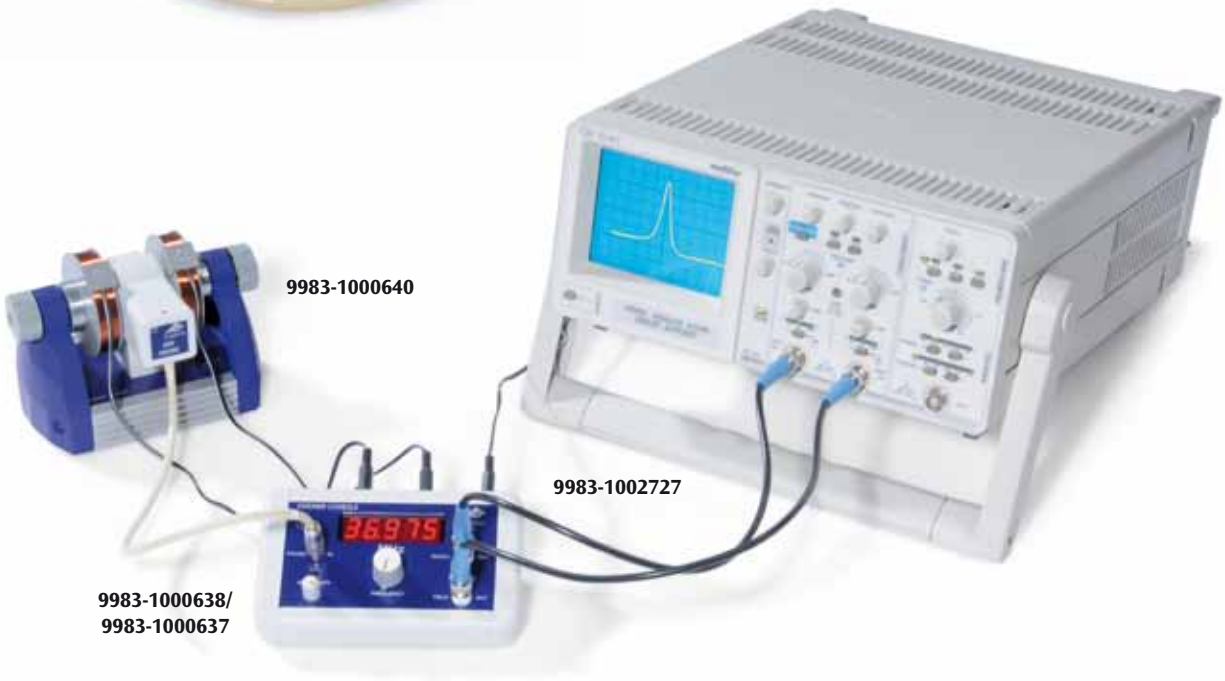




ESR Supplementary Set

Supplementary set for ESR/NMR basic set (9983-1000638/9983-1000637) for experiments on electron spin resonance using DPPH. Consists of an ESR probe-head with radio frequency coil, a sample of DPPH (diphenyl picryl hydrazyl), an empty sample tube for comparison, two mounting rings and two mounting cylinders.
Connection to the probe-head: Four-pin Lemo plug

9983-1000640



www.EngineeringBooksPDF.com

ESR/NMR Basic Set
This basic equipment set is intended for investigating the electron spin resonance (ESR) of an unpaired electron of a DPPH sample as well as the nuclear magnetic resonance (NMR) of glycerine, teflon and polystyrene. Resonances are observed via transitions induced through high frequencies resulting from changes in the external magnetic field. Resonance absorption curves can be represented with a simple dual-channel oscilloscope or with the 3B NET*log*™ unit.

Contents:
1 Basic unit
1 Pair of coils
1 Control panel
1 Plug-in power supply, 12 V AC (230 V, 50/60 Hz)
or
1 Plug-in power supply, 12 V AC (115 V, 50/60 Hz)

The basic unit is a mechanical base for test samples as well as ESR (from 9983-1000640) or NMR probes (from 9983-1000642), a coil pair and a permanent magnet (from 9983-1000642).

Dimensions:	165x105x135 mm³ approx.
Weight:	1.25 kg approx.

The coil pair is used to generate the variable magnetic field for electron spin resonance and – in conjunction with the permanent magnet (from 9983-1000642) – nuclear spin resonance.

Magnetic flux density:	0 – 3.7 mT
Connection:	Barrel connector
Dimensions:	20 mm x 74 mm diam. approx. each
Weight:	0.2 kg approx. each

The control console provides the voltage for control and supply of power to probes and the coil pair. It also processes the signal for display on an oscilloscope and indicates the frequency of the high-frequency signal.

Probe connection:	Four-pin Lemo socket
Coil pair connection:	Saw-tooth current source, 0 – 250 mA, 50 ms, pair of barrel sockets
Field output:	Proportional to coil current, 0 to 1 V, BNC socket
Signal output:	Resonance signal, 0 to 1 V, BNC socket
Frequency range:	45 to 75 MHz approx. (ESR) 10 to 15 MHz approx. (NMR)
Dimensions:	170x105x45 mm³ approx.
Weight:	0.5 kg approx.

Experimental topics:

- Resonance absorption of a high-frequency oscillating circuit
- Dependence of resonance frequency on magnetic fields
- Line width
- Electron spin
- Magnetic moment of an electron
- Determination of the electron g factor
- Proton spin
- Magnetic moment of a proton and nucleus
- Determination of the nucleus g factor
- Nuclear-spin tomography

ESR/NMR Basic Set (230 V, 50/60 Hz)
9983-1000638

ESR/NMR Basic Set (115 V, 50/60 Hz)
9983-1000637

Additionally required:
9983-1000640 ESR Supplementary Set
or
9983-1000642 NMR Supplementary Set

9983-1002727 Analogue Oscilloscope, 2x30 MHz
or
9983-1000540 3B NET*log*™ (230 V, 50/60 Hz)
or
9983-1000539 3B NET*log*™ (115, 50/60 Hz)



9983-1000638/
9983-1000637

www.EngineeringBooksPDF.com

Experiment topics:

- Extrinsic conductivity
- Intrinsic conductivity
- Mobility of electrons and holes
- Drift velocity of charge carriers
- Carrier concentration
- Band separation



9983-1009934



Basic Hall Effect Apparatus

Basic apparatus for providing contact, power supply and support to a germanium crystal on a circuit board (9983-1008522, 9983-1009810 and 9983-1009760) in experiments on the Hall effect or on conductivity. Includes an integrated, adjustable constant current source to provide the current through the sample, a measuring amplifier with offset compensation for Hall voltages and heating to raise the crystal to as high as 170° C, also featuring temperature regulation and a switchable display showing Hall voltage, sample current, sample voltage or temperature. Hall voltage and sample voltage can be tapped directly from the front panel. In addition three equivalent voltage outputs for Hall voltage, sample current and sample temperature can be measured from the side. Includes an attachment for assembling the apparatus on the U-shaped core (9983-1000979) of a transformer assembly kit and 2 connecting leads with 8-pin miniDIN plugs.

Outputs for equivalent voltages:	4-mm safety sockets 8-pin miniDIN sockets (for 3B NET*log*™)
Power supply:	12 V AC, 3 A via 4-mm sockets
Dimensions:	180x110x50 mm³ approx.
Weight:	0.5 kg approx.

9983-1009934

Equipment:

9983-1008522	**Undoped Germanium on Printed Circuit Board**	yes	–	–
9983-1009810	**P-Doped Germanium on Printed Circuit Board**	–	yes	–
9983-1009760	**N-Doped Germanium on Printed Circuit Board**	–	–	yes
9983-1009934	**Basic Hall Effect Apparatus**	yes	yes	yes
9983-1003316 or **9983-1003315**	**Transformer with Rectifier 3, 6, 9, 12 V, 3 A**	yes	yes	yes
9983-1002843	**Set of 15 Safety Experiment Leads**	yes	yes	yes
9983-1000979	**U-Shaped Core**	yes	yes	yes
9983-1009935	**Pair of pole pieces for Hall effect with clamp**	–	yes	yes
9983-1000988	**Coil with 600 Turns (2x)**	–	yes	yes
9983-1003312 or **9983-1003311**	**DC Power Supply 0–20 V, 0–5 A**	–	yes	yes
9983-1009941	**Magnetic Field Sensor ±2000 mT**	–	yes	yes
9983-1000540 or **9983-1000539**	**3B NET*log*™**	–	yes	yes

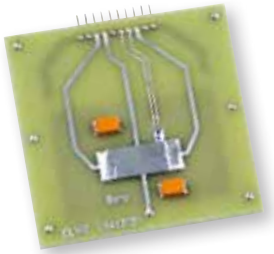
Undoped Germanium on Printed Circuit Board

High-quality interchangeable board with an undoped germanium crystal for investigating the conductivity of undoped germanium as a function of temperature. With contacts for transverse current, integrated resistive heating element with temperature sensor directly under the crystal, and multi pin plug for connecting the circuit board to the basic Hall effect apparatus (9983-1009934).

Crystal dimensions:	20x10x1 mm³ approx.
Overall dimensions:	70x70x10 mm³ approx.
Weight:	30 g approx.

9983-1008522

Additionally required:
9983-1009934 Hall Effect Basic Apparatus



9983-1008522

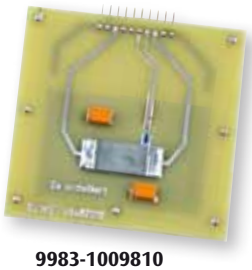
P-Doped Germanium on Printed Circuit Board

High-quality interchangeable board with an p-doped germanium crystal for investigating the conductivity and Hall potential for p-doped germanium as a function of temperature. With contacts for transverse current and Hall potential, integrated resistive heating element with temperature sensor directly under the crystal and multi pin plug for connecting the circuit board to the basic Hall effect apparatus (9983-1009934).

Crystal dimensions:	20x10x1 mm³ approx.
Overall dimensions:	70x70x10 mm³ approx.
Weight:	30 g approx.

9983-1009810

Additionally required:
9983-1009934 Hall Effect Basic Apparatus



9983-1009810

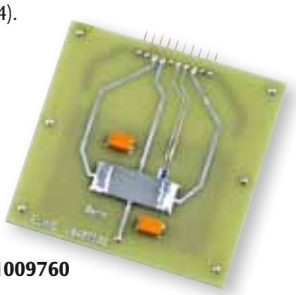
N-Doped Germanium on Printed Circuit Board

High-quality interchangeable board with an n-doped germanium crystal for investigating the conductivity and Hall potential for n-doped germanium as a function of temperature. With contacts for transverse current and Hall potential, integrated resistive heating element with temperature sensor directly under the crystal, and multi pin plug for connecting the circuit board to the basic Hall effect apparatus (9983-1009934).

Crystal dimensions:	20x10x1 mm³ approx.
Overall dimensions:	70x70x10 mm³ approx.
Weight:	30 g approx.

9983-1009760

Additionally required:
9983-1009934 Hall Effect Basic Apparatus



9983-1009760

www.EngineeringBooksPDF.com

Experiment Topics:

- Properties of X-rays:
  - Transmission
  - Linear propagation
  - Ionization
  - X-ray photography
- Fluorescent radiation
- Shielding of X-rays
- Absorption experiments
- Distance law
- Dosimetry and radiation protection
- Diffraction of X-rays:
  - Laue's recordings
  - Debye-Scherrer's recordings
  - Bragg's reflection
  - Duane-Hunt's displacement law (h-determination)
- Moseley's law

X-Ray Apparatus

The experiment chamber is contained in a closed, radiation-proof housing with a transparent synthetic-glass shield. If the synthetic-glass shield is opened, the high-voltage source for the X-ray tube is deactivated automatically. The high-vacuum X-ray tube with a directly heated tungsten cathode and copper anode is positioned in a borosilicate glass chamber with a thin-walled, concave ray emission window. A lead-glass hood with a collimator causes X-rays to emerge in parallel with the experiment plane and provides a shield against scattered radiation. The horizontal counter-tube goniometer consists of a central sample holder and a swiveling arm. In the form of a slide tray, this arm serves as a mount for the Geiger-Müller tube (9983-1000661), ionization chamber (9983-1000668) as well as experimental devices in slide format or on a 5 cmx5 cm base plate (for example, from 9983-1000665, 9983-1000666, 9983-1000667). The swiveling arm can be rotated manually independently of the sample holder, or at a fixed mutual angle with a ratio of 2:1, for instance, for experiments involving Bragg's reflection. The device is equipped with angle and millimeter scales, position markings for experimental devices, as well as radiation-proof bushings for cables and hoses.

Anode voltage:	20/30 kV, switchable and electronically stabilized
Emission current:	0 to 80 µA, continuously adjustable and electronically stabilized
Cathode heating:	4 V, 1 A
Focal spot:	5x1 mm^2
Anode material:	Cu
Lead-glass collimator:	radiation emission aperture with 5 mm diam.
Ray divergence:	better than 10°
Characteristic radiation wavelength:	Cu-K_α: 154 pm Cu-K_β: 138 pm

Counter-tube goniometer:

Swiveling ranges:	0°, +10° to +130° and -10° to +130° relative to the ray axis
Angular coupling:	independent of the sample holder or with a ratio of 2:1
Measurement accuracy of Bragg's angle:	5 arc minutes
Timer:	0 to 55 minutes, continuously adjustable
Power consumption:	100 VA

Dimensions:

X-ray apparatus:	approx. 250 mm x 370 mm diam.
X-ray tube:	approx. 100 mm x 32 mm diam.
Weight:	approx. 9 kg

X-Ray Apparatus (230 V, 50/60 Hz)

9983-1000657

X-Ray Apparatus (115 V, 50/60 Hz)

9983-1000660

Spare Tube for X-Ray Apparatus

(not shown)

Spare tube with Cu anode for X-ray apparatus (9983-1000657) and X -ray apparatus (9983-1000660).

9983-1000664



9983-1000657 / 9983-1000660

www.EngineeringBooksPDF.com

Motor Drive Debye-Scherrer

For structural investigations using the rotating-crystal method, suitable for the Debye-Scherrer camera (contained in 9983-1000665). Power transmission via bevel gears.
Power consumption: 3 VA

Motor Drive Debye-Scherrer (230 V, 50/60 Hz)

9983-1000663

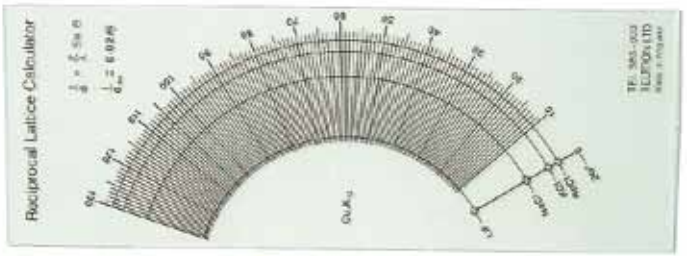
Motor Drive Debye-Scherrer (115 V, 50/60 Hz)

9983-1000662





9983-1000663
9983-1000662





9983-1000666

Crystallography Accessories

These accessories for the basic equipment set (9983-1000665) are intended for additional crystallographic experiments as well as treatments of Moseley's law, the Debye-Scherrer method, Bragg's reflection and material tests.

Contents:

4 foils, Fe, V, Mn, Cr
2 single crystals, KCl, RbCl
5 powder samples, NaF, SiC, NH_4Cl, MgO, Al
2 wire samples, Al, Nb (3x each) for Debye-Scherrer experiments
10 polyethylene threads
1 disc for calculating Bragg's angle

9983-1000666

Radiography Accessories

These accessories for the basic equipment set (9983-1000665) are intended for investigating the following topics: scattering, absorption; dependence on acceleration voltage, emission current and penetration power, resolving power; shielding, half width; exposure time, non destructive materials testing.

Contents:

1 Maltese cross
1 phantom
1 pin diaphragm
1 aluminum layer, stepped
5 aluminum absorbers, 0.1/0.25/0.5/1.0/2.0 mm
1 lead absorber, 0.5 mm
1 plastic absorber
2 magnets
4 materials testing models (porosity, fissures, welding seam, painting)

9983-1000667



9983-1000667

www.EngineeringBooksPDF.com

Geiger-Müller Tube

Self-extinguishing halogen-trigger counter tube for registering alpha, beta, gamma and X-radiation. Enclosed in a plastic housing with a holder for mounting on the swiveling arm of the X-ray apparatus (9983-1000657 resp. 9983-1000660); equipped with a firmly installed BNC patch cord. Includes a retention clip for other types of mounting.

Dose-rate range:	10^{-3} – 10^{2}mGy/h
Mass of the active surface:	Mica: 2.0 – 3.0 mg/cm²
Operating voltage:	500 V
Dimensions:	approx. 50x50x22 mm diam.
Cable length:	approx. 1 m

9983-1000661

Basic Set Bragg

Basic equipment set for Bragg's reflection experiment with a LiF and a NaCl crystal.

Contents:

1 slit diaphragm collimator, 1 mm
2 slit diaphragms, 1 mm/3 mm
2 single crystals, LiF, NaCl
1 Geiger Müller tube (9983-1000661)

9983-1008508



9983-1008508

9983-1000661

Basic Equipment Set

Equipment set for qualitative and quantitative experiments involving, for instance, linear propagation, ionization, penetration capacity of X-radiation and X-ray photography; also for demonstrating the wave nature of X-radiation, investigating fluorescent X-radiation and determining mass-absorption coefficients. In a specially moulded storage box.

9983-1000665

Contents:

1 fluorescent screen
1 Debye-Scherrer camera
2 film cassettes
1 lead mask
2 plate electrodes on a 4 mm contact pin
1 slit diaphragm collimator, 1 mm
1 pin diaphragm collimator, 1 mm diam.
1 ancillary magazine with a circular aperture
2 slit diaphragms, 1 mm/3 mm
1 pin diaphragm, 9.5 mm diam.
2 single crystals, LiF, NaCl
2 mini crystals, LiF
1 powder sample, LiF
10 copper wires
4 absorption foils, Ni, Cu, Co, Zn
1 scattering-foil revolver, coated with V, Cr, Mn, Fe, Co, Ni, Cu, Zn
1 set of assembly aids (acetate adhesive, clips)
1 storage box, specially moulded



9983-1000665

www.EngineeringBooksPDF.com

Bragg Driver

The Bragg driver is a combination of hardware and software which allows the user to collect X-ray diffraction data in combination with the X-ray apparatus (9983-1000657 resp. 9983-1000660). It provides the high voltage and counting circuitry for the Geiger Müller tube (9983-1000661) and includes a software program that allows the user to control the driver and collect data. It includes the USB powered drive, a drive gear, an USB cable and a powder compressor. Scans can be obtained for all crystals available in the basic equipment set (9983-1000665) and the crystallography accessories (9983-1000666). An additional feature includes the ability to scan powders and foils. The software allows selection of scan angles, resolution, and time per step. Once the experiment is completed the software permits zoom-in on the data and the facility to add comments to the file. Data can be exported to a spreadsheet for further analysis.

Time interval for automatic data saving:	30 s
Angular range:	12° – 120°
Time per step:	≥ 0.1 s
Angular step:	≥ 0.05°
GM tube voltage:	0 – 1000 V

9983-1012871

NEW

9983-1012871



www.EngineeringBooksPDF.com

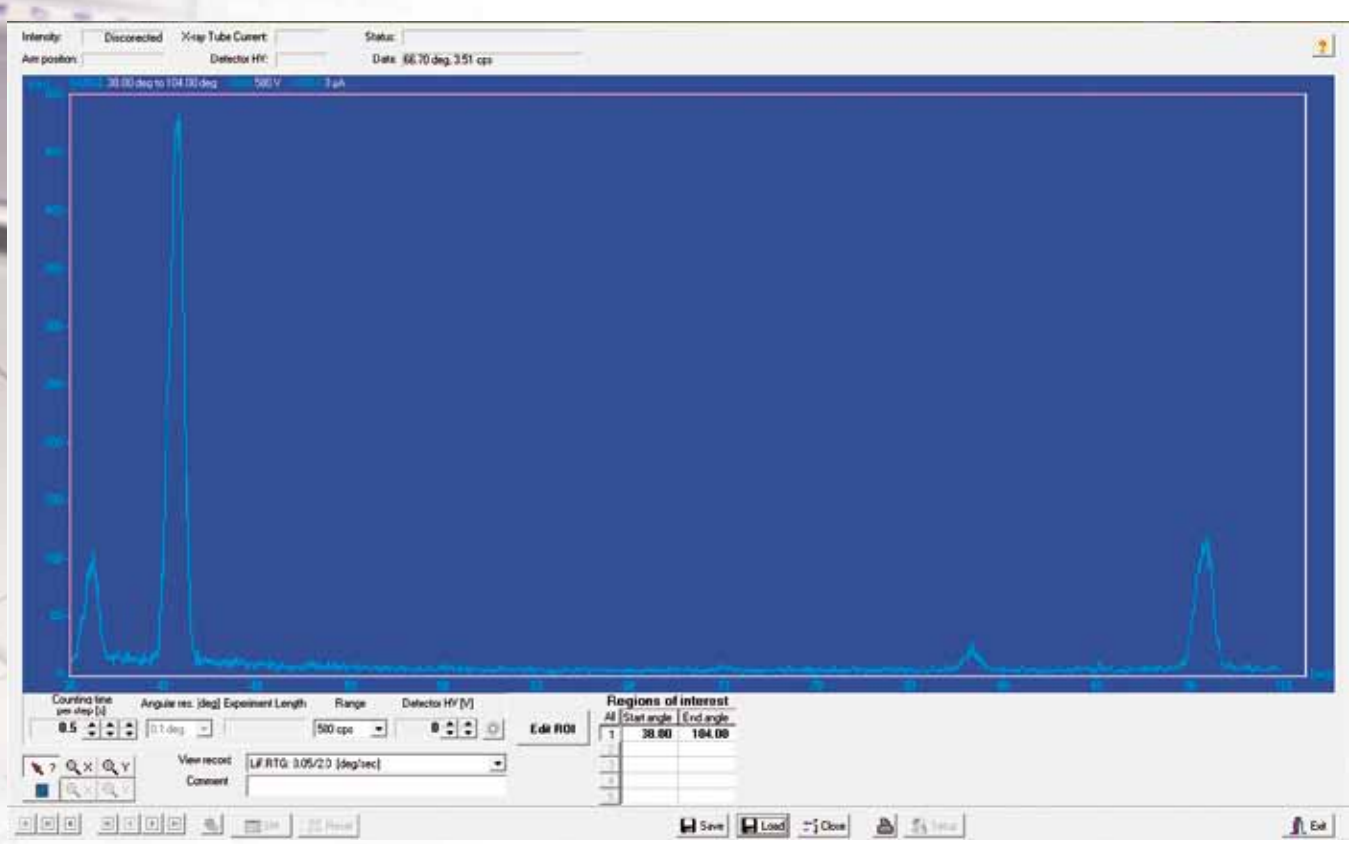
Recommended equipment:

Art. No.		Basic	Intermediate	Advanced
9983-1000657 or **9983-1000660**	X-ray Apparatus	yes	yes	yes
9983-1000661	Geiger Müller Tube	yes	yes	yes
9983-1012871	Bragg Driver	yes	yes	yes
9983-1000665	Basic Equipment Set	yes	yes	yes
9983-1000666	Crystallography Accessories		yes	yes
9983-1000667	Radiography Accessories			yes
9983-1000663/ 9983-1000662	Motor Drive		yes	yes
9983-1000669	Filmpack2	yes	yes	yes
9983-1000670	Filmpack 4	yes	yes	yes

Basic:
Basic experiments using photographic techniques and Geiger Müller tube like Laue experiments, Bragg diffraction experiments, experiments on inverse square law, emission, rectilinear propagation, penetration and absorption of X-rays.

Intermediate:
Basic experiments and experiments on Moseley, Debye-Scherrer diffraction, size of the unit cell in salt crystals in addition.

Advanced:
Intermediate experiments and experimental investigations into radiography, film and the properties of x-rays in addition.



www.EngineeringBooksPDF.com

X-ray Energy Detector

X-ray detector for recording energy spectra of X-rays or γ radiation in the energy range of approx. 2 keV to 60 keV. It mainly consists of a Si-PIN photodiode which is integrated in a metal housing together with a charge sensitive preamplifier, a main amplifier with pulse shaping and a digital signal processing circuit. The detector holder is particularly designed for installation on the swiveling arm of the X-ray apparatus (9983-1000657 resp. 9983-1000660). The power supply is ensured via the USB port of a PC. Including CD with measuring and evaluation software for PC.

Energy range:	approx. 2 keV up to 60 keV
Energy resolution (FWHM):	0.55 keV at $E_{FeK\alpha}$ = 6.40 keV
Entrance window:	Plastics (absorption equivalent to Graphite with d = 40 µm)
Detector:	Si-PIN photo diode
Active Area:	0.8 mm diam.
Thickness:	approx. 200 µm
Dead time per pulse:	approx. 200 µs
Connection:	USB
Cable length:	1.75 m
Dimensions:	80 mm x 22 mm diam.
Mass:	150 g

9983-1008629

Additionally required:
9983-1000657 X-Ray Apparatus (230 V, 50/60 Hz)
9983-1000660 X-Ray Apparatus (115 V, 50/60 Hz)

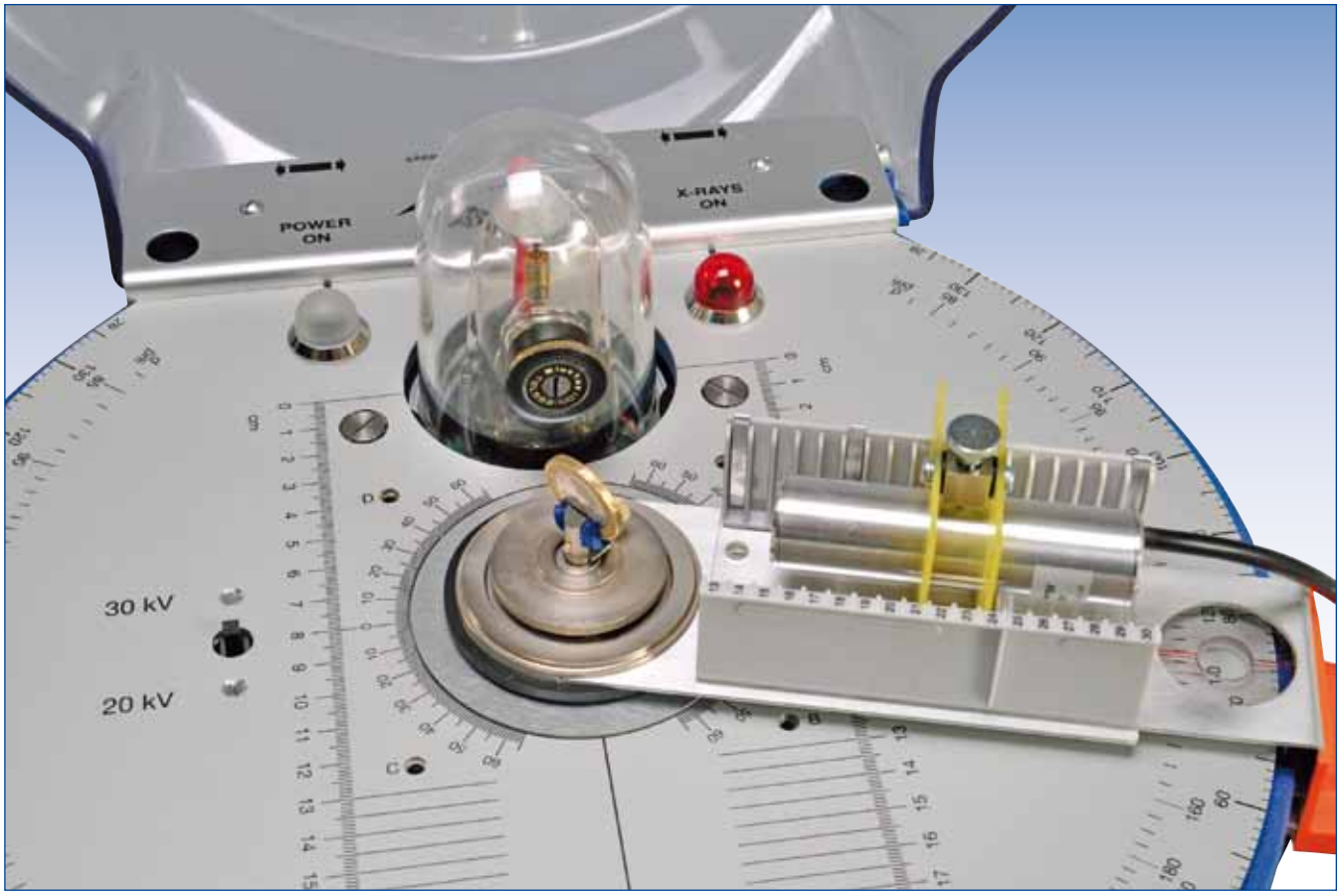
Additionally recommended:
9983-1012868 Set of Fluorescence Samples

Experiment Topics:

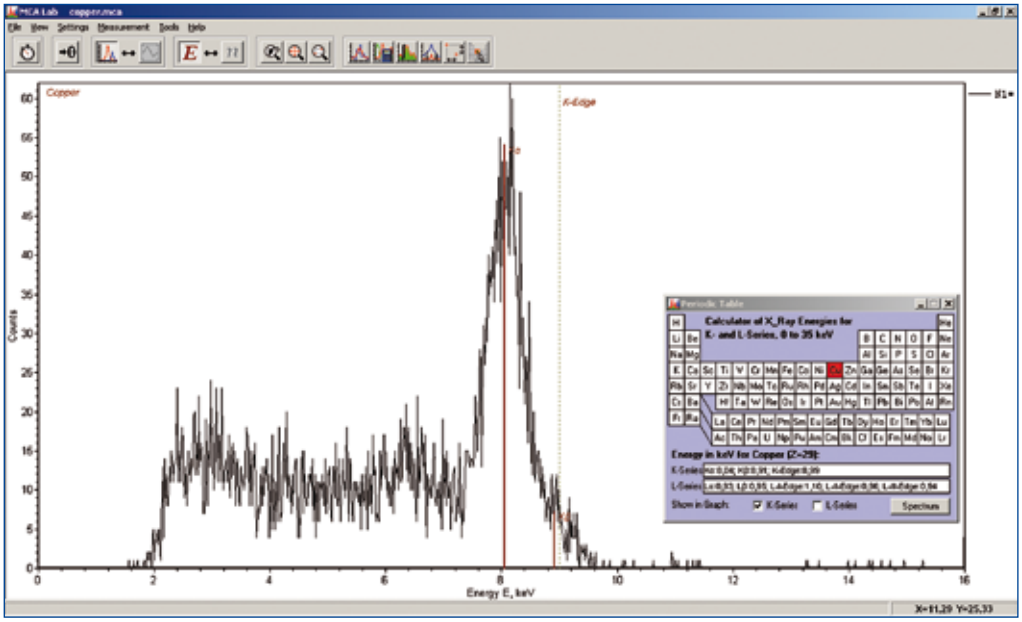
- X-ray energy spectroscopy
- Compton effect
- X-ray fluorescence spectroscopy
- Absorption experiments
- Bragg's reflection
- Duane-Hunt's displacement law
- Moseley's law



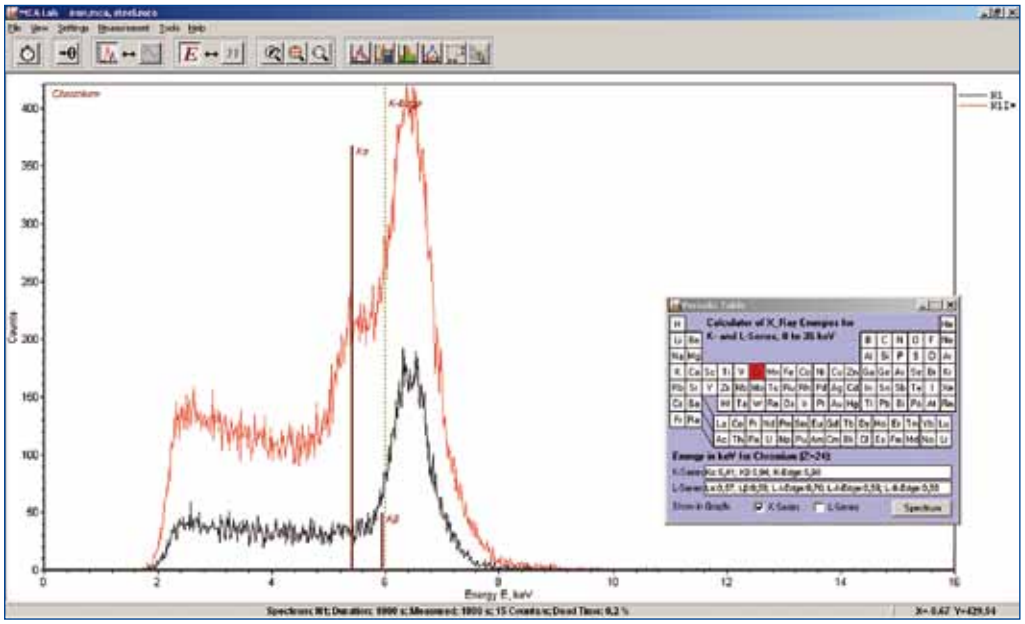
9983-1008629



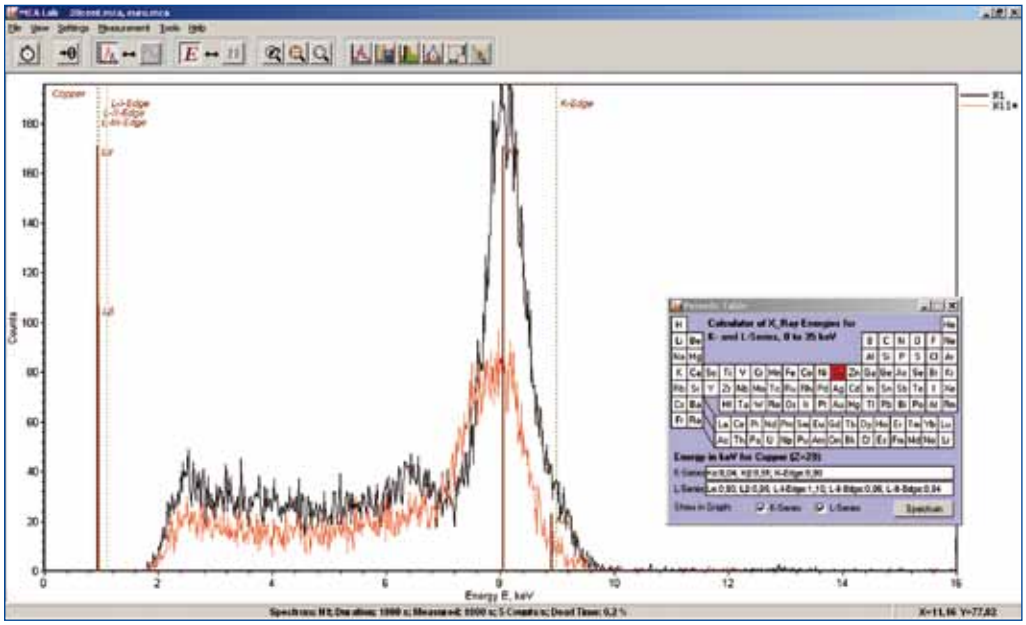
www.EngineeringBooksPDF.com



Energy spectrum of a copper anode



Comparing the x-ray fluorescence spectra of iron (black) and stainless steel (red)



Comparing the x-ray fluorescence spectra of two different coins

www.EngineeringBooksPDF.com



9983-1000628



9983-1000635
9983-1000634



9983-1000668



Ionization Chamber

Intended for investigating the ionization of air and other gases brought about by X-radiation at different pressures (saturation characteristics, model of a Geiger-Müller tube, dosimetry). Possesses a cylinder-shaped cathode, rod-anode and hose shaft for evacuating and introducing gases.

Operating voltage:	max. 2 kV
Ionization current:	10^{-11} – 10^{-10} A
Rod-electrode:	approx. 75 mm long
Chamber:	approx. 85 mm x 25 mm diam.
Hose shaft:	approx. 5 mm diam.

9983-1000668

Additionally required:
9983-1000628 Pico-Ammeter Amplifier

Set of Fluorescence Samples

Set of 7 samples for material analysis with the X-ray energy detector (9983-1008629). The material composition can be determined from the energies of the appropriate X-ray fluorescence lines. Thus, for example the difference between stainless and low carbon steel, or between copper, brass and bronze can be seen clearly.

Materials:
Stainless Steel S321, Low Carbon Steel, Copper C101, Brass C260, Bronze C220, Zinc and Lead.

9983-1012868



9983-1012868

Pico-Ammeter Amplifier

Current amplifier for measuring electrical currents in the pico-ampere range. With zero-point adjustment; the measured currents can be fed via the voltage output to an XY-recorder, interface or other measuring device. Includes a jack.

Measuring ranges:	0 to ±200 nA 0 to ±20 nA 0 to ±2 nA 0 to ±200 pA via a BNC jack
Additionally:	0 to ±200 µA via a jack
Voltage output:	0 to 1V, proportional to the set measuring range via 4 mm jacks
Dimensions:	170x105x45 mm³

9983-1000628

Additionally required:
9983-1000635 Plug in Power Supply TEL (230 V, 50/60 Hz)
or
9983-1000634 Plug in Power Supply TEL (115 V, 50/60 Hz)

Plug in Power Supply TEL

Plug in Power supply with an electronically regulated output voltage. Connecting lead with a 6-pole, self locking special plug.

Lead length:	approx. 1 m
Output:	12 VDC, 400 mA

Plug-in Power Supply TEL (230 V, 50/60 Hz)

9983-1000635

Plug-in Power Supply TEL (115 V, 50/60 Hz)

9983-1000634

Filmpack 2

Highly sensitive film (38x35 mm²) for α-, β- and X-radiation. Single packaging in opaque plastic cases allows development and fixing in daylight (duration: approx. 6 minutes).

Contents:
20 film sheets (38x35 mm²) in light-tight plastic cases
1 bottle of X-ray developer
1 bottle of X-ray fixer
1 syringe with a cannula for introducing chemicals into the film cases
1 metal clip

9983-1000669

Filmpack 4

Like 9983-1000669, but consisting of 12 film sheets, 150x12 mm², in light-tight plastic cases for a Debye-Scherrer camera.

9983-1000670

9983-1000669 9983-1000670



www.EngineeringBooksPDF.com

Geiger-Müller Counter Tube

Self-quenching halogen pulse ionisation chamber for detecting alpha, beta, gamma and x-ray radiation. In metal housing with mica window, removable mounting clamp with shaft. Long plateau length.

Filling:	Neon/argon mixture, halogen as quenching agent
Cathode dimensions:	approx. 39x14 mm²
Window:	mica, 9 mm diam.
Mass per unit area:	1.5 – 2.0 mg/cm²
Plateau length:	400 V – 600 V
Operating voltage:	400 – 600 V (recommended: 500 V)
Relative plateau slope:	0.04 %/V
Dead time:	90 µs
Limiting resistor:	10 MΩ, integrated in holder
Shaft:	approx. 100 mm x 10 mm diam.
Dimensions counter tube:	approx. 85 mm x 25 mm diam.
Weight:	approx. 160 g

9983-1001035



9983-1001035

Additionally required:

9983-1002746 HF Patch Cord, 1 m
9983-1001033 Digital Counter (230 V, 50/60 Hz)
or
9983-1001032 Digital Counter (115 V, 50/60 Hz)

Digital Counter

Digital counter/timer for measuring duration of motion, transition times, periods, pendulum periods and frequencies, as well as for counting events or Geiger tube pulses. Includes a speaker that can be turned on and off, power supplies for direct connection to light barriers (9983-1000563) or for powering a Geiger-Müller counter (9983-1001035). For event counting, a fixed counting period can be programmed in a range from 1 s to 99999 s. Counter events (start, stop) can either be triggered by a signal to the input sockets or manually via switches. Includes plug-in power supply.

Time measurement:	0.1 ms – 99999 s
Resolution:	0.1 ms / 1 ms / 0.1 s
Frequency measurement:	1 – 100 kHz, where voltage > 1.5 V_{pp}
Resolution:	1 mHz (1 – 100 Hz), 1 Hz (1 – 100 kHz)
Counting periods:	1/10/60/100 s or manually triggered
Input A:	miniDIN 8 socket, 4 mm safety sockets
Input B:	miniDIN 8 socket, 4 mm safety sockets
Input voltage A:	0.5 V – 15 V AC
Input voltage B:	1 V – 15 V AC
Active edge	Rising/falling
Counter tube input:	BNC socket
Power supply:	550 V / 1 MΩ
Display:	5-digit LED display
Operating voltage:	9 – 12 V DC via plug-in power supply
Dimensions:	250x100x160 mm³ approx.
Weight:	0.8 kg approx.

Digital Counter (230 V, 50/60 MHz)

9983-1001033

Digital Counter (115 V, 50/60 MHz)

9983-1001032



9983-1002722

Geiger Counter

Versatile, easy to use and compact precision instrument for measuring α-, β- and γ-radiation. With filter selection switch at the front of the Geiger-Müller counter tube for filtering out types of radiation (γ/β, γ/α/β or γ only), large display and integrated USB interface. Including USB cable, Windows software, and operating instructions. The following functions and operating modes are available for measurement:

- Standard mode for displaying the current radiation level. Display of the equivalent dose as a numerical value and as bar chart and display of the time until a selected cumulative dose limit is reached (default 5 µSv/h). Also equipped with variable acoustic and optical warning threshold signal and display of average radiation from previous day.
- Pulse counting either permanent or with variable gate time. Gate time adjustable in seconds, minute or hours. Additional optional acoustic count indication.
- Count rate measurement. The pulses registered are measured successively and converted into a count rate (number of pulses per second).
- Integrated display of date and time for correct recording of measured radiation.
- The number of pulses registered is stored in the internal memory. This facilitates recording e.g. of weekly values for up to 10 years.
- Computer docking station. The software enables the measured data to be evaluated and processed on an MS-Windows PC.

Radiation types:	α from 4 MeV, β from 0.2 MeV, γ from 0.02 MeV
Measured variables:	equivalent dose in Sv/h, mSv/h, µSv/h pulses/s, pulses/variable time interval
Display:	LCD, 4 digit, numerical with display of measured variable, quasi analogue bar chart, operating mode indicators
Radiation detector:	End window Geiger-Müller counter tube, stainless steel housing with neon-halogen filling
Measuring length:	38.1 mm
Measuring diameter:	9.1 mm
Mica window:	1.5 – 2 mg/cm²
Gamma sensitivity:	114 pulses/min for ^{60}Co radiation = 1 µSv/h in background radiation energy band
Background rate:	10 pulses per minute approx.
Internal memory:	2 kilobytes
Battery life:	3 years approx.
Dimensions:	163x72x30 mm³ approx.
Weight:	155 g approx.

9983-1002722



9983-1001035

9983-1001033 / 9983-1001032

www.EngineeringBooksPDF.com

Important Note:
In accordance with radiation protection regulations, anyone who works with radioactive materials or ionising radiation or plans to do so has the following obligations:

- Avoid unnecessary exposure to radiation or contamination of persons or of the environment.
- Ensure that any unavoidable exposure to radiation or contamination of persons or of the environment is below the limits specified by the regulations and is reduced to the minimum that is possible with present science and technology, taking into account all the circumstances of the case.



9983-1012894

Dosimeter Radex RD 1706

Used for determining dose rates in µSv/h for β-, γ- and X-rays, this radiation meter can be operated by non-professionals while nonetheless offering the features of a professional dosimeter. Including two built-in Geiger-Müller counter tubes and a large, illuminated LCD display.The device measures the activity of β-and γ-particles and uses the results to calculate the dose rate. Depending on dose rate, the measurement and calculation times vary from 26 s to 1 s at high dose rates. Detection of each particle is indicated by an audio signal to facilitate searching for radioactive sources. The difference between the mean dose rate and background radiation level, as well as the background radiation level itself are displayed in the “background” mode. This facilitates, for example, inspections of enclosed spaces and building materials. Overshoot of an adjustable alarm threshold can be indicated either by an audio signal or a vibration signal. Measured values remain saved after the device has been turned off.

Counters:	Two GM counter tubes SBM20-1
Measurement variable:	Ambient equivalent dose rate H*(10)
Measuring range:	0.05…999.0 µSv/h
Alarm threshold:	Adjustable from 0.10 to 99.0 µSv/h
Alarm:	Audio or vibration signal
Measurement and calculation times:	26 s 1 s (at H*(10) > 3.5 µSv/h)
Value display duration:	Continuous
Energy detection range	
X-radiation and γ-radiation:	0.03 to 3.0 MeV
β-radiation:	0.25 to 3.5 MeV
Batteries:	1.5 V, AAA (1 x or 2 x)
Operating time:	500 h, with 2 batteries (1350 mAh) under normal conditions
Dimensions:	105x60x26 mm³
Weight (without batteries):	90 g

9983-1012894



9983-1000918

Spintharioscope

Detection instrument for observing scintillations produced by radioactive decay. When a radiation cartridge (^{226}Ra, 4 kBq, 9983-1006797) is screwed into the instrument so that its radiation outlet is directed downwards onto the exposed zinc sulphide screen, it is possible to look through the eyepiece of the instrument in total darkness and observe the random light flashes that are caused by radioactive decay.

9983-1000918

Additionally required:
9983-1006797 Radiation Cartridge, ^{226}Ra, 4 kBq



9983-1000921

Cloud Chamber

Expansion cloud chamber for observing the paths of α-rays. Cover and sidewall are of plexiglas. With threaded hole for inserting the ^{226}Ra, 4 kBq radiation cartridge (9983-1006797), hinged absorption foil for opening and closing the beam outlet and carrying handle at the side. By compressing the attached rubber ball and then allowing it to expand, a supersaturated methanol-water mixture is produced in the cloud chamber. Following that, the paths of the α-rays revealed by droplet formation are visible for 1 – 2 seconds in the light of an optical lamp.

9983-1000921

Additionally required:
9983-1006797 Radiation Cartridge, ^{226}Ra, 4 kBq



9983-1006797

Radiation Cartridge, ^{226}Ra, 4 kBq

Regulation-exempt radiation source with brass container for shielding. Radium sulphate rolled in gold foil and sealed at one end of a stainless steel cartridge.

Activity:	4 kBq
Weight:	400 g approx.

9983-1006797

www.EngineeringBooksPDF.com

NaI(Tl) Scintillation Detector

An energy-sensitive detector for identifying γ-ray and X-ray fluorescent radiation with high probability. It can record energy spectra, which can be calibrated, and measure the relative intensity of the radiation. Incoming radiation causes a thallium-doped sodium iodide crystal to emit brief pulses of light, which are then converted into electrical pulses in proportion to the energy of the radiation by means of a photomultiplier affixed to the apparatus. The crystal is protected against light penetrating from outside by a thin aluminium cover. The photomultiplier is protected from interference by external magnetic fields by means of mu-metal shielding.

Relative energy resolution:	8% approx. at 662 keV
Connector socket:	14-pin, with centring aid
Dimensions of crystal :	51 mm x 51 mm diam. approx.
Aluminium cover:	0.5 mm approx.
Overall dimensions	185 mm x 58 mm diam. approx.

9983-1008707

Additionally required:
9983-1008708 NaI Operating and Evaluation Unit

Additionally recommended:
9983-1006797 Radiation Cartridge, ^{226}Ra, 4 kBq



9983-1008708

9983-1008707

Warning Notice: "Radioactive"

Warning notice on white plastic. On stem.

Dimensions:	210x300 mm² approx.
Weight:	80 g approx.

9983-1000919

Steel Safe for Radioactive Materials

Steel safe for theft proof storage of radioactive materials in accordance with radiation protection requirements.

Dimensions:	140x300x360 mm³ approx.
Weight:	3 kg approx.

9983-1000920



9983-1000919

9983-1000920

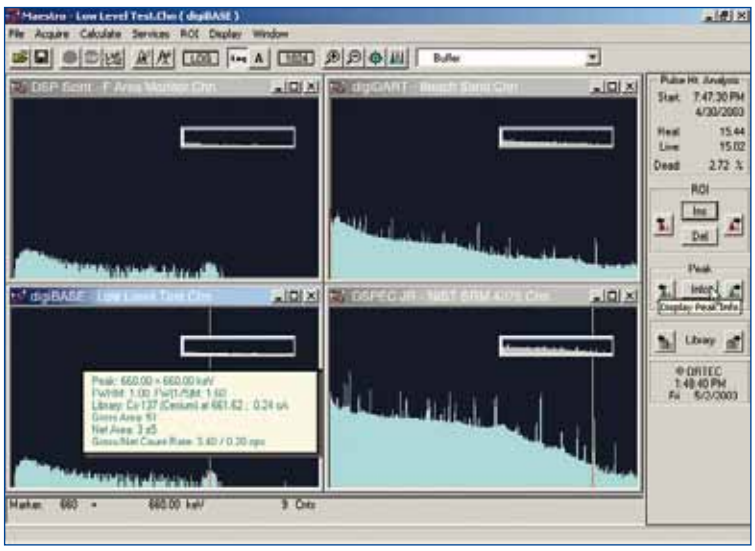
NaI Operating and Evaluation Unit

Complete apparatus for operation and evaluation, designed for measurement and comprehensive evaluation of energy spectra. Consists of a 14-pin connector stage with a high-voltage power supply for the photomultiplier of an NaI(Tl) scintillation detector. Possesses an integrated amplifier with pulse-shaping capability and digital signal processing for four-channel analysis. The power supply for the complete unit is provided via the USB port of a PC. Includes MAESTRO 32 measurement and evaluation software for a PC. The measurement and evaluation software has a versatile graphic user interface, supports identification of the measured radiation energies with the aid of integrated libraries and allows for the setting of all measurement parameters, including the high-voltage supply, from the PC.

Resolution:	1024 channels
Amplification:	1, 3 or 9 (coarse) 0.4 –1.2 (fine)
Integral non-linearity:	<0.05% over 99% of the range
Differential non-linearity:	<1% over 99% of the range
Effect of lag:	<5% for less than 50000 events per second
High-voltage supply:	0 to 1200 V DC
Amplifier drift:	$<0.15 \times 10^{-3}$ per °C
Offset drift:	$<0.05 \times 10^{-3}$ per °C
Pulse shaping:	0.75 – 2 µs

9983-1008708

Screenshot of the measurement and evaluation software MAESTRO 32



www.EngineeringBooksPDF.com



Power Supply for Optical Lamps
Powerful electronic power supply, e.g. for the operation of lamps as used in optics. Short circuit proof, with connection leads and two cascadable 4 mm safety plugs.
Output: 12 V, max. 5 A

Transformer 12 V, 60 VA (230 V, 50/60 Hz)
Dimensions: approx. 100x45x70 mm³

9983-1000593

Transformer 12 V, 60 VA (115 V, 50/60 Hz)
Dimensions: approx. 75x45x45 mm³

9983-1006780

Transformer 12 V, 25 VA
Simple transformer for student exercises. Short circuit proof, with connection leads and two cascadable 4 mm safety plugs.
Output: 12 V AC, max. 2 A
Dimensions: approx. 110x95x65 mm³
Weight: approx. 0.64 kg

Transformer 12 V, 25 VA (230 V, 50/60 Hz)

9983-1000866

Transformer 12 V, 25 VA (115 V, 50/60 Hz)

9983-1000865



Plug In Power Supply 24 V, 700 mA
Plug in 24 V power supply for the operation of a Pohl torsion pendulum (9983-1002956). With 2 m lead and two stackable 4 mm safety plugs.
Output: 24 V AC, max. 700 mA

Plug In Power Supply 24 V, 700 mA (230 V, 50/60 Hz)

9983-1000681

Plug In Power Supply 24 V, 700 mA (115 V, 50/60 Hz)

9983-1000680



Plug-In Power Supply, 12 V AC
Plug-in power supply with 5.5x2.5-mm co-axial power connector.

Art. No.	Voltage	Max. current	Mains voltage
9983-1012900	12 V AC	2000 mA	230 V, 50/60 Hz
9983-1012899	12 V AC	2000 mA	115 V, 50/60 Hz
9983-1001014	12 V AC	750 mA	230 V, 50/60 Hz
9983-1009545	12 V AC	500 mA	115 V, 50/60 Hz

www.EngineeringBooksPDF.com



9983-1003558
9983-1003557

Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A

Safety isolating transformer with safety cut out contained in metal housing. Output voltage switchable in 7 steps

AC output:	2/ 4/ 6/ 8/ 10/ 12/ 14 V, max. 5 A
DC output:	2/ 4/ 6/ 8/ 10/ 12/ 14 V, max. 5 A
Terminals:	4 mm safety sockets
Dimensions:	approx. 260x140x130 mm³
Weight:	approx. 3.1 kg

Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A (230 V, 50/60 Hz)

9983-1003558

Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A (115 V, 50/60 Hz)

9983-1003557

9983-1002772



Voltage Regulating Transformer (230 V, 50/60 Hz)

High performance voltage regulating transformer with high load capacity and continuously adjustable AC output voltage. Two digital rms displays for current strength and output voltage. Thermally protected against overload with an overcurrent circuit breaker. Output electrically isolated from mains input.

Output:	0–260 V AC, max. 3 A
Overload protection:	Thermal
Display:	3 digit LCD
Connection:	earthed socket outlet
Power:	780 VA
Voltage supply:	230 V ±10% 50/60 Hz
Dimensions:	approx. 250x235x178 mm³
Weight:	approx. 20 kg

9983-1002772



9983-1001010
9983-1001009

Transformer with Rectifier 1/ 2/ 3/…12 V, 6 A

Low-voltage power supply with excess voltage circuit breaker in plastic case. Output voltage can be switched between 12 levels.

AC output:	1/ 2/ 3/ 4/ 5/ 6/ 7/ 8/ 9/ 10/ 11/ 12 V, max. 6 A
DC output:	1/ 2/ 3/ 4/ 5/ 6/ 7/ 8/ 9/ 10/ 11/ 12 V, max. 6 A
Terminals:	4 mm safety sockets
Dimensions:	approx. 190x210x160 mm³
Weight:	approx. 3 kg

Transformer with Rectifier 1/ 2/ 3/…12 V, 6 A (230 V, 50/60 Hz)

9983-1001010

Transformer with Rectifier 1/ 2/ 3/…12 V, 6 A (115 V, 50/60 Hz)

9983-1001009



9983-1003316
9983-1003315

Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A

Extra low voltage power supply with overload protection contained in plastic housing. Output voltage switchable in four stages.

AC output:	3/ 6/ 9/ 12 V, max. 3 A
DC output:	3/ 6/ 9/ 12 V, max. 3 A
Terminals:	4 mm safety sockets
Dimensions:	approx. 210x170x90 mm³
Weight:	approx. 2.6 kg

Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (230 V, 50/60 Hz)

9983-1003316

Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (115 V, 50/60 Hz)

9983-1003315

www.EngineeringBooksPDF.com



9983-1002776
9983-1002775

AC/DC Power Supply 0–12 V, 3 A

Extra low voltage power supply for training and demonstration experiments with continuously adjustable, stabilised and regulated DC output voltage and illuminated, analogue display panel. DC voltage output is short circuit proof and noise voltage proof. Four AC outputs galvanically isolated from the DC voltage outputs are overload protected via semiconductor fuses (multifuses).

DC output:	0–12 V, max. 3 A
Stability under full load:	≤20 mV
Residual ripple under full load:	≤2 mV
Analogue display:	class 2.5
AC outputs:	3, 6, 9, 12 V, max. 3 A
Terminals:	4 mm safety sockets
Dimensions:	approx. 230x115x190 mm³
Weight:	approx. 3.5 kg

AC/DC Power Supply 0–12 V, 3 A (230 V, 50/60 Hz)

9983-1002776

AC/DC Power Supply 0–12 V, 3 A (115 V, 50/60 Hz)

9983-1002775



9983-1001007
9983-1001006

AC/DC Power Supply 0–12 V, 3 A, stab.

Extra low voltage power supply for student exercises with continuously adjustable, stabilised DC voltage or stabilised AC voltage. Selection between DC and AC output voltage is performed using a toggle switch.

DC output:	0–12 V, max. 3 A, stabilised
AC output:	0–12 V, max. 3 A, stabilised
Dimensions:	approx. 160x170x65 mm³
Weight:	approx. 2.9 kg

AC/DC Power Supply 0–12 V, 3 A, stab. (230 V, 50/60 Hz)

9983-1001007

AC/DC Power Supply 0–12 V, 3 A, stab. (115 V, 50/60 Hz)

9983-1001006



9983-1002769



9983-1003562
9983-1003561

AC/DC Power Supply 0–30 V, 5 A (230 V, 50/60 Hz)

Continuously adjustable AC/DC power supply unit with digital displays for voltage and current readings, particularly suitable for experiments for students and trainees. The outputs are galvanically isolated. A pushbutton can be used to turn the capacitor filtration of the output direct voltage on and off (smoothing). In the event of an overload, the device is turned off by a thermal overload protection switch.

DC output:	0–30 V, max. 5 A
AC output:	0–30 V, max. 5 A
Max. output power:	150 VA
Display:	2x 3 digit LED
Digit height:	15 mm
Connections:	4 mm jacks
Dimensions:	approx. 280x205x140 mm³
Weight:	approx. 8.3 kg

9983-1002769

AC/DC Power Supply 0–20 V, 0–5 A

Power supply with adjustable and stabilised DC voltage and analogue voltage and current display for DC voltage. The DC voltage component features an automatically alternating voltage and current control and is protected against continuous short circuits. The AC voltage can be selected in eight steps, the output is protected by an overcurrent circuit breaker. The AC and DC voltage outputs are DC isolated. A temperature regulated fan protects the unit from overheating.

DC output:	0–20 V, 0–5 A
AC output:	2, 4, 6, 8, 10, 12, 15, 20 V, max. 5 A
Ripple U:	<10 mV
Dimensions:	approx. 235x175x245 mm³
Weight:	approx. 8 kg

AC/DC Power Supply 0–20 V, 5 A (230 V, 50/60 Hz)

9983-1003562

AC/DC Power Supply 0–20 V, 5 A (115 V, 50/60 Hz)

9983-1003561

www.EngineeringBooksPDF.com



9983-1008691
9983-1008690

AC/DC Power Supply 1/ 2/ 3/…15 V, 10 A

AC and DC power supply adjustable to various levels and housed in metal case. Particularly suitable for experiments by pupils and for lab practicals. Features stabilised DC voltages. Outputs are galvanically isolated and short-circuit-proof.

DC output:	1/ 2/ 3/ 4/ 5/ 6/ 7/ 8/ 9/ 10/ 11/ 12/ 13/ 14/ 15 V, max. 10 A
AC output:	1/ 2/ 3/ 4/ 5/ 6/ 7/ 8/ 9/ 10/ 11/ 12/ 13/ 14/ 15 V, max. 10 A
Max. output power:	150 VA
Connections:	4 mm jacks
Dimensions:	approx. 170x160x250 mm³
Weight:	approx. 6.3 kg

AC/DC Power Supply 1/ 2/ 3/…15 V, 10 A (230 V, 50/60 Hz)

9983-1008691

AC/DC Power Supply 1/ 2/ 3/…15 V, 10 A (115 V, 50/60 Hz)

9983-1008690



9983-1003560
9983-1003559

DC Power Supply 1.5–15 V, 1.5 A

Handy DC power supply contained in a sturdy metal housing. The output voltage is continuously adjustable and is displayed via an analogue measuring instrument. The output is short circuit proof and floating.

Output voltage:	1.5–15 V, max. 1.5 A
Residual ripple:	10 mV
Terminals:	4 mm safety sockets
Dimensions:	approx. 100x80x150 mm³
Weight:	approx. 2 kg

DC Power Supply 1.5–15 V, 1.5 A (230 V, 50/60 Hz)

9983-1003560

DC Power Supply 1.5–15 V, 1.5 A (115 V, 50/60 Hz)

9983-1003559



9983-1008535
9983-1008534

DC Power Supply 450 V

Power supply with three outputs for the electric supply in experiments with the Electrometer (9983-1001025 resp. 9983-1001024).

Output 1:	
Voltage:	0–450 V DC
Max. current:	10 µA
Output 2:	
Voltage:	1.2–12 V DC
Max. current:	100 mA
Output 3:	
Voltage:	0–12 V AC
Max. current:	10 mA
Dimensions:	approx. 250x100x160 mm³
Weight:	approx. 0.8 kg

DC Power Supply 450 V (230 V, 50/60 Hz)

9983-1008535

DC Power Supply 450 V (115 V, 50/60 Hz)

9983-1008534



9983-1003593
9983-1008692

AC/DC Power Supply, 0–30 V, 0–6 A

Combined power supply with separate AC and DC outputs plus separate displays of output voltage and current. The DC output can be used as a voltage source or current source and can be set to any value within its range. The AC output features current limiting and is electronically protected against overload.

DC voltage:	0…30 V
DC current:	0…6 A
AC voltage:	0…30 V
AC current:	max. 6 A
Dimensions:	380x140x300 mm³ approx.
Weight:	12 kg approx.

AC/DC Power Supply 0–30 V, 0–6 A (230 V, 50/60 Hz)

9983-1003593

AC/DC Power Supply 0–30 V, 0–6 A (115 V, 50/60 Hz)

9983-1008692

www.EngineeringBooksPDF.com



9983-1002763
9983-1002762

DC Power Supply

Universal power supply with a digital display for voltage and current. The output voltage and current are continuously adjustable. The device can be used as a constant voltage supply with current limiting or a constant current supply with voltage limiting. Two or more devices can be operated in parallel or series.

Display:	2x 3 digit LED
Accuracy:	1% + 2 digits for *U*, 1% + 4 digits for *I*
Terminals:	4 mm safety sockets
Dimensions:	approx. 210x132x255 mm³

	9983-1002761 9983-1002760	9983-1002763 9983-1002762
Output voltage	0–16 V	0–32 V
Output current	0–10 A	0 –2.5 A
Output power	160 W	80 W
Stability under full load	≤10 mV	≤10 mV
Residual ripple	≤4 mV	≤4 mV
Weight	ca. 5.9 kg	ca. 5.3 kg

DC Power Supply 0–16 V, 0 – 10 A (230 V, 50/60 Hz)
9983-1002761

DC Power Supply 0–32 V, 0 – 2.5 A (230 V, 50/60 Hz)
9983-1002763

DC Power Supply 0–16 V, 0 – 10 A (115 V, 50/60 Hz)
9983-1002760

DC Power Supply 0–32 V, 0 – 2.5 A (115 V, 50/60 Hz)
9983-1002762



9983-1002771

DC Power Supply 0–16 V, 0–20 A

DC high current power supply with digital display of voltage and current. The voltage and current are continuously adjustable by means of coarse and fine controllers. The device can be used as a constant voltage source with current limiting, or a constant current source with voltage limiting. The selected operating mode is indicated by an LED on the front panel. High reliability even under extremely adverse conditions is ensured by automatic transformer switchover, MOSFET power amplifiers and temperature controlled fan speed with monitoring function. This equipment is also provided with a preset function for protecting against excess current and voltage. The design of the device omits any air vents at the top or bottom and does not require an external heat sink. The output is protected against sustained short circuits. Two or more such units can be operated in series or in parallel.

DC output:	0–16 V, 0–20 A
Fine adjustment range *U*:	800 mV
Stability at 0–100% load:	<12 mV
Residual ripple:	<1 mV
Fine-adjustment range *I*:	2 A
Connections:	4 mm jacks
Mains connection:	115 V/230 V, 50/60 Hz
Dimensions:	approx. 240x120x300 mm³
Weight:	approx. 10 kg

9983-1002771



9983-1003312
9983-1003311

DC Power Supply 0–20 V, 0–5 A

Universal power supply with digital current and voltage display. Output voltage and output current are continuously adjustable. The device can be used as a constant voltage source with current limiting or as a constant current source with voltage limiting.

DC output:	0–20 V, 0–5 A
Output power:	100 W
Stability under full load	≤0.01% + 5 mV, ≤0.2% + 5 mA
Residual ripple	≤1 mV, 3 mA
Display:	2x 3 digit LED
Terminals:	4 mm safety sockets
Dimensions:	approx. 130x150x300 mm³
Weight:	approx. 4.7 kg

DC Power Supply 0–20 V, 0–5 A (230 V, 50/60 Hz)
9983-1003312

DC Power Supply 0–20 V, 0–5 A (115 V, 50/60 Hz)
9983-1003311



9983-1012857
9983-1012858

DC Power Supply 1–32 V / 0–20 A

High-quality switched-mode power supply in space-saving housing with intelligent control of fan speed to ensure safe and quiet operation. Simple, precise and fast adjustment of voltage and current levels with dual-function rotary knobs for coarse and fine adjustment. Adjustable current limiting in open circuit. Three user-definable stored configurations for voltage and current limiting make it easy to recall frequently used settings. Full remote control of voltage and current plus output which can be turned on and off.

Display	3-digit, 15 mm, green LED
Output voltage	1–32 V DC
Output current:	0–20 A (output with pole terminals on rear) 0–5 A (output with 4-mm safety sockets on front)
Max. power output:	640 W
Residual ripple:	5 mV rms
Efficiency:	> 87.0 %
Dimensions:	200x90x255 mm
Weight:	2.6 kg

DC Power Supply, 1–32 V / 0–20 A (230 V, 50/60 Hz)
9983-1012857

DC Power Supply, 1–32 V / 0–20 A (115 V, 50/60 Hz)
9983-1012858

www.EngineeringBooksPDF.com



9983-1003308
9983-1003307



9983-1003310
9983-1003309



9983-1001012
9983-1001011

DC Power Supply 0–500 V

Low voltage power supply with four outputs primarily intended to supply power for electron tubes and Helmholtz coils simultaneously, with four independently adjustable DC voltages and analogue dials for each of them. The DC voltages are stabilised and regulated, floating and galvanically isolated from one another, short circuit proof and secure from external voltages.

500 V output:	Voltage:	0–500 V DC, max. 50 mA
	Stability at full load:	≤ 0,01 % ±100 mV
	Residual ripple:	≤ 20 mV
50 V output:	Voltage:	0–50 V DC, max. 50 mA
	Stability at full load:	≤ 0.1 % ±30 mV
	Residual ripple:	≤ 5 mV
8 V output:	Voltage:	0–8 V DC, max. 3 A
	Residual ripple:	≤ 0.1 % ±30 mV
	Overload protection:	Thermal cut-out
12 V output:	Voltage:	0–12 V DC, max. 4 A
	Residual ripple:	≤ 0.1 % ±30 mV
	Overload protection:	Thermal cut-out
Displays:	Analogue, class 2	
Connections:	4 mm safety sockets	
Power consumption:	50 VA	
Dimensions:	85x325x190 mm³ approx.	
Weight:	4 kg approx.	

DC Power Supply 0–500 V (230 V, 50/60 Hz)

9983-1003308

DC Power Supply 0–500 V (115 V, 50/60 Hz)

9983-1003307

High Voltage Power Supply 5 kV

Universally applicable, floating, high-voltage source for operation of electron tubes. With built in, high voltage resistant transformer to supply the heater voltage for electron tubes. Continuously adjustable high voltage, safe to touch, with passive current limitation and analogue voltage display.

High voltage output:	0–-5000 V DC, max. 2 mA
Heater voltage output:	6.3 V AC, max. 3 A, high voltage resistant up to 6 kV
Overload protection:	Primary: fuse Secondary: current-limiting resistors
Connections:	4 mm safety sockets
High-voltage display:	Analogue
Dimensions:	235x130x155 mm³ approx.
Weight:	3.5 kg approx.

High Voltage Power Supply 5 kV (230 V, 50/60 Hz)

9983-1003310

High Voltage Power Supply 5 kV (115 V, 50/60 Hz)

9983-1003309

DC Power Supply 0–300 V

Low voltage power supply to supply voltages for operating narrow electron beam tubes (9983-1000904) or training oscilloscope (9983-1000902). The DC voltages 0–-50 V and 0–+300 V have a common zero volt ground so that DC voltages of up to 350 V can be supplied. In addition, a ramp generator is available for generating an adjustable, temporally linear rising or falling voltage. For this reason, experiments on the law of induction and the charging and discharging of capacitors can also be carried out.

Outputs:	0–300 V DC, max. 200 mA/ 0–-50 V DC, max. 10 mA/ 4–12 V DC, max. 400 mA
Ramp generator:	2.5–50 V/s, linear rising or falling
Operating voltage:	230/115 V AC, 50 (60) Hz
Connections:	4 mm safety sockets
Dimensions:	240x230x170 mm³ approx.
Weight:	3.7 kg approx.

DC Power Supply 0–300 V (230 V, 50/60 Hz)

9983-1001012

DC Power Supply 0–300 V (115 V, 50/60 Hz)

9983-1001011

High Voltage Power Supply 6 kV

Universally applicable, floating, high voltage source for electrostatic experiments or operation of spectrum tubes, gas discharge tubes and electron tubes. With built in, high voltage resistant transformer to supply the heater voltage for electron tubes. Continuously adjustable high voltage, safe to touch, with passive current limitation and digital voltage display.

High voltage output:	0–6000 V DC, max. 2 mA
Heater voltage output:	6.3 V AC, max. 3 A, high-voltage resistant up to 6 kV
Overload protection:	Miniature fuse 3 A, slow-blow
Connections:	4 mm safety sockets
Power consumption:	50 VA
High-voltage display:	3 digit LED
Dimensions:	140x285x220 mm³ approx.
Weight:	6 kg approx.

High Voltage Power Supply 6 kV (230 V, 50/60 Hz)

9983-1003141

High Voltage Power Supply 6 kV (115 V, 50/60 Hz)

9983-1003140



9983-1003141
9983-1003140

www.EngineeringBooksPDF.com



9983-1009957
9983-1009956

FG 100 Function Generator

Externally controllable function generator with power amplifier for use in practical and school experiments studying simple harmonic oscillation, alternating current and induction. Featuring illuminated, digital display for frequency, signal form, offset and other parameters. The output is short-circuit protected as well as being protected against induced voltages and spark discharges, e.g. for when experiment leads are unintentionally pulled out while coils are connected. In internal sweep mode, one trigger pulse is output per cycle and the voltage output is proportional to the frequency. With retractable feet. Includes power supply.

Signals:	
Frequency range:	0.001 Hz to 100 kHz
Signal forms:	Sine, square, triangular
Offset:	0 to ±5 V, adjustable in 0.1 V steps
Output:	
Output amplitude:	0 to 10 V, continuously adjustable
Power output:	10 W, permanent
Output current:	1 A, permanent, 2 A max.
Sweep:	
Sweep modes:	External, continuous internal, individual internal
Frequency range:	1 Hz to 100 kHz
Stop/start frequency ratio:	Max. 1000:1, e.g. 2 Hz to 2 kHz max.
Time range:	0.04 s to 200 s
External sweep:	Start via trigger pulse or application of 0 to 5 V control voltage
Max. modulation frequency: 200 Hz	
Internal sweep:	Start and stop via Start/Stop button One trigger output per cycle plus proportional voltage
General data:	
Power supply:	Plug-in power supply, 12 V AC, 2 A
Dimensions:	170x105x40 mm
Additional features:	Fold-out feet

FG 100 Function Generator (230 V, 50/60 Hz)

9983-1009957

FG 100 Function Generator (115 V, 50/60 Hz)

9983-1009956

Function Generator 0.02 Hz–2 MHz

Multifunctional function generator with four different functions in a single device: function generator, sweep generator, pulse generator and 50 MHz frequency meter.

Frequency range:	0.02 Hz–2 MHz in 7 ranges
Accuracy:	±5%
Waveform:	Sine, square, triangle, pulse, saw-tooth, ramp
Signal outputs:	
Output voltage:	0– ±5 V_{PP}
Output impedance:	50 Ω ±5%
Attenuator:	0– 20 dB continuously adjustable and 20 dB fixed
Sinusoidal:	Ripple factor <1% (0.2 Hz–100 kHz)
Square-wave:	Rise time <120 ns
Triangular:	Linearity error <1% (0.2 Hz–100 kHz)
Rise time TTL:	<25 ns
Rise time CMOS:	<140 ns (max.)
Pulse duty factor:	1:1–10:1
Sweep generator:	
Sweep generator:	internal or external, linear
Sweep frequencies:	0.02 Hz–2 MHz (7 ranges)
Sweep time:	20 ms–2 s
Frequency meter:	
Frequency range:	200 mHz–50 MHz
Accuracy:	5% of reading ±1 Digit
Max. input voltage:	250 V_{pp}
Input impedance:	890 Ω
Display:	6-digit LED
Dimensions:	approx. 280x240x90 mm³
Weight:	approx. 2 kg

Function Generator 0.02 Hz–2 MHz (230 V, 50/60 Hz)

9983-1002744

Function Generator 0.02 Hz–2 MHz (115 V, 50/60 Hz)

9983-1002743





9983-1002744
9983-1002743

www.EngineeringBooksPDF.com



NEW

9983-1008677



9983-1001038

Two-Channel Function Generator, 20 MHz

Incorporating DDS (Direct Digital Synthesis) technology, this real, two-channel function generator generates stable, highly precise signals with low distortion. Waveforms can be selected in standard form with variable parameters including frequency, amplitude, offset and phase, or edited freely. Numerous modulation types are implemented. A frequency meter is integrated.

Channels:	2 independent channels with adjustable phase
Frequency range:	1 µHz…20 MHz (sine)
Standard signals:	Constant, sine, rectangular, ramp, pulse, exponential rise / fall, sync, white noise
Editable signals:	48 pre-configured forms (100 MSa/s, 14-bit vertical accuracy)
Modulation:	Amplitude (AM), frequency (FM), phase (PM), frequency shift keying (FSK), sweep, burst
Display:	LCD, 256 pixels x 64 pixels, 4 grey stages, graphic and alphanumeric
Frequency meter:	100 mHz to 200 MHz
Outputs:	Signals, synchronization signal, external modulation signal
Inputs:	External modulation signal, external 10-MHz signal, external trigger signal
Interface configurations:	USB device, USB host
Supply voltage:	100–240 V, 50/60 Hz
Dimensions:	approx.230x110x290 mm³
Weight:	approx.2.7 kg

9983-1008677

Sine Wave Generator

Sine wave generator with power output up to 16 W in a frequency range from 1 Hz to 100 kHz. The apparatus contains a preamplifier, which can be used in isolation (e.g. as a microphone amplifier) or with a power output stage connected downstream as a broadband amplifier (0 up to 100 kHz).

Sine wave generator with power output:

Frequency range:	1 Hz–100 kHz, in 5 decadic stages, scale with linear division
Frequency deviation:	<5 %
Output voltage:	0–6 V, adjustable
Max. output current:	10 A, short circuit proof
Max. output power:	16 W constant, 30 W temporary
Input impedance:	100 kΩ
Preamplifier:	
Gain factor:	1–300, continuously adjustable
Input:	AC coupled, with switchable microphone voltage
Max. output voltage:	10 V_{PP}
Max. output current:	15 mA, short circuit proof
Output impedance:	1 kΩ
Power amplifier:	
Voltage gain:	8.5
Operating voltage:	12 V AC
Dimensions:	approx. 160x160x50 mm³
Weight:	approx. 1.1 kg

9983-1001038

Additionally required:
9983-1000866 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
9983-1000865 Transformer 12 V, 25 VA (115 V, 50/60 Hz)

Power Function Generator

Function generator with external sweep capability including power amplifier designed to conduct experiments on simple harmonic oscillation, alternating current and induction. Can be used as a function generator, a stabilised current source or a power amplifier. Equipped with a digital frequency display showing value and unit and an electronic circuit to protect against capacitive and inductive overload.

Frequency display:	3½ digit LED display with 13 mm digit height
Unit display:	mHz, Hz, kHz
Function generator:	
Waveform:	Sinusoidal, triangular, square-wave
Frequency range:	10 mHz–100 kHz, 7 decades
Output voltage:	0–20 V, 10 mA, short-circuit proof
DC Offset:	0–±10 V
Internal resistance:	10 mΩ
Modulation:	FM and AM via external generator
Sweep range:	sweep through 7 decades
Power unit:	
Frequency range:	0–50 kHz
Input impedance:	1 MΩ || 60 pF
AF-gain:	10
Max. output power:	30 W
Dimensions:	approx. 125x170x225 mm³
Weight:	approx. 6.5 kg

Power Function Generator (230 V, 50/60 Hz)

9983-1001037

Power Function Generator (115 V, 50/60 Hz)

9983-1001036

9983-1001037
9983-1001036



www.EngineeringBooksPDF.com



9983-1002745

Analogue Oscilloscope, 1x10 MHz (230 V, 50/60 Hz)

Analogue single channel oscilloscope with all the functions and possible display modes of conventional dual beam analogue oscilloscopes. With a bandwidth of 10 MHz, this is a high performance device which is easy to operate, even for inexperienced users.

9983-1002745

Additionally recommended:
9983-1002777 Oscilloscope Probe 100 MHz



9983-1008695

Analogue Oscilloscope, 2x20 MHz (230 V, 50/60 Hz)

Robust, easy-to-operate dual channel oscilloscope with a bandwidth of 20 MHz. Includes 2 adapters and 2 BNC/4-mm safety plug connector cables.

9983-1008695

Additionally recommended:
9983-1002777 Oscilloscope Probe 100 MHz



9983-1002727

Analogue Oscilloscope, 2x30 MHz

Microprocessor controlled analogue oscilloscope for the display of rapid periodic signals. With SMART AUTOSET for both channels, which reproduces the last configuration used when the device is switched back on.

9983-1002727

Additionally recommended:
9983-1002777 Oscilloscope Probe 100 MHz



9983-1002729

Analogue Oscilloscope 2x150 MHz

Analogue dual channel oscilloscope with high bandwidth for accurate tracing of very fast periodic events. Including two scope probes.

9983-1002729



9983-1002728

Analogue/Digital Storage Oscilloscope 2x40 MHz

Analogue/digital storage oscilloscope for the display and storage of rapid periodic and aperiodic signals. With moveable cursors and 17 measurement functions. Fully equipped for direct PC and printer connection (RS232 interface).

Cursor measurements:	ΔV, Δt, 1/Δt, phase
Memory:	2048x8 Bit pro channel
Scan rate:	Single Shot: 50 MS/s
Glitch capture:	20 ns
Operating mode:	Roll Refresh, Single, XY-mode, Envelope, Average, Dot Join

9983-1002728

Additionally recommended:
9983-1002777 Oscilloscope Probe 100 MHz

www.EngineeringBooksPDF.com

	9983-1002745	9983-1008695	9983-1002727	9983-1002729	9983-1002728
Vertical deflection:					
Operation modes:	CH1, XY	CH1, CH2, -CH2, DUAL (ALT/CHOP) ADD, XY	CH1, CH2, -CH2, ALT, CHOP, ADD, XY	CH1, CH2, -CH2, ALT, CHOP, ADD, XY	CH1, CH2, -CH2, ALT, CHOP, ADD, XY
Bandwidth :	10 MHz	20 MHz	30 MHz	150 MHz	40 MHz
Rise time:	≤ 35 ns	≤ 17.5 ns	< 11.7 ns	≤ 2.3 ns	≤ 8.75 ns
Deflection coefficient:	5 mV/div.–5 V/div., 10 steps	5 mV/div. –20 V/div., 12 steps	5 mV/div.–20 V/div., 12 steps	2 mV/div.–5 V/div., 11 steps	5 mV/div.–20 V/div., 12 steps
Accuracy.	±3%	±3%	±3%	±3%	±3%
Input impedance:	1 MΩ ±3% // 25 pF ±5 pF	1 MΩ // 25 pF	1 MΩ // 25 pF	1 MΩ ±1% // 15 pF	1 MΩ // 25 pF
Horizontal deflection :					
Time coefficient :	100 ns/div.–100 ms/div., 19 steps	200 ns/div.–500 ms/div., 20 steps	50 ns/div.–200 ms/div., 21 steps	50 ns/div.–100 ms/div., 20 steps	10 ns/div.–200 s/div. (digital), 50 ns/div.–200 ms/div. (analogue)
Accuracy :	±3%	±5%	±3%	±3%	±2% (digital), ±3% (analogue)
Enhancement:	---	up to 10 ns/div.	up to 10 ns/div.	up to 5 ns/div.	up to 5 ns/div. (analogue)
Accuracy :	---	±10%	±5%	±5%	±5%
Triggering:					
Operation mode:	Auto, Normal, TV	Auto, Normal, TV-V, TV-H	Auto, Normal, TV	Auto, Normal, TV	Flanke +/-, TV
Trigger source :	Y INPUT, LINE, EXT	CH1, CH2, ALT, LINE, EXT	CH1, CH2, ALT, LINE, EXT	CH1, CH2, ALT, LINE, EXT	CH1, CH2, ALT, LINE, EXT
Trigger coupling :	DC	AC	DC, AC, LFR, HFR, TVV, TVH	DC, AC, LFR, HFR, TV ALL, TV CPT	DC, AC, LFR, HFR, TV
Data:					
Screen size:	48x60 mm²	80x100 mm²	80x100 mm²	80x100 mm²	80x100 mm²
Supply voltage :	230 V, 50/60 Hz	230 V, 50/60 Hz	94–264 V, 48–440 Hz	94–264 V, 48–440 Hz	94–264 V, 48–440 Hz
Dimensions:	approx. 278x215x85 mm³	approx. 435x330x160 mm³	approx. 435x330x163 mm³	approx. 435x330x163 mm³	approx. 435x330x163 mm³
Weight:	approx. 3 kg	approx. 5.5 kg	approx. 5.5 kg	approx. 5.5 kg	approx. 5.5 kg

Oscilloscope Probe, 100 MHz

Probe to extend the voltage measurement range of any standard commercial oscilloscope. A changeover switch allows selection of bandwidth. The device includes a channel identification terminal, spring-loaded terminal connection, ground lead, insulating cover tip, measuring tip, special tip for IC measurements, trimmer key and BNC adapter.

Bandwidth:	DC to 100 MHz (1:10), DC to 6 MHz (1:1)
Input resistance:	10 MΩ (1:10), 1MΩ (1:1)
Input capacitance:	16 pF (1:10), 90 pF (1:1)
Max. measuring voltage:	600 VDC, 600 VAC
Connection:	BNC plug
Cable length:	approx. 1.20 m

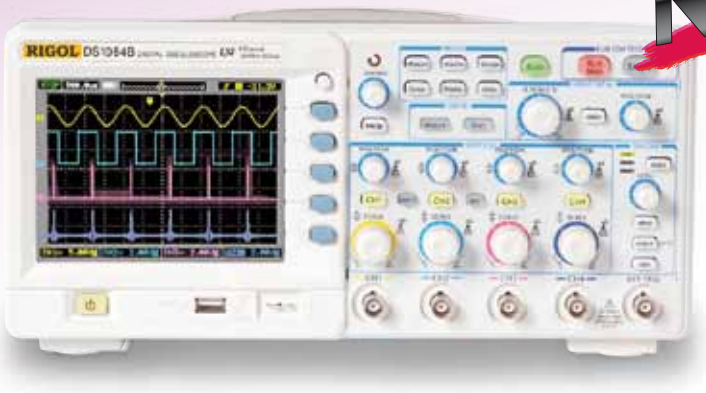
9983-1002777



9983-1002777

www.EngineeringBooksPDF.com

9983-1008676



NEW



9983-1012879



Digital Oscilloscope 4x60 MHz

Capable of simultaneously displaying four independent channels in colour, this digital oscilloscope offers the following functions: Storage and recall of measured signals, automatic measurement of up to 22 parameters, mathematical operations including fast Fourier transformation, delayed sampling, digital filtering. Including four probes, software and USB cable.

Inputs:	
Coupling:	DC, AC, GND
Impedance:	1 MΩ 1.2 MΩ (<254 mV AC)
Capacitance:	18 pF ± 3 pF
Probe attenuation factors:	0.001x–1000x
Maximum input voltage:	100 V_{rms}, 1000 V_{pp} (in CAT II)
Mathematical operations:	FFT, +, - , *
Vertical deflection:	
Deflection coefficient:	2 mV/div.–10 V/div., 12 stages
Offset range:	2 mV/div.–10 V/div.
Accuracy:	±4 % (2 mV/div.–5 mV/div.) ±3 % (10 mV/div.–10 V/div.)
A/D converter:	8-bit resolution
Bandwidth	60 MHz
Rise time:	<5.8 ns
Horizontal deflection:	
Time coefficient:	5 ns/div.–50 s/div., 31 stages
Trigger:	
Trigger sensitivity:	0.1 div.–1.0 div., adjustable
Trigger threshold:	±6 div. (internal), ±1.2 V (EXT), ±6 V (EXT/5)
Trigger hold-off:	100 ns–1.5 s
Operating mode:	Edge, pulse width, video, pattern and alternate trigger
Cursor measurements:	
Manual:	Voltage difference, time difference, reciprocal time difference
Track:	Voltage values for Y-axis Time values for X-axis
Automatic:	On-line
Automatic measurement:	
Measurement variables:	V_{pp}, V_{amp}, V_{max}, V_{min}, V_{top}, V_{base}, V_{avg}, V_{rms}, Overshoot, Preshoot, Freq, Period, Rise Time, Fall Time, +Width, -Width, +Duty, -Duty, Delay A→B-+, Delay A→B+-, Phase A→B+-, Phase A→B-+
General data:	
Display:	TFT-LCD, 5.7 inches, 320 pixels x 240 pixels, 64 k colours
Memory:	16 k
Interface configurations:	USB device, dual USB host
Supply voltage:	100–240 V, 50/60 Hz
Dimensions:	approx. 325x160x135 mm³
Weight:	approx. 3 kg

9983-1008676

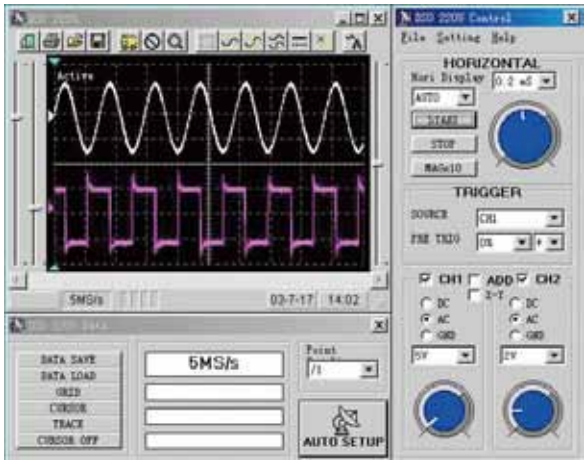
USB Oscilloscope 2x40 MHz

Meant for connection to a PC with USB ports, this two-channel USB oscilloscope comes with a USB cable as well as Windows software. On being connected to a PC, the digital storage oscilloscope not only offers a wide spectrum of features but also the added advantage of being able to save measured data and process them further, for example, for purposes ranging as far as FFT analysis. The monitor's surface is modelled after that of a conventional oscilloscope. Operation is facilitated by an auto-set function for automatic adaptation to measuring signals and numerous trigger functions.

Technical data:

Channels:	Two
Operating modes:	CH1, CH2, X/Y
Sampling rate:	100 MSa/s (real time)
Input coupling:	DC, AC, GND
Input impedance	1 MΩ ll 50 pF
Input voltage:	0–35 V
Deflection coefficient:	10 mV/div.–5 V/div.
Accuracy:	± 3 %
A/D converter:	8-bit resolution
Bandwidth:	40 MHz
Time coefficient:	4 ns/div.–1 h/div.
Roll mode:	1 s/div.–1 h/div.
Trigger:	Auto/Normal/Single/Ext.
Calibrator:	1 kHz/ 2 Vpp
Memory depth:	32 kpts/channel (64 kpts with 1 channel)
Interface:	USB 2.0
Voltage supply:	Via two USB ports
Dimensions:	190x40x100 mm³
Weight:	340 g
Windows:	98SE/ ME/ 2000/ XP/ VistaTM
Analysis options:	LabVIEW® compatible, data transfer to spreadsheet programs

9983-1012879



www.EngineeringBooksPDF.com



9983-1003132
9983-1003131



Rear of instrument

Power and Energy Meter with PC Interface

Power and Energy Meter for measuring electrical active, apparent and reactive power as well as electrical work in the case of voltages and currents with any continuous curve shape. The voltage, current, frequency, phase angle, power factor and time are measured simultaneously and can be displayed digitally via a pushbutton. It is also possible to simultaneously measure and display two temperatures as well as the difference between them. This device is particularly suitable for experiments involving heat pumps and Stirling engines. The power and energy meter can be used alone or together with a PC. It has an internal data logger with a real-time clock. All 13 parameters and the time–a total of 3100 measured values–can be stored. The storage of measured values can be commenced manually, or at a specified point in time, or if a power or temperature limit is exceeded or fallen short of. The stored data can be transferred subsequently to a PC via a RS232 interface. Includes Windows Software and interface cable. The software permits programming of the data logger, graphic displays of measured values and export of all measured data to a spreadsheet program.

Terminals:	4 mm safety sockets (front panel), Euro socket (rear panel)
Voltage (front panel):	
Measuring ranges:	0–30 V_{RMS}, 0–42 V DC
Resolution:	0.01 / 0.1 V_{RMS}, 0.01 / 0.1 V DC
Accuracy:	±1% of measured value / ±1 digit
Input impedance:	75 kΩ
Frequency range:	0–1000 Hz
Current (front panel):	
Measuring range:	0–10 A
Resolution:	0.01 A
Accuracy:	±1% of measured value / ±1 digit
Frequency range:	0–1000 Hz
Input impedance:	50 mΩ
Frequency range:	0–1000 Hz
Voltage (rear panel):	
Measuring range:	10–240 V_{RMS}
Resolution:	0.01 / 0.1 V_{RMS}
Accuracy:	±1% of measured value / ±1 digit
Input impedance:	950 kΩ
Current (rear panel):	
Measuring range:	0–10 A_{RMS}
Resolution:	0.01 A_{RMS}
Accuracy:	±1% of measured value / ±1 digit
Frequency range:	45 Hz–65 Hz
Input impedance:	50 mΩ
Power:	
Active power:	0–2400 W
Reactive power:	0–2400 VA (only sinusoidal)
Apparent power:	0–2400 VA (only sinusoidal)
Resolution:	0.01 / 0.1 / 1 W
Accuracy:	±2% of measured value / ±1 digit
Frequency:	
Measuring range:	DC/ 16–999 Hz
Resolution:	0.1 Hz
Accuracy:	±1% of measured value / ±1 digit
Phase angle:	
φ:	0°–±90°
Resolution:	0.1°
cos φ:	0,999–0,000
Resolution:	0,001
Accuracy:	±1% of measured value / ±1 digit
Power factor (ratio of active power to apparent power):	
cosphi:	0.999–0.000
Resolution:	0.001
Accuracy:	±1% of measured value / ±1 digit
Work:	
Measuring ranges:	0.0–9999x1000 Ws / 0.0–9999 Wh
Resolution:	0.1 Ws / 0.0001 Wh
Accuracy:	±2% of measured value / ±1 digit
Time:	
Measuring range:	0–9999x1000 s
Resolution:	1 s
Accuracy:	±0.1%
Temperature 1 and 2	
Measuring range:	-100°C–450°C
Resolution:	0.1°C
Accuracy:	±1% of measured value / ±1 digit
Connections:	Thermocouple jack Type K
Display:	4 digit LED, 7 segments
Digit height:	20 mm
Computer connection:	Serial interface (RS232) for PC (DB9)
Power consumption:	50 VA
Dimensions:	approx. 215x310x210 mm³
Weight:	approx. 5.7 kg

Power and Energy Meter with PC Interface (230 V, 50/60 Hz)

9983-1003132

Power and Energy Meter with PC Interface (115 V, 50/60 Hz)

9983-1003131

Additionally recommended:
9983-1003137 NiCr-Ni Temperature Sensor

NiCr-Ni Temperature Sensor

Clad thermocouple for temperature measurement in conjunction with the energy meter (9983-1003132 resp. 9983-1003131); equipped with a 2-pole, standard flat connector.

Measurement range: -40°C–500°C

9983-1003137



www.EngineeringBooksPDF.com

Measuring Instruments for Student Use

Sturdy pointer instruments for measuring current or voltage. In shock proof desktop housings. Built especially for student and practical lab experiments. With moving coil instruments, mirror scale and 4 mm safety sockets.

Accuracy: class 2.0
Dimensions: approx. 90x106x103 mm³



9983-1002786 9983-1002788 9983-1002790



9983-1002787 9983-1002789

Art. No.	Designation	Meas. ranges	Scale division	Internal resistance
9983-1002786	**Ammeter, DC**	50 mA, 500 mA, 5,0 A	1 mA, 10 mA, 0.1 A	10 Ω
9983-1002787	**Voltmeter, DC**	3.0 V, 15 V, 300 V	0.1 V, 1 V, 10 V	1 KΩ/V
9983-1002788	**Ammeter, AC**	1.00 A, 5.0 A	0.02 A, 0.1 A	Rectifier
9983-1002789	**Voltmeter, AC**	15.0 V, 150 V	0.5 V, 5 V	Rectifier
9983-1002790	**Galvanometer, DC**	± 35 µA	1 µA	1000 Ω

Analogue Multimeter AM50

Hand held multimeter for measuring voltage and current for a wide range of applications in student and practical experiments. A heavy duty device with excellent overload protection, zero point of scale centre or left and automatic battery cut off after approx. 45 minutes.

Measuring ranges:
- Direct voltage: 100 mV–300 V, 8 levels
- Alternating voltage: 3 V–300 V, 5 levels
- Direct current: 0.1 mA–3 A, 6 levels
- Alternating current: 0.1 mA–3 A, 6 levels

Internal resistance: 10 MΩ
Scale zero-point: Centre/left
Accuracy: class 2 (DC) / class 3 (AC)
Supply voltage: 1x 9 V battery
Dimensions: approx. 98x138x35 mm³
Weight: approx. 0.3 kg

9983-1003073

Analogue Multimeter AM51

Low price hand held multimeter for measuring current, voltage and resistance. For universal use in student experiments and practicals.

Measuring ranges:
- Direct voltage: 100 mV–600 V, 7 steps
- Alternating voltage: 10 V–600 V, 5 steps
- Direct current: 50 µA–1 A, 5 steps
- Alternating current: 3 mA–3 A, 4 steps
- Resistance: Ωx1/ 10/ 100

Internal resistance: 20 kΩ/V (DC) / 6.67 kΩ/V (AC)
Scale zero-point: left
Accuracy: class 2.5
Supply voltage: 1x 1.5 V battery
Dimensions: approx. 98x138x35 mm³
Weight: approx. 0.25 kg

9983-1003074



9983-1003073



9983-1003074

www.EngineeringBooksPDF.com



9983-1006811



9983-1006810

BEST SELLER

No replacement of fuses required. Operable with an inexpensive 1.5-V battery

Multimeter ESCOLA

Moving coil multimeter contained in shockproof plastic housing for any requirements in student experiments. Two easy-to-read, linear mirror scales and clearly identifiable measurement ranges guarantee error-free readings of the measurement values. Electronic overload protection is achieved without equipment safety fuses, thus eliminating the tedious task of changing of fuses and ordering replacement parts. The protective circuitry operates without auxiliary power and is also guaranteed to function with a flat or missing battery. Alternating quantities are linearised by the use of a measurement amplifier with a cut-off frequency of 20 kHz. The amplifier operates with a single, low cost 1.5 V battery cell (R6; Mignon cell). Nevertheless, under normal use the measuring instrument should remain operational for years between battery replacements since the maximum discharge current during operation is 1.5 mA. The status of the equipment is indicated by a red bar.

Scale length:	80 mm
Supply voltage:	1x1.5 V Mignon cell/IEC R6
Dimensions:	approx. 100x150x50 mm³
Weight:	approx. 300 g

Multimeter ESCOLA2

Student measuring instrument for the measurement of voltages and currents. Equipped with electronic protection against overloading and electronic zero calibration for all DC current and voltage ranges.

Measurement ranges:

Direct and alternating voltage:	0.3–30 V, 5 ranges each
Direct and alternating current:	1–3000 mA, 5 ranges each
Accuracy:	Class 2 (DC), class 3 (AC)
Scale length:	80 mm
Scale zero point:	Centre/left

9983-1006811

9983-1002726



Multimeter ESCOLA10

Student measuring instrument for the measurement of voltage, current, resistance, impedance, conductance and admittance. Equipped with electronic protection against overload and a potentiometer to electronically calibrate the zero point as well as the end value setting for measuring resistance and conductance. Includes battery test function. The separate terminal sockets for current and voltage permit connection of the instrument that allows for current as well as voltage to be measured without having to reconnect the measuring leads, so that resistance and conductance, capacitance and admittance can all be measured very simply.

Measurement ranges:

Direct and alternating voltage:	0.1–600 V, 9 ranges each
Direct and alternating current:	0.1 mA–10 A, 11 ranges each
Frequency range:	20 Hz–20 kHz
Internal resistance:	1 MΩ
Accuracy:	class 2 (DC), class 3 (AC)
Scale zero point:	Centre/left
Long term maximum voltage:	600 V
Long term maximum current:	35 A
Safety classification:	CAT II 600 V (IEC-1010-1)

9983-1006810

Zero Point Galvanometer CA 403

Reasonably priced, sturdy and easy to use analogue measuring instrument with moving coil instrument and rectifier, particularly well suited for student and practical experiments, may be used as a DC microammeter and DC millivoltmeter. This device has only one control knob, includes safety sockets and quick break fuses, is electrically protected and double insulated.

Measurement ranges:	100 mV DC, 30 µA DC, 3 mA DC
Internal resistance:	3333 Ω, 460 Ω, 500 Ω
Accuracy:	±1.5%
Zero point:	centre
Mirrored scale:	yes
Connection:	4 mm security sockets
Fuse:	0.315 A HBC 380 V 50 kA
Dimensions:	approx. 165x105x50 mm³
Weight:	approx. 450 g

9983-1002726

www.EngineeringBooksPDF.com

Digital Mini Multimeter

Very reasonably priced mini multimeter in pocket format for measuring voltage, DC current, resistance and temperature and also including diode and continuity tests. Overload protection for mA ranges, 10 amp range is unprotected. Includes measuring leads, type K thermocouple and battery.

DC voltage:	200 mV–250 V, 5 ranges, ±0.8% ± 2 digits
AC voltage:	200/ 250 V, 2 ranges, ±1.2% ± 10 digits
DC current:	200 µA–10 A, 5 ranges, ±1,0% ± 2 digits
Resistance:	200 Ω–2000 kΩ, 5 ranges, ±0.8% ± 2 digits
Temperature:	0–1000°C, ±2,0% ± 3 digits
Display:	3½ digit LCD, 12 mm, max: 1999
Operating voltage:	9 V battery
Safety classification:	CAT II 600 V (IEC-1010-1)
Dimensions:	approx. 70x140x30 mm³
Weight:	approx. 210 g

9983-1002783

Digital Multimeter P1035

Compact 3½ digit multimeter for measuring voltage, current, resistance and temperature and also including diode and continuity tests. Complete with pouch, leads and battery.

DC voltage:	200 mV–600 V, 5 ranges, ±0.5% ± 2 digits
AC voltage:	200/ 600 V, 2 ranges, ±1.2% ± 10 digits
DC current:	2000 µA–10 A, 4 ranges, ±1% ± 2 digits
Resistance:	200 Ω–2000 kΩ, 5 ranges, ±0.8% ± 2 digits
Display:	3½ digit LCD, 27 mm, max: 1999
Operating voltage:	9 V battery
Safety classification:	CAT III 600 V (IEC-1010-1)
Dimensions:	approx. 70x150x48 mm³
Weight:	approx. 260 g

9983-1002781



9983-1002783



9983-1002781



9983-1002785



9983-1002784

Digital Multimeter P3340

Digital multimeter for universal use in measuring voltage, current, resistance, frequency, capacitance, temperature and also including diode and continuity tests . Includes a measurement value hold function, analogue bar graphs, automatic polarity reversing, overload and overvoltage protection as well as an acoustic overload indicator, automatic switch off. Device comes in a shock-proof holster with fold-out stand. Including testing leads, type K temperature sensor and batteries.

DC voltage:	400 mV–1000 V, 5 ranges, ±0.5% ± 2 digits
AC voltage:	4–700 V, 4 ranges, ±1.2% ± 3 digits
DC current:	400 µA–10 A, 6 ranges, ±1% ± 3 digits
AC current:	400 µA–10 A, 6 ranges, ±1.5% ± 5 digits
Resistance:	400 Ω–40 MΩ, 6 ranges, ±1% ± 2 digits
Capacity:	40 nF–100 µF, 5 ranges, ±3% ± 5 digits
Temperature:	-20–760°C, ±3% ± 3 digits
Display:	3¾ digit LCD, 39 mm, max: 3999
Operating voltage:	9 V battery
Safety classification:	CAT II 1000 V (IEC-1010-1)
Dimensions:	approx. 92x195x38 mm³
Weight:	approx. 200 g

9983-1002785

Digital Multimeter P3320

Digital multimeter for universal use in measuring voltage, current, resistance, frequency, capacitance and temperature. With real time rms measurement feature and backlighting. 3⅝ digit LCD display with function symbols and analogue bar graphics. Automatic and manual range selection. With non-contact voltage detector. Includes measuring leads, type K thermocouple, shock resistant pouch and battery.

DC voltage:	600 mV–1000 V, 5 ranges, ±1.2% ± 2 digits
AC voltage:	6 V–1000 V, 4 ranges, ±1,5% ± 10 digits
DC current:	6 A–10 A, 2 ranges, ±2.5% ± 5 digits
AC current:	6 A–10 A, 2 ranges, ±3% ± 5 digits
Resistance:	600 Ω–60 MΩ, 6 ranges, ±1% ± 2 digits
Capacitiy:	40 nF–4000 µF, 6 ranges, ±5% ± 5 digits
Frequency:	10 Hz–10 MHz, 7 ranges, ±1,2% ± 3 digits
Temperature:	-20–760°C, ±3%
Display:	3⅝ digit LCD, 19 mm, max: 3999
Operating voltage:	9 V battery
Safety classification:	CAT III 600 V / CAT II 1000 V (IEC-1010-1)
Dimensions:	approx. 70x150x48 mm³
Weight:	approx. 260 g

9983-1002784

www.EngineeringBooksPDF.com



NEW

9983-1012865



9983-1006809

DMM 1000 Iso-Multimeter

Digital multimeter with integrated insulation resistance measuring capability for voltages from 50 V to 1000 V and additional measuring functions for testing AC and DC voltage and current, resistance, capacitance, frequency and temperature plus diode testing. Automatic blocking of sockets (ABS), which are not used for specific functions. Automatic shut-off, excess voltage and overload warning, true RMS (TRMS) measurement capability for distorted input signals. Back-lit liquid crystal display with digital read-out and analogue bar chart scale. Supplied with English instructions and impact-resistant protective case with stand legs.

Safety category:	CAT II 1000V
	CAT III 600 V

9983-1012865

Digital Multimeter E

Compact 3½-digit multimeter for measuring voltage, current and resistance as well as for diode and hFE gain testing. Overload protection in µA/mA range but no protection for 20-A range. Folding digital display. Includes measuring leads and battery.

DC voltage:	200 mV–1000 V, 5 ranges, ±0.5% ± 1 digit
AC voltage:	200 mV–750 V, 5 ranges, ±0.8% ± 3 digits
DC current:	20 µA–20 A, 7 ranges, ±0.8% ± 1 digit
AC current:	20 µA–20 A, 7 ranges, ±1.0% ± 3 digits
Resistance:	200 Ω–20 MΩ, 6 ranges, ±0.8% ± 1 digit
Display:	3½ display LCD, 24 mm, max. 1999
Operating voltage:	9 V battery 6F22
Safety classification:	CAT II 600 V (IEC-1010-1)
Dimensions:	approx. 85x185x35 mm³
Weight:	approx. 230 g

9983-1006809

Digital Storage Multimeter

This innovative digital multimeter uses an opto-coupled USB cable to connect directly to a computer to allow you to record up to three measurements per second. A wide range of functionalities such as autoranging, relative measurements, and Min/Max/Hold also make this a highly versatile stand-alone tool. Measuring modes include DCV, ACV, DCA, ACA, resistance, diode, continuity, frequency, capacitance and temperature. The unit is supplied with a carrying case, USB cable, Software for Windows 2000/XP/Vista/7, type-K thermocouple, test leads, test clips, battery and operation manual.

DC voltage:	600 mV–1000 V, 5 ranges
AC voltage:	600 mV–700 V, 5 ranges
DC current:	600 µA–10 A, 6 ranges
AC current	600 µA–10 A, 6 ranges
Resistance:	600 Ω- 60 MΩ, 6 ranges
Frequency:	100 Hz–1 MHz, 5 ranges
Capacity:	60 nF–300 µF, 5 ranges
Temperature:	-55 °C–1000 °C, 2 ranges
Display:	3⅝ digit LCD, 18 mm
Operating voltage:	9 V battery (included)
Safety classification:	CAT II (IEC-1010-1)
Dimensions:	90x190x40 mm³ approx.
Weight:	500 g approx.

9983-1008631



9983-1008631

www.EngineeringBooksPDF.com



9983-1012817



9983-1012816

Digital Wattmeter

Digital single-phase wattmeter with LCD display for accurate measurement (2000 points) of the true effective power.

Display:	3.5 digits, 13 mm
Measuring functions:	V AC, V DC, A AC, A DC, W AC
Current measurements:	
DC:	10 A ± (1% + 1 digit) + 10 mA.
AC:	10 A ± (1% + 1 digit) ±10 mA
Voltage drop:	200 mV
Voltage measurements:	
DC:	200 and 1000 V (±0.5% + 1 digit) ±0.1 V and ±1 V
AC:	200 and 750 V (±0.5% + 1 digit) ±0.1 V and ±1 V
Impedance:	1 MΩ
Power measurements:	
AC:	0 to 6000 W in 2 ranges (2000 and 6000 W)
Accuracy:	±1% + 1 digit.
Resolution:	1 W and 10 W, based on the range
Protection:	1000 V in AC, 1100 V in DC
Polarity:	bipolar through automatic switching
Power supply:	9V battery (not included)
Power consumption:	±6 mA
Dimensions:	185x90x60 mm³
Mass:	500 g (with the battery)

9983-1010225

DMM Digital Multimeter

Digital multimeter for conducting measurements in situations where a high degree of safety needs to be assured. Automatic blocking of sockets (ABS), which are not used for specific functions. Back-lit liquid crystal display with digital read-out and analogue bar chart scale. Economy mode with automatic shut-off after 10 minutes without the measured reading changing. Excess voltage and overload warning, automatic or manual range selection, data storage and maximum and minimum functions. Supplied with measurement leads, 9-V block battery, spare fuse, English instructions, test report and impact-resistant protective case with stand legs and carrying strap.

Measured variables and ranges:

DC voltage:	30.00 mV (10 µV)…1000 V (1 V), 6 ranges ±0.25% ±1 digit
AC voltage:	3.000 V (1 mV)…1000 V (1 V), 4 ranges ±0.75% ±1 digit
Direct current:	300.0 µA (100 nA)…10.00 A (10 mA), 6 ranges ±1.00% ±2 digits
Alternating current:	3.000 mA (1 µA)…10.00 A (10 mA), 4 ranges ±1.50% ±2 digits
Resistance:	30.00 Ω (10 mΩ)…30.00 MΩ (10 kΩ), 7 ranges
Capacitance:	30.00 nF (10 pF)…30.00 µF (10 nF), 4 ranges
Frequency:	300.0 Hz (0.1 Hz)…100.0 kHz (100 Hz), 4 ranges

Other variables:

Duty cycle:	2.0 %…98.0 %
Temperature*:	-200.0 °C…+850.0°C (Pt 100) -100.0 °C…+850.0°C (Pt 1000)
Continuity test:	Yes
Diode test:	2 V

Other data:

Safety category:	CAT III 1000 V (IEC 61010-1:2001) CAT IV 600 V (IEC 61010-1:2001)
Dimensions:	200x80x30 mm³
Weight:	700 g approx.

* Sensors available on request



9983-1010225

DMM50 Digital Multimeter

Digital multimeter without true RMS (TRMS) measurement capability.

9983-1012817

DMM60 Digital Multimeter

Digital multimeter with true RMS (TRMS) measurement capability for distorted input signals.

9983-1012816

www.EngineeringBooksPDF.com

Sound Level Meter P5055

Universally deployable digital meter used to determine the sound level of any number of acoustic sources across a wide sound range. Device is housed in a robust plastic casing with integrated calibration signal and large LCD display for easy reading of measured values. Includes range selection switch and maximum hold function. There are two evaluation levels (A and C) available for the frequency. The measurement in the A-range is oriented on the human ear and is particularly well suited for measurements out in the open, while the C-range is designed for measurements of motor noise. The device's response time can be adjusted between fast and slow. The slow mode brings about attenuation of the measurement i.e. the measured value displayed corresponds to the average sound level. Fast mode is used to measure brief noise sequences and to determine the maximum noise level. Furthermore, the device also offers the option of connecting an external measuring instrument (e.g. for compiling and printing out measurement sequences) via an analogue output (phone jack). On the underside of the sound level meter there is a drill hole for attaching to a stand. Supplied in a foam lined portable bag.

Measurement range:	35 – 130 dB
Resolution:	0.1 dB
Accuracy:	± 3.5 dB at 94 dB (1kHz)
Display:	3½-digit LCD display
Digit height:	17 mm
Microphone:	Electret capacitor micorphone
Power supply:	9 V block-type battery
Dimensions:	251x64x40 mm³ approx.
Weight:	250 g approx.

9983-1002778

Digital Energy Meter

Digital meter for measuring consumption of electrical energy by appliances connected to the mains and for determining bills given a rate for kilowatts per hour. It is also possible to demonstrate stand-by operation for larger appliances. If the connected appliance consumes more than 3600 W a warning signal is emitted. Supplied with an internal battery for memory back-up.

Values displayed:	Energy, costs incurred, power, voltage, current, time, day of the week
Input voltage:	230 V, 50/60 Hz
Maximum permitted load:	3680 W/16 A
Minimum load for display:	1 W/0.005 A
Energy:	0.00 – 9999.99 kWh
Current:	0 – 16 A
Active power:	1 – 3680 W
Accuracy:	±1%
Safety classification:	Cat II 300 V (IEC-1010-1)
Operating voltage:	internal battery for memory back-up
Dimensions:	128x64x78 mm³
Weight:	170 g

9983-1002802

Digital Luxmeter

Extremely reasonably priced, easy to use pocket luxmeter for testing and measurement of light conditions. C.I.E. standard spectrum. Including light sensor, pouch and battery

Measuring ranges:	200 – 50000 lux, 4 ranges, ±5%
Operating voltage:	Battery
Dimensions:	approx. 65x115x25 mm³
Weight:	approx. 160 g

9983-1002779

Noise Level Meter P8005

Digital noise level meter with circuit for suppressing background noise for measuring all types of sound levels in the environment, including noise levels in schools, offices, factories, traffic noise, household noise or for noise-reduction projects. Allows for manual or automatic selection of levels and measurements of minimum and maximum levels. Thanks to its built in USB port, the supplied 9 V mains adapter and stand, it is also suitable for permanent or long term measurement. Includes case, USB cable, Windows software, stand, 9 V mains adapter, 9 V battery and instruction manual.

Digital display:	4 digit LCD
Height of digits:	20 mm
Multi-functions display:	58x44 mm²
	Digital display of measurement, measuring time, bar graphs plus overs and unders
Background lighting:	blue
Applicable standards:	IEC-61672-1 type 2, ANSI S1.4 type 2
Frequency range:	31.5 Hz – 8 kHz
Dynamic range:	50 dB
Level ranges:	30 – 80 dB (low)
	50 – 100 dB (medium)
	80 – 130 dB (high)
	30 – 130 dB (automatic)
Resolution:	0.1 dB
Precision:	±1.4 dB
Response times:	125 ms (fast), 1s (slow)
Microphone:	½-inch, with electret capacitor
Display update:	Twice a second
Analogue output:	AC/DC
Operating voltage:	9 V battery or 9 V mains adapter
Dimensions:	90x280x50 mm³ approx.
Weight:	350 g approx.

9983-1002780



9983-1002802



9983-1002780



9983-1002778



9983-1002779

www.EngineeringBooksPDF.com



9983-1001033
9983-1001032

Digital Counter

Digital counter/timer for measuring duration of motion, transition times, periods, pendulum periods and frequencies, as well as for counting events or Geiger tube pulses. Includes a speaker that can be turned on and off, power supplies for direct connection to light barriers (9983-1000563) or for powering a Geiger-Müller counter (9983-1001035). For event counting, a fixed counting period can be programmed in a range from 1 s to 99999 s. Counter events (start, stop) can either be triggered by a signal to the input sockets or manually via switches. Includes plug in power supply.

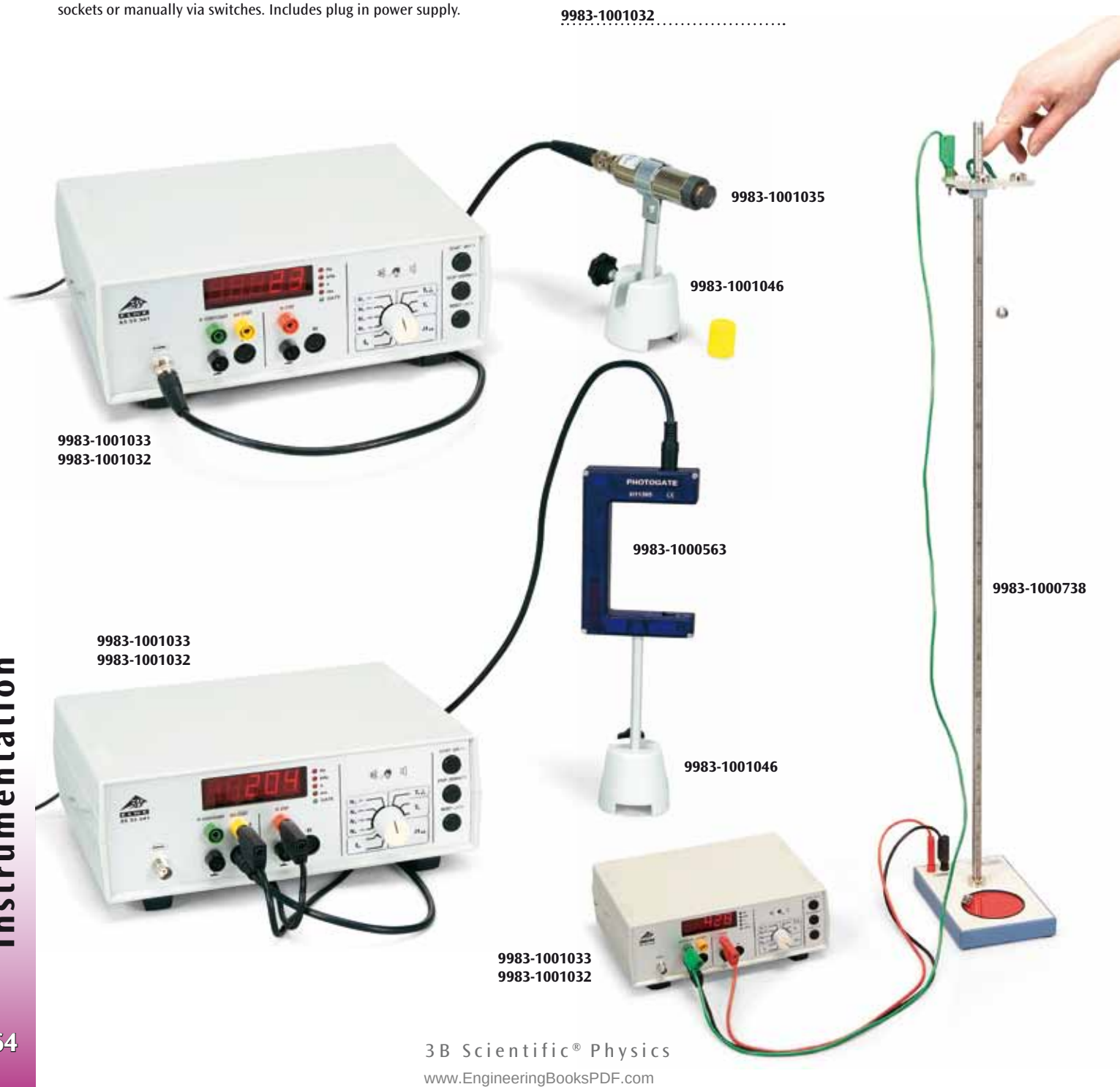
Time measurement:	0.1 ms – 99999 s
Resolution:	0.1 ms / 1 ms / 0.1 s
Frequency measurement:	1 – 100 kHz, where voltage > 1.5 V_{PP}
Resolution:	1 mHz (1 – 100 Hz), 1 Hz (1 – 100 kHz)
Counting periods:	1/10/60 s or manually triggered
Input A:	miniDIN 8 socket, 4 mm safety sockets
Input B:	miniDIN 8 socket, 4 mm safety sockets
Input voltage A:	0.5 V – 15 V AC
Input voltage B:	1 V – 15 V AC
Active edge	Rising/falling
Counter tube input:	BNC socket
Power supply:	550 V / 1 MΩ
Display:	5 digit LED display
Operating voltage:	9 – 12 V DC via plug in power supply
Dimensions:	250x100x160 mm³ approx.
Weight:	0.8 kg approx.

Digital Counter (230 V, 50/60 Hz)

9983-1001033

Digital Counter (115 V, 50/60 Hz)

9983-1001032



www.EngineeringBooksPDF.com

9983-1003123
9983-1003122



Digital Counter with Interface

Microprocessor controlled digital counter for measuring duration of motion, transition times, periods, pendulum periods and frequencies, as well as for counting events or Geiger tube pulses. Keyboard operated. With adjustable trigger edge, speaker that can be turned on and off, power supply for direct connection to light barriers (9983-1000563) and adjustable low voltage output for supplying a Geiger-Müller tube (9983-1001035). With RS 232 interface and supplied cable plus software for graphic depiction of measured data and export to spreadsheet programs.

Frequency (Input A):

Measuring range:	0.01 Hz – 100 kHz
Resolution	10 mHz – 10 Hz
Type of measurement:	Repeated measurement / single measurement

Period of oscillation (Input A):

Measuring range:	1 ms – 100 s
Resolution:	0.01 – 10 ms
Type of measurement:	Repeated measurement / single measurement

Pulse counting (Input A)/rate measurement (counter tube input):

Measuring range:	0 – 9999 pulses
Resolution:	1 pulse
Type of measurement:	Continuous measurement Single measurement for counting periods of 1 s, 6 s, 10 s, 60 s, repeated measurement for a period of 10 s

Time for motion between A and B:

Measuring range:	0.01 ms – 100 s
Resolution:	0.01 ms
Start:	START/STOP button, pulse at A.
Stop:	START/STOP button, pulse at B.

Transition times via A and B:

Measuring range:	0.01 ms – 100 s
Resolution:	0.01 ms
Type of measurement:	Simultaneous measurement at both inputs

Transition time and period of motion:

Measuring range:	0.01 ms – 100 s
Resolution:	0.01 ms
Type of measurement:	Time for motion from A to B, time for transition at A, time for transition at B
Input A:	BNC socket, miniDIN 8 socket, two 4 mm safety sockets
Input B:	BNC socket, miniDIN 8 socket, two 4 mm safety sockets
Tube input:	BNC socket (on reverse)
Power supply:	300 – 625 V DC, continuously adjustable
Measurement display:	7 segment LED, 4 digit
Height of digits:	20 mm
Function display:	LCD with illumination, 2x 16 digit
Computer connection:	RS 232
Power consumption:	20 VA approx.
Dimensions:	95x245x185 mm³ approx.
Weight:	5 kg approx.

Digital Counter with Interface (230 V, 50/60 Hz)

9983-1003123

Digital Counter with Interface (115 V, 50/60 Hz)

9983-1003122

Millisecond Counter

Inexpensive, compact counter for measuring milliseconds, e.g. in conjunction with the free-fall apparatus (9983-1000738). Each count is started and stopped by a signal at the input sockets. The device is automatically reset to zero each time it is restarted. Includes plug-in power supply.

Time measurement:	1 ms – 9999 s
Supply voltage:	5 V DC
Connectors:	4-mm safety sockets
Dimensions:	105x75x35 mm approx.
Weight:	400 g approx.

Millisecond Counter (230 V, 50/60 Hz)

9983-1012832

Millisecond Counter (115 V, 50/60 Hz)

9983-1012833



9983-1012832
9983-1012833

www.EngineeringBooksPDF.com

Experiment Motor with Gearbox

Experiment motor for universal use in experiments on rotational motion, e.g. for experiments using the rings demonstrating flattening of the earth (9983-1000750) or Watt's governor (9983-1009695). Can also be used as a generator in conjunction with the included hand crank. Robust clockwise and counter-clockwise rotating IDC motor with epicyclic gearbox and quick-action chuck in a tough anodized aluminum casing with removable and adjustable stainless steel stand rod. Can also be mounted on the clamp for the projectile launcher (9983-1002655). Speed of rotation is adjusted by altering the supply voltage. Adjustable torque. Includes 3 belt pulleys of different diameters on a mounting axle.

Speed without load:	approx. 480 rpm at 12 V
Speed sensitivity:	approx. 40 rpm per V
Span of chuck:	0.8 to 10 mm
Stand rod:	12 mm diam.
Pulleys:	10 mm diam., 20 mm diam., 40 mm diam.
Axle:	10 mm diam.
Drive belt:	130 mm diam. x 4 mm
Nominal voltage:	12 V DC, 5A
Connection:	via 4-mm safety sockets
Dimensions:	210x95x60 mm³
Mass:	1.2 kg

Contents:
Experiment motor
Stand rod with knurled screws
Hand crank
Pulleys
Drive belt

9983-1002663

Additionally required:
9983-1003312 DC Power Supply 0– 20 V, 5 A (230 V, 50/60 Hz)
or
9983-1003311 DC Power Supply 0– 20 V, 5 A (115 V, 50/60 Hz)

Additionally recommended:
9983-1003331 Digital Stroboscope (230 V, 50/60 Hz)
or
9983-1003330 Digital Stroboscope (115 V, 50/60 Hz)



9983-1002663

Digital Stroboscope

Portable microprocessor-controlled device with quartz-controlled time base for observation of periodic movements, as well as for frequency and rotation speed measurement. Xenon flash tube built into a robust plastic casing with handle and photo thread for mounting on a stand, continuous frequency adjustment in two ranges through coarse and fine setting using control knobs, 4-digit digital display permits readings of the desired flash sequence per minute.

Meas. ranges:	100 min-1 –1000 min-1 (approx. 1.5 Hz –18 Hz)
	1000 min-1 –10000 min-1 (approx. 18 Hz –165 Hz)
Accuracy:	± (0.05% + 1 digit)
Display:	4-digit LED
Resolution:	0.1 min-1 (< 1000 min-1)
	1 min-1 (1000 min-1 –9999 min-1)
	10 min-1 (10000 min-1)
Flash duration:	60 µs –100 µs
Flash energy:	4 Ws
Flash angle:	80°
Dimensions:	210x210x120 mm³ approx.
Weight:	1 kg approx.

Digital Stroboscope (230 V, 50/60 Hz)
9983-1003331

Digital Stroboscope (115 V, 50/60 Hz)
9983-1003330



9983-1003331
9983-1003330

Spare Bulb, Stroboscope (not shown)

Spare bulb for the Digital Stroboscope (9983-1003331).

9983-1003332

www.EngineeringBooksPDF.com



9983-1001028

Measuring Amplifier S

Measuring amplifier for measuring small voltages and current in conjunction with an ordinary voltmeter in the course of student experiments.
Measuring range with reference to 1 V output voltage:

Voltage (AC/DC):	1 mV – 1 V
Current (AC/DC):	100 nA – 100 µA
Frequency range:	0 – 20 kHz (v = 1)
	0 – 500 Hz (v =1000)
Input impedance:	10 kΩ
Input U:	BNC socket
Input I:	BNC socket
Max input voltage:	10 V
Output:	4 mm safety sockets
Max output voltage:	10 V
Limiting frequency:	100 Hz
Gain factor:	106
Accuracy:	2 %
Operating voltage:	12 V AC
Dimensions:	approx. 175x85x65 mm³
Weight:	approx. 250g

9983-1001028

Additionally required:
9983-1000866 Transformator 12 V, 25 VA (230 V, 50/60 Hz)
or
9983-1000865 Transformator 12 V, 25 VA (115 V, 50/60 Hz)
9983-1003073 Analogue Multimeter AM50

Microvoltmeter

Measuring instrument and amplifier for measuring very small DC and AC voltages, e.g. thermo-voltages, inductive voltages and photo-electric voltages. With LED display. The measuring input includes a filter that can be switched in for smoothing the signal or for setting an upper frequency limit. The signal is input via a BNC socket or 4 mm safety sockets. An additional DIN socket is provided for the connection of Hall sensors, the axial/tangential magnetic field sensor (9983-1001040).

Inputs:	4 mm safety sockets, BNC socket, DIN socket
Outputs:	4 mm safety sockets
Measuring ranges:	199.9 µV – 199.9 mV AC /DC, 4 ranges each
Gain factors:	10 – 10000, 4 decades
AC frequency range:	10 Hz – 1 kHz
Input resistance:	100 kΩ (DC), 900 kΩ (AC)
Upper frequency limit:	1 Hz – 1 kHz, 4 decades
Precision:	5%
Sampling rate:	3 measurements/s
Output signal:	0 – ±2 V, max. 1 mA
Dimensions:	approx. 235x250x180 mm³
Weight:	approx. 3.3 kg

Microvoltmeter (230 V, 50/60 Hz)

9983-1001016

Microvoltmeter (115 V, 50/60 Hz)

9983-1001015

Additionally recommended:
9983-1001040 Magnetic Field Sensor, Axial/Tangential



9983-1001022
9983-1001021

Measuring Amplifier

Measuring amplifier for recording very small voltage, current and charge. For display purposes, any DC meter capable of measuring in the range up to 10 V can be used with no additional configuration. Including offset correction and polarity switch. Additional outputs are provided so that the -15 V and +15 V operating voltage can be tapped for use in external circuitry, e.g. bridge circuits.

Input:	BNC sockets
Measuring range with reference to 1 V output voltage:	
Voltage:	0.1 mV – 100 V, 7 ranges
Current:	10 pA – 10 µA, 7 ranges
Charge:	10 pAs – 100 nAs, 5 ranges
Input resistance:	10 Ω (voltage), compensated 0 Ω (charge, current)
Overvoltage protection:	up to 300 V
Precision:	typically 3%
Signal output:	0 – 10 V, configurable zero point, polarity switch
Fixed voltage output:	±15 V, max. 50 mA
Dimensions:	approx. 235x230x180 mm³
Weight:	approx. 2.8 kg

Measuring Amplifier (230 V, 50/60 Hz)

9983-1001022

Measuring Amplifier (115 V, 50/60 Hz)

9983-1001021

Additionally required:
9983-1003073 Analogue Multimeter AM50



9983-1001016
9983-1001015

www.EngineeringBooksPDF.com



9983-1003419,
9983-1003420



9983-1003433,
9983-1003434

Mechanical Balance 610

- Solid, all-metal construction
- Notched positions for sliding weights on three sliding beams
- Captive sliding weights
- Magnetic damping
- Zero point adjustment
- Extensible scale range

	9983-1003419	9983-1003420
Scale range	0 – 610 g	0 – 610 g
Scale range with additional weights	2610.0 g	2610.0 g
Readability	0.1 g	0.1 g
Tare range	—	225 g
Sliding weight		
front centre rear	0.1 g – 10 g 100 g – 500 g 10 g – 100 g	0.1 g – 10 g 100 g – 500 g 10 g – 100 g
Plate diameter	150 mm	150 mm

Electronic Scales

Universal scales in robust plastic casing, with easy-clean foil keyboard. Menu functions, easy selection using two buttons. High-resolution, easy-to-read LCD display, overload and underload display, battery or mains operation optional. Automatic shutdown after five minutes in battery operation. Batteries included

	9983-1003433	9983-1003434
Scale range	0 – 200.0 g	0 – 5000 g
Accuracy	0.1 g	1 g
Weight units	g. lb:oz	g. lb:oz
Counter-balancing range	subtractive, entire weight range	subtractive, entire weight range
Power supply	3 AA alkaline batteries	3 AA alkaline batteries
Dimensions	approx. 193x135x39 mm³	approx. 193x135x39 mm³
Weight	ca. 470 g	ca. 470 g



9983-1003421

Mechanical Balance 311

- Solid, all-metal construction
- Notched positions for sliding weights on four sliding beams
- Captive sliding weights
- Magnetic damping
- Zero point adjustment

Scale range: 0 – 311.00 g
Readability: 0.01 g
Sliding weight ranges: 0.01 – 1 g (1st beam), 1 – 10 g (2nd beam), 10 –100 g (3rd beam), 100 –200 g (4th beam)
Pan diameter: 100 mm

9983-1003421

www.EngineeringBooksPDF.com

Specific Benefits:

- Flexible Power:
  Use either the included AC adapter, or 4 “AA” batteries to power your Scout Pro.
- Easy to Clean:
  Sealed front panel and moulded spill ring.
- Easy to View:
  High contrast LCD quickly displays weight and applications data, as well as indicators for stability, over/underload conditions, and low battery power.



9983-1003431





9983-1003429, 9983-1012774

Round or Square Stainless Steel Platform
Removable for easy cleaning.

9983-1009772, 9983-1003426
9983-1003428, 9983-1003427



Lockswitch
The Scout Pro can be locked into a specific configuration using the integral locking switch.



Weigh Below Hook
The integral weigh-below-hook on the bottom of the Scout Pro allows density determination or calculation of the specific gravity of samples.



Integral Shipping Lock
Quickly accessible under the weighing pan, the shipping lock allows you to lock and go.

Electronic Scales Scout Pro

Precision scales with removable stainless steel platform. Multi-function with percentage weighing, totalisation, display hold, and parts counting. Includes calibrating weight.

	9983-1009772/ 9983-1003426	9983-1003428/ 9983-1003427	9983-1003429/ 9983-1012774
Weight range	0 – 200.00 g	0 – 400.00 g	0 – 600.0 g
Accuracy	0.01 g	0.01 g	0.1 g
Display	LCD, 6 digits, 15 mm		
Weight ranges	g, N, oz, %	g, N, oz, %	g, kg, N, oz, lb, %
Calibration	Automatic using external weight		
Scale pan	120 mm diam.	120 mm diam.	165x140 mm
Dimensions	ca. 192x54x210 mm³		
Weight	ca. 700 g	ca. 700 g	ca. 800 g

Other weight ranges available on request.

Electronic Scale Pro 200 g (230 V, 50/60 Hz)
9983-1009772

Electronic Scale Pro 200 g (115 V, 50/60 Hz)
9983-1003426

Electronic Scale Pro 400 g (230 V, 50/60 Hz)
9983-1003428

Electronic Scale Pro 400 g (115 V, 50/60 Hz)
9983-1003427

Electronic Scale Pro 600 g (230 V, 50/60 Hz)
9983-1003429

Electronic Scale Pro 600 g (115 V, 50/60 Hz)
9983-1012774

Accessories:
USB Interface
For connecting Scout Pro to a printer or PC.
9983-1003431

www.EngineeringBooksPDF.com



9983-1012881

ABS Analytical Scales (230 V, 50/60 Hz)

Precision analytical scales with automatic adjustment mechanism and high resolution. Tough metal casing with glass windscreen, large graphic display and RS232 port. The scales offer practically every function needed in laboratories:

- Counting items
- Percentage weights
- Switching between different units
- Capacity display for weight range
- GLP/ISO protocols
- Programmable 4-digit ID number
- CAL adjustment program for setting accuracy

Max. measuring range:	220 g
Precision:	0.1 mg
Reproducibility:	0.1 mg
Linearity:	±0.2 mg
Time to settle:	3 – 5 s approx.
Item counting	
Minimum weight:	1 mg
References:	10, 20, 50, 100
Weight display:	LCD, 13 mm
Weighing platform:	80 mm diam.
Power supply:	12 V DC power supply, mains voltage 230 V, 50/60 Hz
Dimensions:	225x315x330 mm³
Weight:	7 kg

9983-1012881



9983-1003264
9983-1003263

Overhead Projector

Reliable overhead projector in modern moulded plastic housing with collapsible reflector column. High quality optical system with correction to avoid coloured edges and highly efficient low noise cooling.

Lamp:	36 V, 400 W
Light flux:	2200 lumens
Aperture:	285x285 mm² approx.
Dimensions of housing:	450x440x320 mm³ approx.
Weight:	9 kg approx.

Overhead Projector (230 V, 50/60 Hz)

9983-1003264

Overhead Projector (115 V, 50/60 Hz)

9983-1003263



Replacement Bulb for Overhead Projector

(not shown)

Replacement bulb for overhead projector, 36 V, 400 W.

9983-1003265

www.EngineeringBooksPDF.com

9983-1005402
9983-1005401

BEST SELLER



NEW

9983-1012403



Monocular Course Microscope Model 100

The monocular course microscope Model 100is distinguished by its robust construction and ease of operation. It is equipped with three achromatic objectives as used in common practice and has a simple object stage with two clips for holding slides. It can be supplemented by means of a variety of spare parts and accessories.

Monocular Course Microscope Model 100 (230 V, 50/60 Hz)

9983-1005402 .....

Monocular Course Microscope Model 100 (115 V, 50/60 Hz)

9983-1005401 .....

Monocular Polarisation Microscope

High-quality mechanics and optics along with ease of operation are the stand-out features of the monocular polarisation microscope. Its compact and ergonomic design makes it easier to work with it. The main application for polarisation microscopes is in mineralogy, where they are used for investigating optically anisotropic objects, e.g. crystals or minerals (intrinsic birefringence) or isotropic materials being acted upon by mechanical forces (stress-induced birefringence).

9983-1012403 .....

	9983-1005402, 9983-1005401	9983-1012403
Stand	All-metal stand, arm firmly connected with base, pinion knobs attached on both sides of the stand for coarse and fine focusing	Robust, all metal stand with arm permanently connected to the base. Focussing by means of separate knobs for coarse and fine adjustment located on either side of the stand and operated by rack and pinion drive with ball bearings and retaining lever, adjustable stopper for protecting the object slides and objective.
Tube	Monocular inclined 45°, head rotation 360°	Monocular inclined 30°, head rotation 360°
Polarisation equipment	–	Polariser with scale and analyser, which can be inserted into the tube.
Eyepieces	Wide field eyepiece WF 10x 18 mm with pointer and eyepiece lock	Wide field eyepiece WF 10x 18 mm
Objectives	Revolving nosepiece with 3 achromatic objectives 4x / 0.10, 10x / 0.25, 40x / 0.65	Inverted objective revolver with 3 achromatic objectives 4x / 0.10, 10x / 0.25, 40x / 0.65
Enlargement	40x, 100x, 400x	40x – 400x
Object stage	110x120 mm² with 2 specimen clips	Circular object stage 120 mm in diameter, which can be rotated 360°, scale with Vernier and 2 specimen clips
Illumination	115 V resp. 230 V, 20 W tungsten lamp integrated in base, with blue filter in lamp shaft and a converging lens, power supply 115 V resp. 230 V 50/60 Hz	Adjustable 6 V, 20 W halogen lamp incorporated into the base, universal 85 to 265 V, 50/60 Hz power supply
Condenser	Bright-field condenser N.A. 0.65, iris diaphragm, filter holder and blue filter	Abbe condenser N.A.1,25 with iris diaphragm, focussed via rack and pinion drive
Dimensions	approx. 175x135x370 mm³	approx. 240x190x385 mm³
Weight	approx. 2.9 kg	approx. 5.5 kg
Supplied	Complete with dust cover	Complete with dust cover

www.EngineeringBooksPDF.com

HD Video Flex®

Robust, ultra high resolution desktop digital colour camera for direct connection to a PC or notebook via a USB interface. Thanks to the ball and socket bearing, video head that can pivot and swivel via its flexible gooseneck, the camera can be easily and accurately connected, e.g. to microscopes and telescopes, or directed towards visual material, running processes or items of scientific or technical interest so that they can be viewed on a monitor. The heavy, triangular base ensures the necessary stability. Audio recordings are possible via a microphone equipped computer. An external power supply is not necessary as the camera is powered via the USB connection. Includes microscope adapter, Discovery Scope Kit, Applied Vision™ software and carrying case. Compatible with interactive whiteboards. The Applied Vision™ software for picture recording, reproduction and processing is characterized by its user friendliness and features e.g.

- Full screen, real time video
- Still frame recording
- Recording of films in AVI format
- Time-lapse recording
- Internet streaming
- Can be used in local network
- Zoom function
- Image processing
- Brightness, contrast control and positive/ negative image display
- Drawing tools
- Organizer/memo function
- Printout of real time images
- Memory function (jpeg, bmp, tiff)
- Choice of background
- Creation of image collages
- Comparison of two adjacent images
- Measurement of the distance between 2 points or the area of a circle
- Exporting data to an Excel spreadsheet or MS Word
- Compatible with Windows, Mac and Linux
- Free software updates
- Unlimited local licences

9983-1012828



	9983-1012828	9983-1003436	9983-1012834	9983-1012643	9983-1012835
Photosensitivity	8 lux	20 lux	20 lux	3 lux	2 integrated white LEDs
Image digitization	digital CMOS	digital CMOS	¼" CMOS	¼" CCD	digital CMOS
Output signal	digital / USB 2.0	digital / USB 2.0	digital / USB 2.0	S-Video / USB 2.0	digital / USB 2.0
Resolution	HD 1080P	1280x960 SXGA	1280x1024	640x480	2048x1536
Live video	up to 30 images per second	up to 30 images per second	up to 30 images per second	up to 30 images per second	up to 30 images per second
TV system	–	–	–	PAL	–
Microphone	–	–	–	–	yes
Lens	8 mm HD	6 mm glass	glass f = 2.8 and 1.729 mm	8 mm glass, D-mount	F2.8 coated
Focal distance	6 mm to infinity	8 mm to infinity		6 mm to infinity	100 mm to infinity
Focus	manual	manual	auto	manual	auto
Microscope adapter	34,5 mm built-in and 28 mm	34,5 mm built-in and 28 mm	34,5 mm built-in and 28 mm	26 mm, 28 mm, 34 mm	–
Power supply	via USB	via USB	via USB	via USB	via USB
Cable	USB connecting cable, approx. 170 cm	USB connecting cable, approx. 150 cm	USB connecting cable, approx. 170 cm	USB connecting cable, approx. 180 cm	USB connecting cable, approx. 180 cm
Dimensions	approx. 180x180x720 mm³	approx. 180x180x640 mm³	approx. 180x180x640 mm³	approx. 180x190x560 mm³	approx. 200x200x630 mm³
Weight	approx. 4.55 kg	approx. 1.7 kg	approx. 1.65 kg	approx. 1.8 kg	approx. 2.04 kg

www.EngineeringBooksPDF.com

iCam Digital
This innovative, inexpensive desk-top colour video camera is the perfect instrument for the presentation of various objects, images and text, for making video portfolios and sending video e-mails. The camera has video (PAL), S-video and USB outputs, so that it is easy to connect it to televisions as well as Mac or Windows computers, video recorders and LCD projectors. The iCam Digital camera is particularly suitable for microscope images. The focussing ring exactly matches the supplied microscope adapter. Includes Applied Vision™ software. NTSC version available on request.

9983-1012643

FlexCam® 2
This modern document camera with high definition (HD) resolution can do the job of multiple presentation devices, e.g. overhead projectors, opaque projectors or slide projectors. Documents, pictures, objects etc. can be laid directly onto the flat base under the camera. The two bright white LEDs integrated into the head of the camera provide excellent illumination of the field of view. A built-in microphone allows sound recordings to be made. Includes Applied Vision™ software.

9983-1012835



9983-1012835

Vision Viewer™
Lighter version of the HD Video Flex® (9983-1012828) with similar optical properties and for the same applications. The difference is that the video head is directly attached to the gooseneck arm (with no universal joint). Compatible with interactive whiteboards.Includes a microscope adapter, observation set (Discovery Scope Kit) and Applied Vision™ software.

9983-1003436

Auto Focus Vision Viewer™
High-resolution, easy-to-use, desk-top colour video camera with a host of uses. Particularly suitable for presenting printed text, images and other objects or even dynamic processes. Includes auto-focus camera lens and wide field of vision (43x36 cm), flexible goose-neck support and integrated USB cable. Compatible with interactive whiteboards. Includes microscope adapter and Applied Vision™ software.

9983-1012834



9983-1012643



9983-1003436



9983-1012834

www.EngineeringBooksPDF.com



9983-1002807
9983-1002806



9983-1010229



9983-1002808

Magnetic Stirrer with Heater

Magnetic stirrer with stainless steel hotplate and secure safety circuit. Variable heating temperature and smooth starting stirrer motor. Housing resistant to chemicals.

Quantity stirred, max. (H_2O):	10 l
Speed:	100 – 2000 rpm
Heater power:	400 W
Heating temperature range:	Room temperature to 320° C
Work plate:	125 mm diam.
Dimensions:	168x105x220 mm³ approx.
Weight:	2.4 kg approx.

Magnetic Stirrer with Heater (230 V, 50/60 Hz)

9983-1002807

Magnetic Stirrer with Heater (115 V, 50/60 Hz)

9983-1002806

SPEEDSAFE Magnetic Stirrer (230 V, 50/60 Hz)

Inexpensive, compact magnetic stirrer which can be adjusted to any speed within its range. Its casing and base plate are made of ABS plastic, making it to resistant to chemical spray. Includes stirring rods.

Speed:	100…1000 rpm
Maximum stirrable volume:	1 l
Mains voltage:	230 V, 50/60 Hz
Dimensions:	120x120x45 mm³
Weight:	700 g approx.

9983-1010229

Magnetic Stirrer

Ultra flat magnetic stirrer with non wearing drive featuring no moving parts. With feature for changing direction of stirring automatically every 30 seconds for improved homogenization. Work plate and housing resistant to chemicals, non slip and secure base. Including plug in power supply.

Quantity stirred, max. (H_2O):	0.8 l
Speed:	15 – 1500 rpm
Work plate:	100 mm diam.
Power supply:	power supply unit 100 V – 240 V
Dimensions:	114x12x161 mm³ approx.
Weight:	0.3 kg approx.

9983-1002808

12L Magnetic Stirrer (230 V, 50/60 Hz)

Electronically regulated magnetic stirrer in stainless steel casing with an aluminium hot plate. Accommodates stand rods (12 mm diam.) and has a 12 V DC output to supply power to accessories.

Maximum speed:	350 rpm
Hot plate:	135 mm diam.
Maximum temperature:	450°C
Power consumption:	400 W
Dimensions:	165x220x105 mm³
Weight:	2 kg

9983-1011739

Additionally recommended:

9983-1010034 Adapter for Round-Bottomed Flasks, 100 ml
9983-1010035 Adapter for Round-Bottomed Flasks, 150 ml
9983-1010036 Adapter for Round-Bottomed Flasks, 250 ml
9983-1010037 Water Bath
9983-1010038 Frame for Water Bath



9983-1011739



9983-1010037

9983-1010038



9983-1010034



9983-1010035



9983-1010036

Adapters for Round-Bottomed Flasks

Adapters for heating round-bottomed flasks on the 12L magnetic stirrer (9983-1011739)

Adapter for Round-Bottomed Flasks, 100 ml

9983-1010034

Adapter for Round-Bottomed Flasks, 150 ml

9983-1010035

Adapter for Round-Bottomed Flasks, 250 ml

9983-1010036

Water Bath

Vessel holding 4 l of water for use with the 12L magnetic stirrer (9983-1011739).

9983-1010037

Frame for Water Bath

Frame for supporting multiple smaller vessels inside the water bath (9983-1010037).

9983-1010038

www.EngineeringBooksPDF.com

Whiteboards

Metal board with enamelled surface for demonstration experiments using magnetic components, e.g., for mechanics or optics. Scratch- and acid resistant steel board that can be written on using water soluble pens. Can be wall mounted or set up on a stand.

Art. No.	Designation	Dimensions
9983-1002591	Whiteboard	600x900 mm²
9983-1002592	Whiteboard	900x1200 mm²



9983-1002593



9983-1002591 / 9983-1002664

Set of Drawing Instruments for Whiteboard

Consisting of a flat profile ruler with decimetre scale divisions, a triangular set square for geometry, circle instrument with centimetre scale, and a pointing baton. With storage case.

Flat profile ruler:	Marked at decimetre intervals, polystyrene, 1000 mm
Set square triangle:	Plexiglas, 600 mm
Circle instrument:	centimetre scale, 520 mm
Pointing baton:	Fibreglass, 1050 mm

9983-1002593



9983-1002665

9983-1002664

Whiteboard Holders

Aluminium frame for mounting whiteboards (9983-1002591 or 9983-1002592). With two adjusting screws for mounting the board either horizontally or vertically. The horizontal frame consists of profile rails suitable for mounting standard experiment panels of DIN A4 size. T-stands ensure stability on the workbench.

Holder for Whiteboard, Small

For holding 2 experiment panels of DIN A4 size.

Dimensions: 625x600 mm² approx.

9983-1002664

Holder for Whiteboard, Large

For holding 8 experiment panels of DIN A4 size.

Dimensions: 925x900 mm² approx.

9983-1002665

www.EngineeringBooksPDF.com

9983-1002941



9983-1002942
9983-1002943



Laboratory Jacks
Height adjustable table with continuously variable extension mechanism for raising experiment equipment. May be fixed in place via wing nuts.

Art. No.	Designation	Maximum load	Tabletop	Height of table	Weight
9983-1002943	Laboratory Jack I	30 kg	320x220 mm²	65–250 mm	2.6 kg
9983-1002941	Laboratory Jack II	40 kg	200x200 mm²	70–260 mm	2.3 kg
9983-1002942	Laboratory Jack III	50 kg	160x130 mm²	60–250 mm	1.2 kg



9983-1001042

Stand with H-Shaped Base
Provides a firm base for large and extensive structures, with six clamping positions for stand rods up to 12 mm diameter.
Max. stand area: 300x280 mm²
Weight: 1.7 kg approx.

9983-1001042



9983-1001044

Stand Base, A-Shaped
Levelable duplex tripod base, extremely stable, for holding two rods of 4 up to 15 mm diameter. Made of grey cast iron.

Art. No.	Leg length	Weight
9983-1001044	200 mm	1.5 kg
9983-1001043	280 mm	3.7 kg



9983-1002835

Tripod Stand
Levelable duplex tripod base, extremely stable, for holding two rods of up to 16 mm diameter. Distance between rods 135 mm.

Art. No.	Leg length	Weight
9983-1002835	150 mm	1450 g
9983-1002836	185 mm	1850 g



9983-1002834

Barrel Foot, 1 kg
Heavy base for holding rods of up to 13 mm diameter. Made of powder-coated cast iron.

9983-1002834



9983-1001046



9983-1001045

Barrel Foot
Heavy base to accommodate stand rods up to 12 mm in diameter and rectangular plates of up to 10 mm or 12 mm thickness. Made of painted cast iron.

Art. No.	Weight	Height	Diameter
9983-1001045	0.9 kg	56 mm	64 mm
9983-1001046	0.5 kg	47 mm	54 mm

www.EngineeringBooksPDF.com

Multiclamp
Universal clamp for attachment of rods up to 13 mm diameter and for holding plates, rulers, etc. of up to 13 mm thickness in a multitude of alignments. Nickel-plated steel screws.

9983-1002830



9983-1002830

Bosshead
Bosshead for connecting rods of up to 16 mm diameter. Powder-coated zinc die-casting, 110 g. Nickel-plated steel screws.

9983-1002827



9983-1002827

Cross-Bosshead
Cross-bosshead for connecting rods of up to 20 mm diameter. Powder-coated zinc die-casting, 130 g. Nickel-plated steel screws.

9983-1002831



9983-1002831

Clamp with Hook
Clamp with hook for attaching rods of up to 16 mm diameter. Powder-coated zinc die-casting, 93 g. Nickel-plated steel screws.

9983-1002828



9983-1002828

Clamp with Jaw Clamp
Stand clamp with jaw clamp for attaching rods up to 16 mm diameter. Powder-coated zinc die-casting, 190 g. Clamp with cork lining.
Clamping width: 20–40 mm

9983-1002829



9983-1002829

Universal Jaw Clamp
Clamp with cork lining. Unpainted zinc die-casting, 180 g.
Clamping width: 0 – 80 mm

9983-1002833



9983-1002833

Table Clamp
Table clamp for vertically attaching rods of up to 13 mm to tabletops. Powder-coated aluminum alloy, 350 g
Clamping width: 0 – 60 mm

9983-1002832



9983-1002832

Adjustable Double Clamp
Double clamp with two grippers which can be rotated by 360° with respect to one another. Made of non-corroding aluminium alloy.
Clamp opening widths: 3…16 mm and 3…20 mm

9983-1010083



9983-1010083

Drilled Rod
Plastic rod with six lateral bore holes and one axial bore hole for the attachment of components with 4 mm plugs.
Length: 250 mm
Diameter: 12 mm
Bore hole spacing: 19 mm and 50 mm
Bore hole diameter: 4 mm

9983-1002710



9983-1002710

www.EngineeringBooksPDF.com



9983-1002937

9983-1002934

NEW



9983-1012848
9983-1012847

SW Stand Equipment Set

Stand equipment for easy, understandable and stable assemblies, e.g. for investigating mechanical oscillations and waves.using the sensors from the SW sensors set (9983-1012850 resp. 9983-1012851). Including SW base plate as non-tilting base with three special threads to accommodate stand rods with internal and external threads, which can be extended by screwing stand rods with external thread onto the end. Two double clamps for use with the SW tie bar or 10-mm diameter stand rods. The SW tie bar serves as multi-function holder for fitting between stand rods on the base plate in order to build set-ups featuring the dynamic force sensors from the SW sensors set.

Base plate: 345x240x16 mm³ approx.
Stand rods: 400 mm x 10 mm diam. approx.

Contents:
1 SW Base plate
2 Stand rods with internal and external thread
2 Stand rods with external thread
2 SW Double clamps
1 SW Tie bar

9983-1012849

Additionally recommended:
9983-1012848 Steel Rod 280 mm
9983-1012847 Steel Rod 400 mm

Stainless Steel Rods

Art. No.	Length	Diameter
9983-1002932	100 mm	12 mm
9983-1002933	250 mm	12 mm
9983-1002934	470 mm	12 mm
9983-1002935	750 mm	12 mm
9983-1002936	1000 mm	12 mm
9983-1002937	1500 mm	12 mm
9983-1012848	280 mm	10 mm
9983-1012847	400 mm	10 mm



9983-1012849

NEW



9983-1010124 /
9983-1010160



9983-1002622

9983-1002621

9983-1002623

Tubing

Silicone, transparent, 1 m long.

Art. No.	Internal diameter	Wall thickness
9983-1002621	2 mm	1 mm
9983-1002622	6 mm	2 mm

PVC Tubing

Tubing made of crystal clear PVC. Length 20 m.

Art. No.	Internal diameter	Wall thickness
9983-1010124	4 mm	1 mm
9983-1010160	6 mm	1,5 mm

Tubing Clamps, Set of 3

Connection adapters, 12 mm to 8 mm diameter, for attachment of hoses.

9983-1002623



9983-1012831

9983-1012830

NEW

Vacuum Hoses

Vacuum hoses made of natural rubber according to DIN 12865. Colour red.



9983-1002619

9983-1002620

Art. No.	Length	Internal diameter	Wall strength	Temperature range
9983-1012831	1 m	4 mm	4 mm	-30° up to + 85°
9983-1012830	1 m	6 mm	4 mm	-30° up to + 85°
9983-1002619	1 m	8 mm	5 mm	-30° up to + 85°
9983-1002620	1 m	10 mm	5 mm	-30° up to + 85°

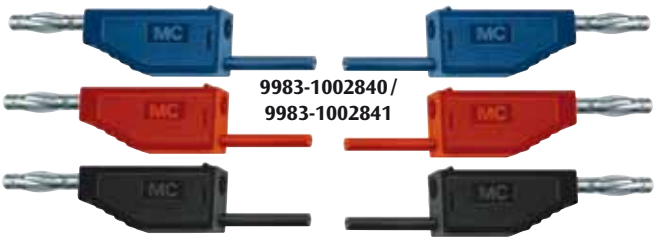
www.EngineeringBooksPDF.com

For a reliable connection

Set of 15 Experiment Leads, 75 cm

Set of 15 copper leads with highly-flexible PVC insulation, 75 cm long, with stackable 4 mm laminated plugs at both ends. Five leads in each of the colours red, black and blue.
Voltage: Safety extra low voltage
Plugs and sockets: Nickel-plated

Art. No.	Conductor cross-section	Max. continuous current
9983-1002840	1 mm²	19 A
9983-1002841	2.5 mm²	32 A



9983-1002840 / 9983-1002841

Set of Experiment Leads for Electron Tube Experiments

Set of 18 copper leads with highly flexible PVC insulation for all connections to series D electron tubes.
Wire cross-section: 1 mm²
Max. continuous current: 19 A
Plug and jack: 4 mm (nickel-plated)

9983-1002847

Quantity	Length	Colour	Connection
3	75 cm	red	Safety jack/plug
4	75 cm	blue	Plug/plug
2	75 cm	black	Plug/plug
2	50 cm	blue	Plug/plug
5	25 cm	black	Plug/plug
2	25 cm	red	Plug/plug



9983-1002847

Experiment Lead, Plug and Socket

Experiment lead with 4 mm laminated plug and 4 mm socket. 75 cm long, colour red.
Wire cross-section: 1 mm²
Max. continuous current: 19 A

9983-1002838



9983-1002838

Experiment Lead, Safety Plug and Socket

Experiment lead with stackable 4 mm safety-grade laminated plug and 4 mm socket. 75 cm long, colour red.
Wire cross-section: 1 mm²
Max. continuous current: 19 A

9983-1002839



9983-1002839

Crocodile Clip 4 mm, Not Insulated

Not insulated test clip with 4 mm sockets for accepting 4 mm-test leads or any other 4 mm-Multilam plug. Connection also possible with screw clamp or soldering.

9983-1002844

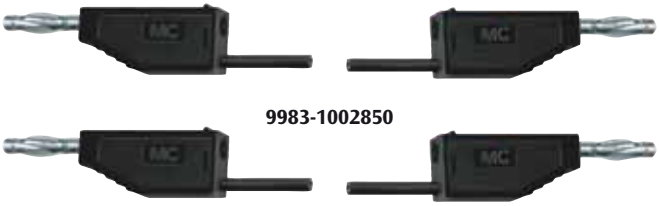


9983-1002844

Pair of Experiment Leads, 75 cm

Set of two copper leads with highly flexible PVC insulation, 75 cm long, black, with cascadable 4 mm laminated plugs at both ends.
Conductor cross-section: 1 mm²
Voltage: Safety extra low voltage
Max. continuous current: 19 A

9983-1002850



9983-1002850

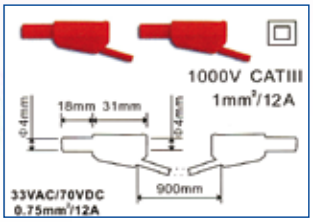
www.EngineeringBooksPDF.com

For your safety

NEW



9983-1010236





9983-1009734

9983-1002845

Set of 5 Safety Experiment Leads

Art. No.	Length	Colour
9983-1010236	0.25 m	black
9983-1010237	0.50 m	black
9983-1010238	1.00 m	black
9983-1010239	0.25 m	red
9983-1010240	0.50 m	red
9983-1010241	1.00 m	red

Safety Crocodile Clip 4 mm, Black

Fully insulated safety crocodile clip with 4 mm safety socket for accepting 4 mm safety test leads or any other 4 mm Multilam plug.

9983-1002845

Safety Crocodile Clip 4 mm, Red

Fully insulated safety crocodile clip with 4 mm safety socket for accepting 4 mm safety test leads or any other 4 mm Multilam plug.

9983-1009734

Set of 15 Safety Experiment Leads, 75 cm

Set of 15 copper leads with highly-flexible PVC insulation, 75 cm long, with stackable 4 mm safety laminated plugs at both ends. Four leads in each of the colours red, black and blue, and one lead in each of the colours green, brown and yellow-green.

Wire cross-section: 2,5 mm²
Voltage: Low voltage
Max. continuous current: 32 A

9983-1002843

Pair of Safety Experiment Leads, 75 cm

(not shown)

Set of two copper leads with highly flexible PVC insulation, 75 cm long, black, with stackable 4 mm safety laminated plugs at both ends.

Conductor cross-section: 2.5 mm²
Voltage: Safety extra low voltage
Max. continuous current: 32 A

9983-1002849



9983-1002843

Set of Three Safety Experiment Leads for Free-Fall Apparatus

(not shown)

Set of three copper leads with highly flexible PVC insulation for connecting to free-fall apparatus (9983-1000738), with stackable 4 mm safety laminated plugs at both ends. Two leads 75 cm long, one red and one black. One green lead, 150 cm long.

Wire cross-section: 2,5 mm²
Voltage: Low voltage
Max. continuous current: 32 A

9983-1002848

Pair of High-Voltage Cables, 150 cm

Set of two copper leads sheathed in highly flexible PVC, 150 cm long with 4-mm safety plugs at either end housed in rigid insulating sleeves. One red cable and one black.

Cable cross section: 0.5 mm²
Voltage: Up to 5 kV (using high-voltage power supply 9983-1003310 resp. 9983-1003309)

9983-1002851



9983-1002851

NEW

9983-1012873



Set of Fuses

Set of fuses, including 105 fast-acting fuses of a high switching capacity and 135 slow-acting fuses of a low switching capacity. Stored in a box.

Dimensions: 5 mm diam. x 20 mm
Rated voltage: 250 V

Type SP:
Material: Glass tube
Time response: Fast
Switching capacity: 1000 A @ 250 V
Assortment: 1 A (15 units); 3.15 A; 6.3 A; 10 A (30 units in each case)

Type FST:
Material: Ceramic tube
Time response: Slow
Switching capacity: 35 A @ 250 V
Assortment: 0.5 A; 1 A; 1.25 A; 1.6 A; 2 A; 2.5 A; 3.15 A; 6.3 A; 10 A (15 units each)

9983-1012873

www.EngineeringBooksPDF.com

BNC Patch-Cord Connector
Coupling at either end with a BNC jack for connecting high-frequency patch cords.
9983-1002749

Adapter, BNC Plug/ 4 mm Jacks
Crossover from a BNC plug to 4 mm jacks with 19 mm spacing.
9983-1002750

For high-frequency signals

9983-1002751



9983-1002750

9983-1002748



9983-1002752



9983-1002749



9983-1002746

HF-Patch Cord
Shielded patch cords for low loss, low capacitance transmission of high frequency signals. Equipped at either end with a BNC plug.
Impedance: 50 Ω
Length: 1 m
9983-1002746

HF Patch Cord, BNC/4 mm Plug
Shielded patch cord for low loss, low capacitance transmission of high frequency signals. Lead with a BNC plug at one end and two 4 mm plugs at the other end.
Impedance: 50 Ω
Length: 1 m
9983-1002748

Adapter, BNC Jack/ 4-mm-Plugs
Crossover from a BNC jack to 4 mm plugs with 19 mm spacing.
9983-1002751

T-Piece, BNC
T-piece for connecting two high-frequency patch cords to one BNC jack.
9983-1002752

9983-1003651



Universal Plug
Earth-contact socket with various adapters permitting worldwide use. The adapter suitable for the national standard is fitted as the mains contact.
Maximum rated load: 250 V AC, 10–16 A
9983-1003651

Adapter, BNC Plug/ 4 mm Safety Jacks
Crossover from a BNC plug to 4 mm safety jacks with 19 mm spacing.
9983-1010181

NEW

9983-1010181



Cuvette, Rectangular, 80x30x80 mm³
Plane-parallel cuvette of plexiglas with highly-polished optical surfaces for investigating the paths of light beams in liquids.
Dimensions: 80x30x80 mm³
9983-1003534

9983-1003534

Set of 3 Funnel Holders
Set of 3 stainless steel rings with attaching nut for 12 mm rod diameter. Inner diameters of rings 55 mm, 75 mm and 95 mm.
9983-1010182

Plastic Trough (not shown)
Transparent plastic trough.
Dimensions: 170x130x85 mm³
9983-4000036

9983-1010182



Funnel
Funnel, 50 mm diameter, plastic.
9983-1003568

9983-1003568



www.EngineeringBooksPDF.com









Set of 10 Glass Stirrers
Set of 10 Stirrers, made of sodiocalcic glass. 4 to 5 mm diam., length 250 mm

9983-1010110

Plane Mirror
Glass mirror, ground edges.
Dimensions: approx. 170x130 mm²

9983-1003190

Watch Glass Dishes
Made of thin-walled soda-glass, ground rim. Diameter 80 mm or 125 mm.

Art. No.	Designation
9983-1002868	Set of 10 Watch Glass Dishes, 80 mm
9983-1002869	Set of 10 Watch Glass Dishes, 125 mm

Graduated Cylinder, 250 ml
Graduated cylinder made of borosilicate glass. Tall form with spout and hexagonal base.
Scale: 250 ml
Divisions: 2.5 ml

9983-1010114

Vessel with Overflow
Vessel with overflow, 275 ml, made of Plexiglas.

9983-1003518

Graduated Cylinder, 100 ml
Graduated cylinder made of Duran glass. Tall form with spout with hexagonal base.
Scale: 100 ml
Divisions: 1 ml

9983-1002870

Free-Standing Cylinder
Non-graduated cylinder made of Duran glass. With round base and coarse ground rim.
Height: 300 mm
Diameter: 40 mm

9983-1002871

Beakers, 600 ml
Set of 10 beakers made of Borosilicate glass. With scale, 100 ml divisions and spout.

Art. No.	Designation
9983-1002872	Set of 10 Beakers, Low Form
9983-1002873	Set of 10 Beakers, Tall Form

Round-Bottomed Flask, 250 ml
(not shown)
Round-bottomed flask made of borosilicate glass, 250 ml.

9983-1011768

Round-Bottomed Flask, 500 ml
(not shown)
Round-bottomed flask made of borosilicate glass, 500 ml.

9983-1011769

Set of 8 Test Tubes
Set of 8 Test Tubes, 16 mm diam.

9983-1001051

Gas Test Tube, 250 ml
To collect gases; made of ordinary glass; with thick round bottom.

9983-1010113

Gas Syringe
For storing and measuring quantities of gases and liquids. Consists of a glass cylinder with a scale having divisions of 0.5 ml or 1 ml. The ground finish of the glass cylinder ensures extreme tightness and smooth operation.

Art. No.	Volume	Division	Valve
9983-1002886	100 ml	1 ml	1-way
9983-1002887	50 ml	0.5 ml	–
9983-1002888	25 ml	0.5 ml	–

www.EngineeringBooksPDF.com

Resonance Bowl

Dating from the Song Dynasty (960–1279 A.D.), this bronze basin has two prominent handles and four fish in relief on the bottom, as well as lines emanating from the mouths or tails of the fish. When the handles are rubbed briskly with the palms of the hands, a harmonious sound is heard and standing waves are excited in the four quadrants along the circumference, causing water columns to come alive, spouting more than 30 cm into the air, as if squirting from the fish.

Diameter: approx. 380 mm
Height: approx. 150 mm

9983-1003206

BEST SELLER

9983-1003206



Pythagorean Cup

Pythagoras is known to most students today as the author of the Pythagorean Theorem ($a^2 + b^2 = c^2$). There was far more to Pythagoras' philosophy than this: he was a deep thinker on religion, the nature of the soul, and the harmony of the cosmos. With the "Pythagorean Cup" he illustrated to his students the virtues of moderation: when filled halfway, it retains its contents, but if it's too full, all of the liquid drains out through a hole in the bottom. Our Pythagorean cup is manufactured of clear blown glass. The secret of the construction is a siphon, which is built in the centre of the cup. Ideal to explain to your students the principle of a siphon with an historical background.

Height: approx. 250 mm
Diameter: approx. 80 mm

9983-1002904

9983-1002904





9983-1008686

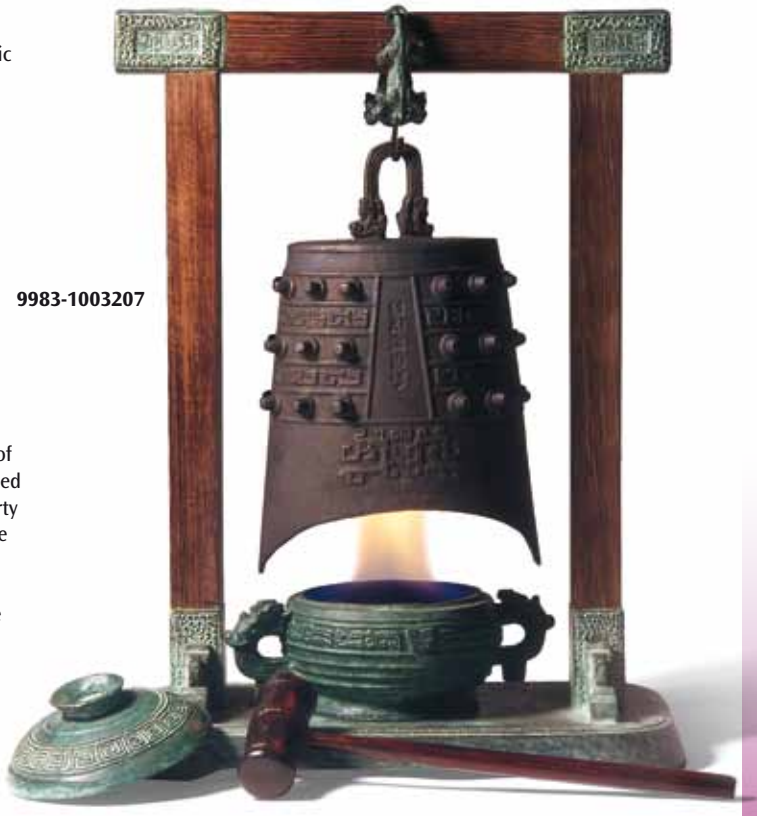
Magic Mirror

The Western Han "Light-Transmitting" Mirror known as the magic mirror has a history of more than two thousand years. It is a miracle created by the ingenious Chinese craftsmen in Western Han Dynasty (206 B.C–24 A.D.) through combining the optical and mechanical principles with superb metallurgical technology. Those wonderful mirrors are able to reflect the decorative pattern cast on their backs onto a white screen when sunlight is shining on their polished fronts. The fabrication technology of this magic mirror was lost in Song Dynasty (960 – 1279 A.D.) and had remained a mystery until 1975. With a perfect combination of science and technology, culture and art, the celebrated Magic Mirror is a perfect classroom tool as well as a cherished gift.

Diameter: approx. 70 mm
Thickness: approx. 10 mm

9983-1008686

9983-1003207



Yi Bell

The "faith bell" is shaped after the two-tone bell unearthed in the tomb of Marquis Yi in 1978. This reproduction has been cast using a newly designed copper alloy containing magnesium and exhibits a unique physical property resulting from a combination of bell design and the effect of temperature on vibrational damping. At room temperature the bell exhibits excessive damping and gives a dull sound when struck, as though it were made of wood. After being heated with an alcohol burner for several minutes, the bell is restruck and rings beautifully.

Dimensions: approx. 295x210x120 mm^3

9983-1003207

www.EngineeringBooksPDF.com

Description	Art. No.	Page
"Addition of Colours" School Apparatus	9983-1012821	156
"Renewable Energy" *Kit*	9983-1008703	31
"Solar Hydrogen" *Kit*	9983-1008702	109
3B NET*lab*™	9983-1000544	34
3B NET*log*™ (115 V, 50/60 Hz)	9983-1000539	35
3B NET*log*™ (230 V, 50/60 Hz)	9983-1000540	35
3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)	9983-1000541	35
3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)	9983-1000009	35
3B POWER*log* (115 V, 50/60 Hz)	9983-1000542	42
3B POWER*log* (230 V, 50/60 Hz)	9983-1000543	42
3B Student *Kit*	–	14–18
60°-Prism, Crown Glass, 40 mm x 40 mm	9983-1010028	153
60°-Prism, Flint Glass, 40 mm x 40 mm	9983-1010029	153
6-Piece Model of a Human Eye	9983-1000259	175
– A –		
ABS Analytical Scales (230 V, 50/60 Hz)	9983-1012881	270
Absolute Pressure Sensor, 2500 hPa	9983-1000546	39
AC/DC Power Supply 0–12 V, 3 A (115 V, 50/60 Hz)	9983-1002775	248
AC/DC Power Supply 0–12 V, 3 A (230 V, 50/60 Hz)	9983-1002776	248
AC/DC Power Supply 0–12 V, 3 A, stab. (115 V, 50/60 Hz)	9983-1001006	248
AC/DC Power Supply 0–12 V, 3 A, stab. (230 V, 50/60 Hz)	9983-1001007	248
AC/DC Power Supply 0–20 V, 0–5 A (115 V, 50/60 Hz)	9983-1003561	248
AC/DC Power Supply 0–20 V, 0–5 A (230 V, 50/60 Hz)	9983-1003562	248
AC/DC Power Supply 0–30 V, 5 A (230 V, 50/60 Hz)	9983-1002769	248
AC/DC Power Supply 0–30 V, 6 A (115 V, 50/60 Hz)	9983-1008692	213, 249
AC/DC Power Supply 0–30 V, 6 A (230 V, 50/60 Hz)	9983-1003593	213, 249
AC/DC Power Supply 1/ 2/ 3/–15 V, 10 A (115 V, 50/60 Hz)	9983-1008690	249
AC/DC Power Supply 1/ 2/ 3/–15 V, 10 A (230 V, 50/60 Hz)	9983-1008691	249
Acceleration Sensor, ±25g	9983-1000560	37
Acceleration Sensor, ±5g	9983-1000561	37
Accessories for Faraday Effect	9983-1012861	154
Accessories for Kinetic Gas Theory	9983-1000704	122
Accessories for Rope Waves	9983-1008540	90
Accessories for Spring Oscillations	9983-1000703	90
Accessory Set for the Interferometer	9983-1002652	167
Achromatic Objective 10x / 0.25	9983-1005408	144
Acoustics Kit	9983-1000816	19
Acrylic Body with Drilled Holes	9983-1002589	101
Acrylic Puck	9983-1003362	61
Adapter Flange DN 16 KF / NS 19/26	9983-1002929	85
Adapter Flange DN 16 KF / Shaft 12 mm	9983-1002928	85
Adapter for Round-Bottomed Flasks, 100 ml	9983-1010034	274
Adapter for Round-Bottomed Flasks, 150 ml	9983-1010035	274
Adapter for Round-Bottomed Flasks, 250 ml	9983-1010036	274
Adapter, BNC Jack/4-mm-Plugs	9983-1002751	281
Adapter, BNC Plug/4 mm Jacks	9983-1002750	281
Adapter, BNC Plug/4 mm Safety Jacks	9983-1010181	281
Additional Coil for Tesla Transformer	9983-1000967	213
Adjustable Double Clamp	9983-1010083	277
Adjustable Slit K	9983-1008519	139
Adjustable Slit on Stem	9983-1000856	146
Adsorption Cooler Ice-Quick	9983-1002826	129
Aerodynamics	–	86
Air Cushion Deflector	9983-1003347	59
Air Cushion Plate	9983-1002981	123
Air Cushion Table (230 V 50/60 Hz)	9983-1013210	60
Air Cushion Table (115 V 50/60 Hz)	9983-1012569	60
Air Flow Apparatus	9983-1000765	87
Air Flow Generator (115 V, 50/60 Hz)	9983-1000605	59, 86
Air Flow Generator (230 V, 50/60 Hz)	9983-1000606	59, 86
Air Track on U-shaped Base Profile, 1.9 m	9983-1003341	58
Air Track, 1.6 m	9983-1003342	59
Alcohol Meter	9983-1002875	76
Alignment Laser Diode	9983-1008634	168–171
Aluminium Shot, 100 g	9983-1000832	117
Aluminum Plates, Set of 10	9983-1002716	195
Aluminum Puck	9983-1003363	61
Aluminum Test Block with Protractor Scale	9983-1002585	100
Amici Direct Vision Prism	9983-1002862	154
Ammeter, AC	9983-1002788	258
Ammeter, DC	9983-1002786	258
Amplifier	–	267
Analogue Multimeter AM50	9983-1003073	258
Analogue Multimeter AM51	9983-1003074	258
Analogue Oscilloscope 2x150 MHz	9983-1002729	254–255
Analogue Oscilloscope, 1x10 MHz (230 V, 50/60 Hz)	9983-1002745	254–255
Analogue Oscilloscope, 2x20 MHz (230 V, 50/60 Hz)	9983-1008695	254–255
Analogue Oscilloscope, 2x30 MHz	9983-1002727	254–255
Analogue/Digital Storage Oscilloscope 2x40 MHz	9983-1002728	254–255
Aneroid Barometer F	9983-1010232	111
Apertures, Optical	–	149–152
Apparatus for Investigation of Capillary Effects	9983-1003510	79
Areometers, Set of 3	9983-1003012	76
Arm Phantom Set	9983-1012880	104
Assembly Kit "Bell, Relay and Bimetallic Switch"	9983-1000994	188
Astronomy	–	52
Atomic and Nuclear Physics	–	228–245
Atomic Orbitals	–	232
Atwood's Machine	9983-1003367	63
Auto Focus Vision Viewer™	9983-1012834	272–273
Auxiliary Coil	9983-1000645	218
– B –		
Balance weights	–	50–51
Ball and Ring	9983-1003382	118
Ball with Ring	9983-1000831	118
Ballistic Pendulum	9983-1002656	65
Balloons, Set of 100	9983-1010125	82
Band Wave Device	9983-1000808	91
Bar Magnet, AlNiCo, 70 mm	9983-1003554	196
Bar Magnets, 80 mm, Pair	9983-1003085	196
Bar Magnets, AlNiCo, 60 mm, Pair with Two Iron Yokes	9983-1003086	196
Barometer	9983-1000549	39
Baroscope	9983-1003169	83
Barrel Foot, 1000 g	9983-1002834	276
Barrel Foot, 500 g	9983-1001046	276
Barrel Foot, 900 g	9983-1001045	276
Basic Equipment Set for the X-Ray Apparatus	9983-1000665	242b
Basic Experiment Board (115 V, 50/60 Hz)	9983-1000572	189
Basic Experiment Board (230 V, 50/60 Hz)	9983-1000573	189
Basic Optics Equipment Set	9983-1000609	141
Basic Set Bragg	9983-1008508	242c
Basic Set for Kröncke Optical System (115 V, 50/60 Hz)	9983-1009931	26–27
Basic Set for Kröncke Optical Sytem (230 V, 50/60 Hz)	9983-1009932	26–27
Basic Student Experiments	–	28–30
Battery Box	9983-1003117	93
Battery Holder in 3B Box	9983-1010192	184–185
Battery Holder, P4W50	9983-1012994	191
Beakers, Low Form, Set of 10	9983-1002872	282
Beakers, Tall Form, Set of 10	9983-1002873	282
Bench Scales, Harvard Junior	9983-1012872	51
Bicycle Dynamo, Transparent	9983-1010164	209
Bicycle Wheel Gyroscope	9983-1003489	68
Block and Tackle, Experiment Set	9983-1003224	55
Block for Friction Experiments	9983-4003876	54
Blood Pressure Sensor	9983-1000578	40
BNC Patch Cord Connector	9983-1002749	281
Board for Laser Ray Box	9983-1003056	136
Bodies for Air Resistance and Buoyancy Experiments, Set	9983-1000760	86
Bolometer	9983-1000840	107
Bosshead	9983-1002827	277
Boyle's Law Apparatus	9983-1003045	125
Boyle's Law Apparatus S	9983-1003236	126
Bragg Drive	9983-1012871	242d–e
Brass Resistance 0.3 mm / 50 m	9983-1000959	182
Bravais Lattices, Set of 14	9983-1012837	230–231
Breast Model with Benign Tumor	9983-1000345	102
Broken Down Cubic Decimetre	9983-1010121	47
Buffer Solution	9983-1002753	41
Bumper Springs, Set of 20	9983-1003348	59
Bumper Springs, Soft, Set of 20	9983-1003349	59
Buoyancy	–	75
Buoyancy Apparatus	9983-1000791	75
Button on 3B Box	9983-1010146	184–185
– C –		
Calcite Crystal	9983-5006663	154
Callipers Model	9983-1010214	47
Callipers S	9983-1010217	46
Callipers, 150 mm	9983-1002601	46
Calorimeter 200 ml	9983-1000823	117
Calorimeter Cylinder, Al	9983-1003254	116
Calorimeter Cylinder, Brass	9983-1003255	116
Calorimeter Cylinder, Cu	9983-1003256	116
Calorimeter Cylinder, Steel	9983-1003257	116
Calorimeter Cylinders, Set of 4	9983-1003253	116
Calorimeter with Heating Coil, 1200 ml	9983-1000821	117
Calorimeter with Heating Coil, 150 ml	9983-1000822	117
Calorimeters	–	117
Capacitance Decade	9983-1002797	188

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Capacitance Decade 0,1 µF	9983-1002736	187
Capacitance Decade 1 µF	9983-1002737	187
Capacitor 0.1 µF, 100 V, P2W19	9983-1012953	190
Capacitor 0.22 µF, 250 V, P2W19	9983-1012945	190
Capacitor 0.47 µF, 100 V, P2W19	9983-1012954	190
Capacitor 1 µF, 100 V, P2W19	9983-1012955	190
Capacitor 1 nF, 100 V, P2W19	9983-1012949	190
Capacitor 10 µF, 35 V, P2W19	9983-1012957	190
Capacitor 10 nF, 100 V, P2W19	9983-1012952	190
Capacitor 100 µF, 35 V, P2W19	9983-1012959	190
Capacitor 100 pF, 160 V, P2W19	9983-1012947	190
Capacitor 2.2 µF, 63 V, P2W19	9983-1012956	190
Capacitor 2.2 nF, 160 V, P2W19	9983-1012950	190
Capacitor 22 nF, 100 V, P2W19	9983-1012943	190
Capacitor 2200 µF	9983-1000689	186
Capacitor 4.7 µF, 63 V, P2W19	9983-1012946	190
Capacitor 4.7 nF, 100 V, P2W19	9983-1012951	190
Capacitor 47 µF, 35 V, P2W19	9983-1012958	190
Capacitor 47 nF, 100 V, P2W19	9983-1012944	190
Capacitor 470 µF, 16 V, P2W19	9983-1012960	190
Capacitor 470 pF, 160 V, P2W19	9983-1012948	190
Carbon Configurations, Set of 3	9983-1012836	230–231
Carbon Electrodes	9983-1003508	194
Carbon Plates, Set of 5	9983-1002717	195
Cartesian Diver	9983-1002867	75
Cast Iron Bolts, Set of 10	9983-1000827	118
Castor Oil	9983-1002671	125
Cathode Ray Tube	9983-1000901	225
Cavendish Torsion Balance	9983-1003337	52
CCD Camera	–	158–159
CCD Linear Camera (115 V, 50/60 Hz)	9983-1003147	158–159
CCD Linear Camera (230 V, 50/60 Hz)	9983-1003148	158–159
Cell Holder on Stem	9983-1002721	161
Centre of Gravity Plate	9983-1008513	53
Centrifugal Pump	9983-1002575	103
Change-Over Switch (SPDT) on 3B Box	9983-1012694	184–185
Change-Over Switch, Double Pole, P4W50	9983-1012991	192
Chaotic Pendulum	9983-1003340	72
Charge Indicator	9983-1009962	177
Charge Spoon, Large	9983-1002708	178
Charge Spoon, Small	9983-1002707	178
Charge Storage Device with Piezo Charger	9983-1009963	177
Chladni Plate, Circular	9983-1000705	91
Chladni Plate, Square	9983-1000706	91
Chrome-Nickel Wire 0.5 mm / 50 m	9983-1000954	182
Chrome-Nickel Wire 0.3 mm/ 100 m	9983-1000953	182
Clamp for Projectile Launcher	9983-1002655	64
Clamp K	9983-1008518	139
Clamp with Hook	9983-1002828	277
Clamp with Jaw Clamp	9983-1002829	277
Clamps, Pair	9983-1000977	212
Cloud Chamber	9983-1000921	244
Coil D with 1200 Taps	9983-1000989	210
Coil D with 600 Taps	9983-1000988	210
Coil D with 6000 Taps	9983-1000990	210
Coil D, 900 Turns	9983-1012859	211
Coil on Acrylic Base	9983-1000928	201
Coil S with 1200 Taps	9983-1001002	212
Coil S with 2400 Taps	9983-1001003	212
Coil S with 600 Taps	9983-1001000	212
Coil S with 800 Taps	9983-1001001	212
Coil Spring Slinky	9983-1003516	92
Coil Springs	–	49
Coil with 600 Windings on 3B-Box	9983-1011346	184–185
Coil with Variable Number of Turns per Unit Length	9983-1000965	202
Coil, 10 mH, P2W19	9983-1012983	191
Collimator Lens f = +25 mm	9983-1008644	168–171
Collimator lens f = +75 mm	9983-1008646	168–171
Colour	–	156–157
Colour Filters, Primary Colours, Set of 3	9983-1003185	149
Colour Filters, Secondary Colours, Set of 3	9983-1003186	149
Colour Filters, Set of 7	9983-1003084	149
Colour Mixing, Equipment Set	9983-1003189	157
Communicating Tubes	9983-1003509	81
Compass	9983-1003093	199
Compass Magnet with Plastic Bowl	9983-1003096	198
Component Balance	9983-1000761	86
Component Holder	9983-1003203	146
Computer-Aided Experimentation	–	34–43
Concave Lens K, f = -100 mm	9983-1009864	139
Concave Lens K, f = -500 mm	9983-1009865	139
Concave Lens N, f = -100 mm	9983-1000844	140
Concave Lens on Stem f =-100 mm	9983-1003028	145
Concave Lens on Stem f =-200 mm	9983-1003029	145
Concave Mirror K	9983-1000859	138
Concave Mirror on Stem +75 mm	9983-1003031	145
Conducting Sphere, d = 30 mm, with 4 mm Plug	9983-1001026	178
Conducting Sphere, d = 85 mm, with 4 mm Plug	9983-1000938	178
Conductivity Electrode	9983-1012889	195
Conductivity Electrode for Molten Salts	9983-1012888	195
Conductivity Sensor	9983-1000553	41
Conductivity Standards, Set of 3	9983-1000552	41
Conductivity Tester	9983-1012890	195
Conductors in Magnetic Fields	–	204–205
Connector Box (115 V, 50/60 Hz)	9983-1009954	36
Connector Box (230 V, 50/60 Hz)	9983-1009955	36
Constant Velocity Student Kit	9983-1003502	28
Constantan Resistance 0.3 mm / 100 m	9983-1000956	182
Constantan Resistance 0.4 mm / 50 m	9983-1000957	182
Constantan Resistance 0.5 mm/ 50 m	9983-1000958	182
Constantan Wire 0.2 mm / 100 m	9983-1000955	182
Contact Stand with Terminal Sockets	9983-1000995	183
Control Unit for Critical Potential Tubes (115 V, 50/60 Hz)	9983-1000633	238
Control Unit for Critical Potential Tubes (230 V, 50/60 Hz)	9983-1008506	238
Control Unit for Spectrum Lamps (115 V, 50/60 Hz)	9983-1003195	162
Control Unit for Spectrum Lamps (230 V, 50/60 Hz)	9983-1003196	162
Convex Concave Mirror, f = ±100 mm	9983-1002985	135
Convex Lens K, f = 100 mm	9983-1010300	139
Convex Lens K, f = 150 mm	9983-1000871	139
Convex Lens K, f = 200 mm	9983-1009861	139
Convex Lens K, f = 300 mm	9983-1009866	139
Convex Lens K, f = 50 mm	9983-1000869	139
Convex Lens K, f = 500 mm	9983-1009863	139
Convex Lens N, f = 100 mm	9983-1000842	140
Convex Lens N, f = 300 mm	9983-1000841	140
Convex Lens N, f = 50 mm	9983-1000843	140
Convex Lens on Stem f =+100 mm	9983-1003023	145
Convex Lens on Stem f =+150 mm	9983-1003024	145
Convex Lens on Stem f =+150 mm	9983-1003027	145
Convex Lens on Stem f =+200 mm	9983-1003025	145
Convex Lens on Stem f =+300 mm	9983-1003026	145
Convex Lens on Stem f =+50 mm	9983-1003022	145
Convex Mirror on Stem -75 mm	9983-1003032	145
Copper Calorimeter	9983-1002659	116
Copper Plates, Set of 10	9983-1002712	195
Copper Shot, 200 g	9983-1000833	117
Copper Wire 0.3 mm / 100 m	9983-1000949	182
Copy of a Rowland Grating	9983-1002917	150
Cord for Experiments	9983-1001055	55
Cork Powder, 10 g Bottle	9983-1000815	93
Coupled Harmonic Oscillator	9983-1003354	59
Critical Point Apparatus	9983-1002670	124
Critical Potential Tube S with He-Filling	9983-1000620	238
Critical Potential Tube S with Ne-Filling	9983-1000621	238
Crocodile Clip 4 mm, Not Insulated	9983-1002844	279
Crocodile Clips on 3B Box	9983-1010155	184–185
Crookes Radiometer	9983-1002882	122
Cross Bosshead	9983-1002831	277
Crosspiece DN 16 KF	9983-1002924	85
Crown Glass Prism 60°, 27 mm x 50 mm	9983-1002858	153
Crown Glass Prism 60°, 30 mm x 30 mm	9983-1002864	153
Crown Glass Prism 60°, 45 mm x 50 mm	9983-1002859	153
Crown Glass Prism 90°, 30 mm x 50 mm	9983-1002860	153
Crown Glass Prism 90°, 45 mm x 50 mm	9983-1002861	153
Crystallography Accessories	9983-1000666	242b
Cubes for Determining Density, Set of 7	9983-1000766	77
Current Balance According to Langensiepen	9983-1000975	204
Current Direction Indicator in 3B Box	9983-1012697	184–185
Cuvette, Rectangular, 80x30x80 mm³	9983-1003534	281
Cyclic Processes	–	127–132
Cylinders, Set of 3	9983-1002588	101
Cylindrical Bar Magnet 200x10	9983-1003112	196
Cylindrical Bar Magnet 50x20	9983-1003556	196
Cylindrical Lens f = +15 mm	9983-1008643	168–171
Cylindrical Lens f = +45 mm	9983-1008645	168–171
– D –		
Daniell Cell	9983-1002898	194
Daniell Cell F	9983-1010131	194
DC Power Supply 0–16 V, 0–10 A (115 V, 50/60 Hz)	9983-1002760	250
DC Power Supply 0–16 V, 0–10 A (230 V, 50/60 Hz)	9983-1002761	250
DC Power Supply 0–16 V, 0–16 A	9983-1002771	250
DC Power Supply 0–20 V, 0–5 A (115 V, 50/60 Hz)	9983-1003311	250
DC Power Supply 0–20 V, 0–5 A (230 V, 50/60 Hz)	9983-1003312	250
DC Power Supply 0–300 V (115 V, 50/60 Hz)	9983-1001011	251
DC Power Supply 0–300 V (230 V, 50/60 Hz)	9983-1001012	251
DC Power Supply 0–32 V, 0–2.5 A (115 V, 50/60 Hz)	9983-1002762	250
DC Power Supply 0–32 V, 0–2.5 A (230 V, 50/60 Hz)	9983-1002763	250
DC Power Supply 0–500 V (115 V, 50/60 Hz)	9983-1003307	251

www.EngineeringBooksPDF.com

Description	Art. No.	Page
DC Power Supply 0–500 V (230 V, 50/60 Hz)	9983-1003308	251
DC Power Supply 1.5–15 V, 1.5 A (115 V, 50/60 Hz)	9983-1003559	249
DC Power Supply 1.5–15 V, 1.5 A (230 V, 50/60 Hz)	9983-1003560	249
DC Power Supply 450 V (115 V, 50/60 Hz)	9983-1008534	181, 249
DC Power Supply 450 V (230 V, 50/60 Hz)	9983-1008535	181, 249
DC Power Supply, 1–32 V / 0–20 A (115 V, 50/60 Hz)	9983-1012858	250
DC Power Supply, 1–32 V / 0–20 A (230 V, 50/60 Hz)	9983-1012857	250
Demonstration Aneroid Barometer	9983-1002627	110
Demonstration Dynamo	9983-1003252	206
Demonstration Gratings	9983-1003082	150
Demonstration Polarimeter	9983-1002906	160
Demonstration Polariscope	9983-1000851	160
Demonstration Thermometer -10–110°C	9983-1003014	112–113
Demonstration Tuning Fork	9983-1000700	94
Demonstration Wave Machine, Complete Set	9983-1003491	92
Demonstration Wave Machine, Single Module	9983-1003492	92
Demountable Transformer	–	210–212
Density and Volume	–	76–77
Density Bodies, Set of 5	9983-1000768	75
Density Paradox Set	9983-1003498	76
Device for Archimedes' Principle	9983-1003378	75
Device for Demonstrating the Anomaly of Water	9983-1002889	120
Diac, BR 100, P2W19	9983-1012973	191
Diamagnetic Levitation Apparatus	9983-1003493	197
Diaphragm with 2 cross gratings	9983-1000601	151
Diaphragm with 3 Circular Holes and Disc Pairs	9983-1000603	151
Diaphragm with 3 Double Slits of Different Widths	9983-1000596	151
Diaphragm with 3 ruled gratings	9983-1000599	151
Diaphragm with 3 Single Slits and 1 Double Slit	9983-1000885	150
Diaphragm with 4 Double Slits of Different Spacings	9983-1000597	151
Diaphragm with 4 Multiple Slits and Gratings	9983-1000598	151
Diaphragm with 9 Circular Discs	9983-1000889	151
Diaphragm with 9 Circular Holes	9983-1000891	151
Diaphragm with a Single Slit and Rib	9983-1000602	150
Diesel Engine, Transparent	9983-1002996	132
Diffraction Apertures on Glass Plate	9983-1008664	152
Diffraction Elements, Optical	–	149–152
Digital Callipers, 150 mm	9983-1002602	46
Digital Counter (115 V, 50/60 Hz)	9983-1001032	45, 243, 264
Digital Counter (230 V, 50/60 Hz)	9983-1001033	45, 243, 264
Digital Counter with Interface (115 V, 50/60 Hz)	9983-1003122	265
Digital Counter with Interface (230 V, 50/60 Hz)	9983-1003123	265
Digital Counters	–	265
Digital Energy Meter	9983-1002802	263
Digital Hygro-Thermometer	9983-1003011	110
Digital Input Box	9983-1000571	42
Digital Luxmeter	9983-1002779	263
Digital Mini Multimeter	9983-1002783	260
Digital Multimeter E	9983-1006809	261
Digital Multimeter P1035	9983-1002781	260
Digital Multimeter P3320	9983-1002784	260
Digital Multimeter P3340	9983-1002785	260
Digital Oscilloscope 4x60 MHz	9983-1008676	256
Digital Output Box	9983-1000570	42
Digital Pocket Anemometer	9983-1010250	111
Digital Pocket Thermometer	9983-1003335	114
Digital Quick Response Pocket Thermometer	9983-1002803	112–113
Digital Stopwatch	9983-1002811	45
Digital Storage Multimeter	9983-1008631	261
Digital Stroboscope (115 V, 50/60 Hz)	9983-1003330	266
Digital Stroboscope (230 V, 50/60 Hz)	9983-1003331	266
Digital Thermometer, 1 Channel	9983-1002793	115
Digital Thermometer, 2 Channels	9983-1002794	115
Digital Thermometer, Min/Max	9983-1003010	114
Digital Wattmeter	9983-1010225	262
Diode D	9983-1000646	216
Diode in 3B Box	9983-1010157	184–185
Diode Laser (230 V, 50/60 Hz)	9983-1003006	144
Diode Laser (230 V, 50/60 Hz)	9983-1003007	144
Diode Laser 100 mW	9983-1009498	168–171
Diode Laser 1000 mW	9983-1009497	168–171
Diode S	9983-1000613	221
Displacement Sensor	9983-1000568	37
DMM 1000 Iso-Multimeter	9983-1012865	261
DMM50 Digital Multimeter	9983-1012817	262
DMM60 Digital Multimeter	9983-1012816	262
Doppler Phantom Fluid	9983-1002574	102
Doppler Prisms and Flow Tubes, Set	9983-1002572	104
Doppler Sonography	–	103–104
d-Orbitals, Set of 5	9983-1012840	232
Dosimeter Radex RD 1706	9983-1012894	244
Double Slits on Glass Plate	9983-1003204	152
Doubly Refracting Crystal	9983-5006663	154
Drawing Equipment	–	275
Drawing Instruments for Whiteboard, Set	9983-1002593	275
Drilled Rod	9983-1002710	278
Drip Cup with Basin	9983-1000970	181
Drop and Launch Apparatus	9983-1000588	65
Dry Fuel for Steam Engine B	9983-1012886	131
Dual Beam Tube S	9983-1000622	222
Dual Pole Tube	9983-1008521	224
Dual-Beam Tube D	9983-1000654	217
Dummy Flange DN 16 KF	9983-1002927	85
Dynamometer 1 kg / 10 N, Colour Coded	9983-1003372	48
Dynamometer 1 N, Transparent	9983-1002698	48
Dynamometer 1 N, with Round Dial	9983-1009738	48
Dynamometer 10 N, with Round Dial	9983-1009741	48
Dynamometer 2 kg / 20 N, Colour Coded	9983-1003373	48
Dynamometer 2 N, Transparent	9983-1002699	48
Dynamometer 2 N, with Round Dial	9983-1009739	48
Dynamometer 250 g / 2,5 N, Colour Coded	9983-1003370	48
Dynamometer 3 kg / 30 N, Colour Coded	9983-1003374	48
Dynamometer 5 kg / 50 N, Colour Coded	9983-1003375	48
Dynamometer 5 N, Transparent	9983-1002700	48
Dynamometer 5 N, with Round Dial	9983-1009740	48
Dynamometer 500 g / 5 N, Colour Coded	9983-1003371	48
Dynamometer 6 N, Transparent	9983-1002701	48
Dynamometers	–	48
Dynamometers for Demonstrating Hooke's Law	9983-1003109	49
– E –		
E 10 Lamp Socket, Sideways Facing, P2W19	9983-1012986	191
E 10 Lamp Socket, Upwards Facing, P2W19	9983-1012987	191
E10 Bulbs, 1.3 V, 60 mA, Set of 10	9983-1010199	183
E10 Bulbs, 12 V, 100 mA, Set of 10	9983-1010140	183
E10 Bulbs, 12 V, 500 mA, Set of 10	9983-1010141	183
E10 Bulbs, 3.5 V, 150 mA, Set of 10	9983-1010142	183
E10 Bulbs, 3.5 V, 200 mA, Set of 10	9983-1010143	183
E10 Bulbs, 3.8 V, 300 mA, Set of 10	9983-1010195	183
E10 Bulbs, 4 V, 40 mA, Set of 10	9983-1010196	183
E10 Bulbs, 6 V, 1 A, Set of 10	9983-1010198	183
E10 Bulbs, 6 V, 100 mA, Set of 10	9983-1010145	183
E10 Bulbs, 6 V, 350 mA, Set of 10	9983-1010144	183
E10 Bulbs, 6 V, 50 mA, Set of 10	9983-1010197	183
E10 Lamp Socket on 3B Box	9983-1010138	184–185
E10 Lamp Sockets, Set of 10	9983-1010137	183
E14 Lamp Socket on Stem	9983-1000853	148
E27 Lamp Socket on Stem	9983-1000854	148
ECG/EMG Box	9983-1000579	40
Ecoflam Pellets, Set of 60	9983-1010255	133
Elastic Balls with Plotting Electrode, Pair	9983-1000779	62
Electric Doorbell	9983-1003170	83
Electric Field Meter (115 V, 50/60 Hz)	9983-1001029	180
Electric Field Meter (230 V, 50/60 Hz)	9983-1001030	180
Electrical Burner LAB2 (230 V, 50 Hz)	9983-1010252	133
Electrical Burner LAB3 (230 V, 50 Hz)	9983-1010253	133
Electrical Circuits	–	180–189
Electricity and Magnetism	–	176–227
Electro-Chemistry	–	193–195
Electrochemistry Case	9983-1002719	193
Electrodes for ECG/EMG, Set	9983-5006578	40
Electrolytic Trough	9983-1009884	181
Electrometer (115 V, 50/60 Hz)	9983-1001024	178
Electrometer (230 V, 50/60 Hz)	9983-1001025	178
Electrometer Accessories	9983-1006813	178
Electrometer Box	9983-1000569	39
Electron Deflection Tube D	9983-1000651	214
Electron Diffraction Tube D	9983-1000655	214, 239
Electron Diffraction Tube S	9983-1000623	220, 239
Electron Tubes	–	214–227
Electronic Scale 200 g	9983-1003433	268
Electronic Scale 5000 g	9983-1003434	268
Electronic Scale Scout Pro 200 g (115 V, 50/60 Hz)	9983-1003426	269
Electronic Scale Scout Pro 200 g (230 V, 50/60 Hz)	9983-1009772	269
Electronic Scale Scout Pro 400 g (115 V, 50/60 Hz)	9983-1003427	269
Electronic Scale Scout Pro 400 g (230 V, 50/60 Hz)	9983-1003428	269
Electronic Scale Scout Pro 600 g (115 V, 50/60 Hz)	9983-1012774	269
Electronic Scale Scout Pro 600 g (230 V, 50/60 Hz)	9983-1003429	269
Electroscope	9983-1003048	177
Electroscope S	9983-1009964	177
Electrostatic Equipment Set	9983-1000924	176
Electrostatics	–	176–181
Electromotor and Generator	9983-1013132	207
ELV Motor on 3B Box	9983-1010158	184–185
Energy and the Environment	–	106–111

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Equipment Kit “Hysteresis Curve”	9983-1000963	197
Equipment Set “Ultrasound in SolidsW	9983-1002584	100
Equipment Set Electromagnetism	9983-1002661	205
Equipment Set for Colour Mixing	9983-1003189	157
Equipment Set for Electrochemistry	9983-1002711	195
Equipment Set for Laser Communication	9983-1003055	173
Equipment Set for Powder Tracing	9983-1000739	62
Equipment Set for Wave Optics with Laser	9983-1003053	155
Equipment Set for Waveguide Optics	9983-1003054	173
Equipment Set Optics with Laser Ray Box	9983-1003049	136
Equipment Sets for Optics	–	172–173
Equivalent of Heat	–	116
Ergonomic Magnifying Glass on Stem	9983-1003768	175
ESR Supplementary Set	9983-1000640	240–241
ESR/NMR	–	240–241
ESR/NMR Basic Set (115 V, 50/60 Hz)	9983-1000637	240–241
ESR/NMR Basic Set (230 V, 50/60 Hz)	9983-1000638	240–241
Experiment Lead, Plug and Socket	9983-1002838	279
Experiment Lead, Safety Plug and Socket	9983-1002839	279
Experiment Leads and Cables	–	279–281
Experiment Leads, 75 cm, 1 mm², Set of 15	9983-1002840	279
Experiment Leads, 75 cm, 2.5 mm², Set of 15	9983-1002841	279
Experiment Leads, 75 cm, Pair	9983-1002850	279
Experiment Motor with Gearbox	9983-1002663	209, 266
Experiment Set Pulleys and Block and Tackle	9983-1003224	55
Experimental Lamp, Halogen	9983-1003038	143
Extension Arm D	9983-1002646	143
External Centring Ring DN 10/16 KF	9983-1002931	85
External Micrometer	9983-1002600	46
Extra Pulley	9983-1000699	53
Eye and Vision	–	175
– F –		
Falling Sphere Viscometer	9983-1012827	81
Faraday Cup	9983-1000972	178
FET Transistor, BF 244, P4W50	9983-1012978	192
Fibre Optic Cables, Plain, Set of 8	9983-1010208	175
Field Coil 100 mm	9983-1000591	202
Field Coil 120 mm	9983-1000592	202
Filmpack 2	9983-1000669	242h
Filmpack 4	9983-1000670	242h
Filter Holder with Filter RG850	9983-1008648	168–171
Filter Holder with Filter-Types RG850 and BG40	9983-1008649	168–171
Filters, Optical	–	149–152
Fine Beam Tube on Connection Base	9983-1000904	226
Fine Beam Tube T	9983-1008505	227
Five-Beam Lamp	9983-1003187	137
Flat Coil in a Rotatable Frame	9983-1013131	207
Flat Coils, Pair	9983-1000942	200
FlexCam® 2	9983-1012835	272–273
Flexible Magnetic Field Sensor	9983-1012892	203
Flint Glass Block for Faraday Effect	9983-1012860	154
Flint Glass Prism 60°, 30 mm x 30 mm	9983-1002865	153
Fluorescence Samples, Set	9983-1012868	242h
Focusing lens f = +75 mm	9983-1008647	168–171
f-Orbitals, set of 7	9983-1012838	232
Force Sensor, ±50 N	9983-1000557	37
Force Table	9983-1000694	53
Foucault Pendulum (115 V, 50/60 Hz)	9983-1000747	70
Foucault Pendulum (230 V, 50/60 Hz)	9983-1000748	70
Four-Stroke Engine, Transparent	9983-1002995	132
Frame for Water Bath	9983-1010038	274
Franck-Hertz Tube with Hg	9983-1003549	236–237
Franck-Hertz Tube with Mercury Filling and Heating Chamber (115 V, 50/60 Hz)	9983-1006794	236–237
Franck-Hertz Tube with Mercury Filling and Heating Chamber (230 V, 50/60 Hz)	9983-1006795	236–237
Franck-Hertz Tube with Ne	9983-1003550	236–237
Franck-Hertz Tube with Ne Filling	9983-1000912	236–237
Franck-Hertz-Experiment	–	236–237
Free Electrons in Gases and in Vacuum	–	214–227
Free Fall	–	63
Free Fall Apparatus	9983-1000738	63
Free Fall Tube	9983-1000801	80
Free Standing Cylinder, without Graduation	9983-1002871	75, 282
Frequency Doubling Module	9983-1008636	168–171
Fresnel Biprism	9983-1008652	154
Fresnel Mirror Experiment Set	9983-1003059	156
Fresnel Mirror K	9983-1009927	139
Fresnel Mirror on Stem	9983-1002649	148
Friction	–	54
Friction Measuring Apparatus	9983-1009942	54
Friction Rods	9983-1002709	178
Frosted Disc	9983-1010031	152
Frosted Disc with “d”	9983-1010030	152
Fuel Cell Demonstration System	9983-1002689	108
Fuel Cell Experiment Box	9983-1002690	32
Fuel Cells	–	108–109
Fuel Cell Car	9983-1002692	108
Function Generator 0.02 Hz–2 MHz (115 V, 50/60 Hz)	9983-1002743	253
Function Generator 0.02 Hz–2 MHz (230 V, 50/60 Hz)	9983-1002744	253
Function Generator FG 100 (115 V, 50/60 Hz)	9983-1009956	252
Function Generator FG 100 (230 V, 50/60 Hz)	9983-1009957	252
Function Generators	–	252–253
Functional Model of the Eye	9983-1005047	175
Fundamentals of Atomic Physics	–	234–235
Funhouse Mirror 135x210cm²	9983-1003338	174
Funhouse Mirror 60x130cm²	9983-1003339	174
Funnel	9983-1003568	281
Funnel Holders, Set of 3	9983-1010182	281
Fuse Holder on 3B Box	9983-1010154	184–185
Fusion Ring	9983-1000980	211
– G –		
Galvanometer, DC	9983-1002790	258
Gas Discharge Tube	9983-1002905	224
Gas Discharge Tube S	9983-1000624	223
Gas Expansion Apparatus	9983-1003511	120
Gas Filled Photocell	9983-1000916	235
Gas Laws	–	122–126
Gas Test Tube, 250 ml	9983-1010113	282
Gas Triode D	9983-1000653	216
Gas Triode S with He-Filling	9983-1000618	221
Gas Triode S with Ne-Filling	9983-1000619	221
GASTEC Gas Detector	9983-1012504	30
Gauge with Adapter	9983-1012862	119
Gay-Lussac Pycnometer	9983-1002874	76
Geiger Counter	9983-1002722	243
Geiger-Müller Counter Tube	9983-1001035	243
Geiger-Müller Tube	9983-1000661	242c
Geometric Optics	–	137
Germanium Diode, AA 118, P2W19	9983-1012963	191
Glass Cylinder with 2 Tubes	9983-1002891	79
Glass Cylinder with 3 Tubes	9983-1002890	79
Glass Inset for Newton’s Ring Experiments	9983-1008669	148
Glass Prism, 60°	9983-1008681	153
Glass Prism, 90-60-30°	9983-1009811	153
Glass Shot, 100 g	9983-1000834	117
Glass Stirrer, Set of 10	9983-1010110	282
Glassware	–	281–282
Glider 150 g (Gold)	9983-1003344	59
Glider 300 g (Red)	9983-1003345	59
Glider 450 g (Blue)	9983-1003346	59
Globe with Bar Magnet	9983-1013123	198
Graduated Cube 1 l	9983-1010204	47
Graduated Cuboid 1 l	9983-1010205	47
Graduated Cylinder 1 l	9983-1010206	47
Graduated Cylinder, 100 ml	9983-1002870	117, 282
Graduated Cylinder, 250 ml	9983-1010114	282
Graetz Bridge in 3B Box	9983-1012695	184–185
Grating 1000/mm	9983-1003181	151
Grating 140/mm	9983-1003178	151
Grating 530/mm	9983-1003179	151
Grating 600/mm	9983-1003180	151
Gratings, Set of 4	9983-1003081	151
Gravitation	–	52
Green LED on 3B Box	9983-1010191	184–185
Greenhouse Effect	–	107
Gyroscope	9983-1000695	68
Gyroscope	–	68
Gyroscope Accessories	9983-1000698	68
Gyroscope S	9983-1012328	68
– H –		
Hall Effect Basic Apparatus	9983-1009934	242
Hall Effect	–	242
Halogen Lamp 12 V, 20 W	9983-1003533	138
Halogen Lamp 500 W (230 V, 50/60 Hz)	9983-1000894	106
Halogen Lamp 500 W(115 V, 50/60 Hz)	9983-1000893	106
Halogen Lamp, 12 V, 35 W	9983-1003324	134
Halogen Lamp, 12 V, 55 W	9983-1003322	135
Hand Spectroscope	9983-1003182	164–165
Hand Spectroscope with Amici Prism	9983-1003531	164–165
Hand-Held Analogue Measuring Instruments	–	258–259
Hand-Held Digital Measuring Instruments	–	260–263
HD Video Flex®	9983-1012828	272–273
Heart Model	9983-1002590	101
Heat and Thermodynamics	–	112–133
Heat Conduction	–	121
Heat Conductivity Device	9983-1003383	121
Heat Equivalent Apparatus	9983-1002658	116
Heat Flow	–	122
Heat Flow Device	9983-1002903	121
Heat Flow Device S	9983-1003512	121
Heat Pump D (115 V, 50/60 Hz)	9983-1000819	130
Heat Pump D (230 V, 50/60 Hz)	9983-1000820	130
Heat Sources	–	132–133
Heating Chamber (115 V, 50/60 Hz)	9983-1006796	234
Heating Chamber (230 V, 50/60 Hz)	9983-1012820	234
Helical Spring Snakey	9983-1008687	92

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Helical Spring 1.5 N/m	9983-1000786	49
Helical Spring 86 N/m	9983-1002704	49
Helical Spring 2.5 N/m	9983-1003515	49
Helical Spring 20 N/m, 110 mm	9983-1002703	49
Helical Spring 20 N/m, 180 mm	9983-1002946	49
Helical Spring 3.0 N/m	9983-1002945	49
Helical Spring 5 N/m	9983-1000741	49
Helical Spring 6.0 N/m	9983-1002702	49
Helmholtz Coils 300 mm	9983-1000906	207
Helmholtz Pair of Coils D	9983-1000644	218
Helmholtz Pair of Coils S	9983-1000611	222
Helmholtz Resonator d = 32 mm	9983-1003523	96
Helmholtz Resonator d = 40 mm	9983-1003522	96
Helmholtz Resonator d = 52 mm	9983-1003521	96
Helmholtz Resonator d = 70 mm	9983-1003520	96
He-Ne Laser	9983-1003165	144
Hexagonal Magnet Model	9983-1002975	200
HF Coil, 33 mH, P2W19	9983-1012984	191
HF Patch Cord	9983-1002746	281
HF Patch Cord, BNC/4 mm Plug	9983-1002748	281
Hg High-Pressure Spare Lamp (230 V, 50/60 Hz)	9983-1003161	163
Hg High-Pressure Spectral Lamp (230 V, 50/60 Hz)	9983-1003157	163
Hg Low-Pressure Spare Lamp (230 V, 50/60 Hz)	9983-1003162	163
Hg Low-Pressure Spectral Lamp (230 V, 50/60 Hz)	9983-1003158	163
High Current Coil for Nail Fusing Experiment	9983-1000984	210
High Current Coil S	9983-1000999	212
High Current Coil with Five Turns	9983-1000981	211
High Current Sensor, 10 A	9983-1000545	39
High Voltage Coil Including 2 Horn Shaped Electrodes	9983-1000991	210
High Voltage Power Supply 5 kV (115 V, 50/60 Hz)	9983-1003309	251
High Voltage Power Supply 5 kV (230 V, 50/60 Hz)	9983-1003310	251
High Voltage Power Supply 6 kV (115 V, 50/60 Hz)	9983-1003140	251
High Voltage Power Supply 6 kV (230 V, 50/60 Hz)	9983-1003141	251
High-Pressure Mercury Vapour Lamp	9983-1000852	163, 235
High-Voltage Cables, 150 cm, Pair	9983-1002851	280
Historical Experiments	–	283
Hofmann's Voltameter S	9983-1003507	194
Hofmann's Voltameter	9983-1002899	194
Holder for Components	9983-1008524	182
Holder for Four Optical Components	9983-1008667	146
Holder for Glassware	9983-1010254	133
Holder for Whiteboard, Large	9983-1002665	275
Holder for Whiteboard, Small	9983-1002664	275
Holder K for Diode Laser	9983-1000868	139
Holder on Stem for Direct-Vision Prism	9983-1012863	147
Holder on Stem for Lenses without Frame	9983-1003164	147
Hole Diaphragms, Set of 5	9983-1000848	149
Hologram	9983-1003177	150
Horn Loudspeaker	9983-1000811	97
Horseshoe Magnet 130 mm, with Yoke	9983-1003114	196
Horseshoe Magnet 140 mm, with Yoke	9983-1003088	196
Horseshoe Magnet, 70 mm	9983-1000929	196
H-Racer	9983-1008699	109
Human Pulse Sensor Box	9983-1000575	40
Humidity Sensor	9983-1000554	39
Hydraulic/Pneumatic Lifting Platform	9983-1003495	80
Hydrogen Car	9983-1008700	109
Hygrometer F	9983-1010233	110
– I –		
iCam Digital	9983-1012643	272–273
Ice Bomb	9983-1000828	118
Ice-Quick	9983-1002826	129
Image Objects, Set of 4	9983-1000886	149
Immersion Block Al 100 cm³	9983-1002953	75, 76
Immersion Block Al 50 cm³	9983-1002952	75, 76
Immersion Block Fe 100 cm³	9983-1002955	75, 76
Immersion Block Fe 50 cm³	9983-1002954	75, 76
Immersion Heater (230 V, 50/60 Hz)	9983-1003566	132
Immersion Heater, 12V	9983-1003258	116
Immersion/Circulation Thermostat (115 V, 50/60 Hz)	9983-1008653	125
Immersion/Circulation Thermostat (230 V, 50/60 Hz)	9983-1008654	125
Inclination and Declination Instrument	9983-1006799	199
Inclination Instrument	9983-1003192	199
Inclined Plane	9983-1003213	56
Indigo Solution	9983-1000793	78
Inductance Decades	9983-1002796	188
Induction	–	206–209
Induction Apparatus	9983-1000968	206
Induction Coils, Set of 3	9983-1000590	208
Induction Torch	9983-1010207	209
Inelastic Collision Accessories	9983-1003352	59
Inertia Balance	9983-1003235	72
Infrared Temperature and Humidity Gauge	9983-1002795	110
Infrared Thermometer, 380° C	9983-1008630	115
Infrared Thermometer, 800° C	9983-1002791	115
Insertion Thermometer	9983-1003334	114
Insertion Thermometer F	9983-1010219	114
Instrumentation	–	246–275
Insulated Slider	9983-1002969	183
Insulator with Clamp	9983-1002970	183
Interference Filter 436 nm	9983-1008671	148
Interference Filter 546 nm	9983-1008670	148
Interference Filter 578 nm	9983-1008672	148
Interferometer	9983-1002651	167
Interferometers	–	167
Inverting Spectacles	9983-1000895	154
Ionization Chamber	9983-1000668	242h
Iris Diaphragm K	9983-1000850	138
Iris on Stem	9983-1003017	147
Iron Filings	9983-1000580	200
Iron Plates, Set of 10	9983-1002714	195
Iron Wire 0.3 mm/ 100 m	9983-1000950	182
– J –		
Jet Nozzle (Flow Laminator)	9983-1000758	86
Jolly's Bulb and Gauge	9983-1012870	126
Joule and Wattmeter	–	257
Jumpers, P2W19, Set of 10	9983-1012985	191
– K –		
Kirchhoff-Bunsen Spectroscope	9983-1002911	164–165
Kit Greenhouse Effect (115 V, 50/60 Hz)	9983-1009764	107
Kit Greenhouse Effect (230 V, 50/60 Hz)	9983-1000837	107
Knife-Edge Switch on 3B Box	9983-1010152	184–185
Kolbe's Electroscope	9983-1001027	177
Kröncke Optical System for Student Exercises	–	26–27
Kröncke Optics	–	138–139
K-Type NiCr-Ni Immersion Sensor, -200°C–1150°C	9983-1002805	112–113
K-Type NiCr-Ni Immersion Sensor, -65°C–550°C	9983-1002804	112–113
Kundt's Tube	9983-1000814	93
Kundt's Tube With Scale	9983-1003115	93
– L –		
Lab Material	–	276–282
Laboratory Jack I	9983-1002943	276
Laboratory Jack II	9983-1002941	276
Laboratory Jack III	9983-1002942	276
Laboratory Scales	–	268–270
Laminar Flow	–	87
Laminar Flow Apparatus	9983-1006784	87
Lamp Housing on a Stand Rod	9983-1003197	162
Lamp Socket E10 on Acrylic Base	9983-1000946	182
Lamp Socket E14 on Acrylic Base	9983-1000947	182
Laser Communication, Equipment Set	9983-1003055	173
Laser Diode Driver and Temperature Controller Dsc01-0.5	9983-1008633	168–171
Laser Diode Driver and Two-Way Temperature Controller Dsc01-2.5	9983-1008632	168–171
Laser Diode for Debye-Sears Effect, Green	9983-1002579	98
Laser Diode for Debye-Sears Effect, Red	9983-1002577	98
Laser Diode, Red	9983-1003201	144
Laser Mirror I	9983-1008638	168–171
Laser Mirror II	9983-1008639	168–171
Laser Module, Green	9983-1003202	144
Laser Ray Box (115, 50/60 Hz)	9983-1003051	136
Laser Ray Box (230 V, 50/60Hz)	9983-1003052	136
Laser Reflection Sensor	9983-1001034	36, 45
Laser Safety Goggles for Nd:YAG Laser	9983-1002866	168–171
Launcher S	9983-1000740	65
Leclanché Cell	9983-1002897	195
LED Graetz Bridge in 3B Box	9983-1012696	184–185
LED, Green, Upward Facing, P2W19	9983-1012971	191
LED, Red, Sideways Facing, P2W19	9983-1012972	191
LED, Red, Upward Facing, P2W19	9983-1012962	191
Lenz's Law Copper Tube	9983-1009716	209
Lenz's Law Apparatus	9983-1009959	209
Leslie's Cube	9983-1000835	122
Lever	9983-1008539	56
Light and Optics	–	134–175
Light Box	9983-1003209	29
Light Emitting Diodes for Determination of *h*	9983-1000917	234
Light Metal Tuning Fork, 1000 Hz	9983-1002608	94
Light Metal Tuning Fork, 1700 Hz	9983-1002607	94
Light Sensor	9983-1000562	40
Linear Expansion Apparatus D	9983-1002977	119
Linear Expansion Apparatus S	9983-1002978	119
Linear Expansion Apparatus with Three Pointers	9983-1000830	119
Linear Motion	–	57–59
Lip Whistle	9983-1009924	96

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Lodestone	9983-1003091	197
Loop-Shaped Conductor on Acrylic Base	9983-1000927	201
Lorentz Force Apparatus	9983-1003251	204
Lorentz Motor	9983-1002662	205
Low Temperature Stirling Engine Assembly Kit	9983-1002599	129
Low Voltage Coil D	9983-1000985	210
Low-Frequency Transformer, 1:2, P4W50	9983-1012982	192
Low-Temperature Stirling Engine	9983-1002598	129
Luminescence Tube D	9983-1000648	215
Luminescence Tube S	9983-1000615	220
– M –		
Magdeburg Plates	9983-1003496	82
Magdeburger Hemispheres	9983-1003208	82
Magic Mirror	9983-1008686	283
Magnet Model, Cubic	9983-1002976	200
Magnetic Equipment Set	9983-1003089	196
Magnetic Field Indicator	9983-1003555	199
Magnetic Field Lines Apparatus, Two-Dimensional	9983-1003092	200
Magnetic Field Lines Device, Three-Dimensional	9983-1009765	200
Magnetic Field Sensor ±100 mT	9983-1000558	38
Magnetic Field Sensor ±2000 mT	9983-1009941	38
Magnetic Field Sensor, Axial/Tangential	9983-1001040	203
Magnetic Fields	–	198–203
Magnetic Fields, Set of Apparatus for Displaying	9983-1000925	201
Magnetic Holder for Single-Ray Projector	9983-1003323	134
Magnetic Needle, 80 mm	9983-1000674	199
Magnetic Pucks, Pair	9983-1003364	61
Magnetic Stirrer	9983-1002808	274
Magnetic Stirrer 12L (230 V, 50/60 Hz)	9983-1011739	274
Magnetic Stirrer Speedsafe (230 V, 50/60 Hz)	9983-1010229	274
Magnetic Stirrer with Heater (115 V, 50/60 Hz)	9983-1002806	274
Magnetic Stirrer with Heater (230 V, 50/60 Hz)	9983-1002807	274
Magnetic Stirrers	–	274
Magnetism	–	196–197
Magnetizing Coil	9983-1003237	202
Magnets	–	196–197
Magnets, Set of 10	9983-1003351	59
Magnifying Glass on Stem	9983-1003767	175
Mains Coil with Connecting Lead (115 V, 50/60 Hz)	9983-1000986	210
Mains Coil with Connecting Lead (230 V, 50/60 Hz)	9983-1000987	210
Maltese Cross Tube D	9983-1000649	215
Maltese Cross Tube S	9983-1000011	220
Mariotte Flask	9983-1002894	126
Maximum Minimum Thermometer	9983-1002878	110
Maxwell's Wheel	9983-1000790	63
Measurement Amplifier (115 V, 50/60 Hz)	9983-1001021	267
Measurement Amplifier (230 V, 50/60 Hz)	9983-1001022	267
Measurement of Length	–	46–47
Measurement of Time	–	45
Measurement of Volume	–	47
Measuring Amplifier S	9983-1001028	267
Mechanical Balance 311	9983-1003421	268
Mechanical Balance 610	9983-1003419	268
Mechanical Balance 610 with Tare	9983-1003420	268
Mechanical Cumulative Stopwatch	9983-1002810	45
Mechanical Stopwatch, 15 min	9983-1003369	45
Mechanical Stopwatch, 30 min	9983-1003368	45
Mechanical Waves	–	90–92
Mechanics	–	44–87
Mechanics Kit for Whiteboard	9983-1000735	44
Mechanics on a Whiteboard	–	44
Metal Ring	9983-1000992	211
Metal Strips, Set of 5	9983-1000982	211
Metallophone	9983-1000804	96
Micrometer Screw K	9983-1000887	138
Micromotor, 1.5 V DC, P2W19	9983-1012995	191
Microphone	9983-1000565	37
Microscopes	–	271
Microvoltmeter (115 V, 50/60 Hz)	9983-1001015	267
Microvoltmeter (230 V, 50/60 Hz)	9983-1001016	267
Microwave Set 10.5 GHz (115 V, 50/60 Hz)	9983-1009950	88
Microwave Set 9.4 GHz (230 V, 50/60 Hz)	9983-1009951	88
Millikan's Apparatus	9983-1002819	233
Millikan's Experiment	–	233
Millimetre Paper Sheets, Pack	9983-1000691	181
Millisecond Counter (115 V, 50/60 Hz)	9983-1012833	265
Millisecond Counter (230 V, 50/60 Hz)	9983-1012832	265
Model Crystals	–	230–231
Model Eye for Ultrasonic Biometry	9983-1012869	102
Molecule Building Sets	–	230–231
Moll-Type Thermopile	9983-1000824	107, 122
Momentary Contact Switch on Acrylic Base	9983-1000962	182
Monochord	9983-1000806	96
Monochord D	9983-1002959	96
Monochord Strings, Set of 3	9983-1002960	96
Monocular Course Microscope Model 100 (115 V, 50/60 Hz)	9983-1005401	271
Monocular Course Microscope Model 100 (230 V, 50/60 Hz)	9983-1005402	271
Monocular Polarisation Microscope	9983-1012403	271
MoS_2 Sample	9983-1012877	229
Motion in a Plane	–	60–62
Motor Drive Debye-Scherrer (115 V, 50/60 Hz)	9983-1000662	242c
Motor Drive Debye-Scherrer (230 V, 50/60 Hz)	9983-1000663	242c
Motor with Drive Control	9983-1002705	157
Motor, 12 V DC	9983-1001041	91
Multimeter	–	258–261
Multimeter ESCOLA 10	9983-1006810	259
Multimeter ESCOLA 2	9983-1006811	259
Multiple Ray Projector, Magnetic	9983-1003321	135
Multiple Slits on Glass Plate	9983-1008666	152
– N –		
Na Low-Pressure Spare Lamp (230 V, 50/60 Hz)	9983-1003163	163
Na Low-Pressure Spectral Lamp (230 V, 50/60 Hz)	9983-1003159	163
NaI Operating and Evaluation Unit	9983-1008708	245
NaI(Tl) Scintillation Detector	9983-1008707	245
Nails for Nail Fusing Experiment, Set of 20	9983-1000983	211
Nd:YAG Cristal	9983-1008635	168–171
N-Doped Germanium on Printed Circuit Board	9983-1009760	242
NEVA Optical System	–	140
Newton's Colour Disc	9983-1002983	157
Newton's Colour Disc, with Crank	9983-1010194	156
Newton's Colour Disc, with DC Motor	9983-1010175	156
Nickel Plates, Set of 5	9983-1002715	195
Nickel Wire 0.3 mm / 50 m	9983-1000951	182
NiCr-Ni Temperature Sensor	9983-1003137	257
NMR	–	240–241
NMR Supplementary Set	9983-1000642	240–241
Noise	–	111
Noise Level Indicator SPL	9983-1012741	111
Noise Level Meter P8005	9983-1002780	263
NPN Transistor, BC 550, P4W50	9983-1012976	192
NPN Transistor, BD 137, P4W50	9983-1012974	192
NTC Resistor, 2.2 kΩ, P2W19	9983-1012941	191
– O –		
Object for Measurement Exercises	9983-1006889	47
Object Holder N	9983-1000845	140
Object Holder on Stem	9983-1000855	146
Objective for Beam Divergence	9983-1000675	144
Oersted's Needle Device	9983-1009710	198
Ohm's Law Apparatus in 3B Box	9983-1012698	184–185
Oil for Steam Engine	9983-1012887	131
Operating Unit for Fine-Beam Tube	9983-1009948	227
Operational Amplifier, LM 741, P4W50	9983-1012981	192
Optical Apertures	–	149–152
Optical Base D	9983-1009733	143
Optical Bench K, 1000 mm	9983-1009696	138
Optical Bench K, 2000 mm	9983-1009699	138
Optical Bench K, 500 mm	9983-1009926	138
Optical Bench KL	9983-1008642	168–171
Optical Bench N	9983-4003987	140
Optical Bench U, 1200 mm	9983-1003039	141
Optical Bench U, 600 mm	9983-1003040	141
Optical Components on Stem	–	145–148
Optical Components, Set	9983-1002993	137
Optical Crystals	–	153–154
Optical Diffraction Elements	–	149–152
Optical Disc with Accessories	9983-1003036	141
Optical Disc with Diode Laser (115 V, 50/60 Hz)	9983-1003057	137
Optical Disc with Diode Laser (230 V, 50/60 Hz)	9983-1003058	137
Optical Equivalent to Debye-Scherrer Interference	9983-1000656	239
Optical Filters	–	149–152
Optical Lamp K	9983-1000863	138
Optical Lamp N (115 V, 50/60 Hz)	9983-1009945	140
Optical Lamp N (230 V, 50/60 Hz)	9983-1009946	140
Optical Lamp, Halogen	9983-1003188	143
Optical Lamps on Stem	–	143–144
Optical Precision Bench D, 100 cm	9983-1002628	142
Optical Precision Bench D, 200 cm	9983-1002629	142
Optical Precision Bench D, 50 cm	9983-1002630	142
Optical Rider D, 120/36	9983-1012402	142
Optical Rider D, 120/50	9983-1002637	142
Optical Rider D, 60/36	9983-1002639	142
Optical Rider D, 60/50	9983-1012400	142
Optical Rider D, 90/36	9983-1012401	142
Optical Rider D, 90/50	9983-1002635	142
Optical Rider K	9983-1000862	138
Optical Rider U, 35 mm	9983-1003042	141
Optical Rider U, 75 mm	9983-1003041	141
Optical Telecommunications	–	172
Optical Telecommunications Equipment Set	9983-1008674	172
Optics Kit for Whiteboard	9983-1000604	135

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Optics on a Whiteboard	–	134–136
Optics Using an Optical Bench D	–	142–143
Optics Using an Optical Bench U	–	141
Optics with Laser Ray Box, Equipment Set	9983-1003049	136
Optikit	9983-1010210	29
Orbit™ Tellurium	9983-1008661	52
Organic Molecule Set D	9983-1005278	230–231
Organic Molecule Set S	9983-1005290	230–231
Organic/Inorganic Molecule Set D	9983-1005279	230–231
Organic/Inorganic Molecule Set S	9983-1005291	230–231
Oscillation Tube	9983-1002895	126
Oscillations	–	69–74
Oscilloscope Probe, 100 MHz	9983-1002777	254–255
Oscilloscopes	–	254–256
Outlet Vessel, Glass	9983-1000672	78
Outlet Vessel, Metal	9983-1009715	78
Overhead Projector (115 V, 50/60 Hz)	9983-1003263	270
Overhead Projector (230 V, 50/60 Hz)	9983-1003264	270
– P –		
Pack of Millimetre Paper Sheets	9983-1000691	181
Pair of Bar Magnets, 80 mm	9983-1003085	196
Pair of Bar Magnets, AlNiCo, 60 mm, with Two Iron Yokes	9983-1003086	196
Pair of Capacitor Plates 125 cm²	9983-1000934	179
Pair of Capacitor Plates 250 cm²	9983-1000933	179
Pair of Capacitor Plates 500 cm²	9983-1000932	179
Pair of Clamps	9983-1000977	212
Pair of Elastic Balls with Plotting Electrode	9983-1000779	62
Pair of Experiment Leads, 75 cm	9983-1002850	279
Pair of Flat Coils	9983-1000942	200
Pair of Helmholtz Coils on Mounting Plate	9983-1003193	202
Pair of High-Voltage Cables, 150 cm	9983-1002851	280
Pair of Magnetic Pucks	9983-1003364	61
Pair of Polarsation Filters K	9983-1009929	139
Pair of Pole Shoes	9983-1000978	212
Pair of Pole Shoes and Clamping Brackets for Hall Effect	9983-1009935	212
Pair of Rail Supports	9983-1003044	141
Pair of Reflection Blocks with Delay Line	9983-1002587	100
Pair of Safety Experiment Leads, 75 cm	9983-1002849	280
Pair of Tuning Forks, 440 Hz, on Resonance Boxes	9983-1002612	95
Pair of Tuning Weights	9983-1002611	95
Parallel Light Optical Lamp N (115 V, 50/60 Hz)	9983-1006790	140
Parallel Light Optical Lamp N (230 V, 50/60 Hz)	9983-1006791	140
Pascal's Pressure Sphere	9983-1002892	80
Pascal's Vane Apparatus	9983-1002957	80
Passive Q-Switch	9983-1008637	168–171
P-Doped Germanium on Printed Circuit Board	9983-1009810	242
Pendulum Bobs, Set of 4	9983-1003230	69
Pendulum Rod	9983-1000764	69
Pendulum Rod with Angle Sensor (115 V, 50/60 Hz)	9983-1000762	69
Pendulum Rod with Angle Sensor (230 V, 50/60 Hz)	9983-1000763	69
Pendulum with Plotting Electrode	9983-1000780	62
Periodic Table of the Elements	–	228
Periodic Table of the Elements, with Electron Configurations	9983-1003097	228
Periodic Table of the Elements, with Pictures	9983-1003098	228
Permanent Magnet with Adjustable Pole Spacing	9983-1002660	205
Perrin Tube D	9983-1000650	215
Perrin Tube S	9983-1000616	220
pH Combined Electrode	9983-1002720	193
pH Sensor	9983-1000556	41
Photo Gate	9983-1000563	36, 45
Photo Gate Holder for Projectile Launcher	9983-1002657	64
Photogate Holder for Pendulum	9983-1000756	69
Photoresistor, LDR 05, P2W19	9983-1012940	191
Photovoltaics Equipment Set	9983-1002693	33
Picket Fence	9983-1000564	36
Pico Ammeter Amplifier	9983-1000628	242h
Piezoelectric Charge Source	9983-1000923	177
PIN Photodiode	9983-1008640	168–171
PIN Photodiode, Fast	9983-1008641	168–171
Pirani Vacuum Gauge (115 V, 50/60 H)	9983-1012510	85
Pirani Vacuum Gauge (230 V, 50/60 H)	9983-1012514	85
Piston Vacuum Pump	9983-1000798	84
Planck's Constant Apparatus (115 V, 50/60 Hz)	9983-1000536	234
Planck's Constant Apparatus (230 V, 50/60 Hz)	9983-1000537	234
Plane Mirror	9983-1002984	135
Plane Mirror	9983-1003190	282
Plane Mirror K	9983-1003532	138
Plane Mirror on Stem	9983-1003033	145
Plane Parallel Plate	9983-1002988	135
Plano Concave Lens, f = -400 mm	9983-1002986	135
Plano Convex Lens, f = +400 mm	9983-1002987	135
Plastic Plate	9983-1000936	179
Plastic Trough	9983-4000036	281
Plate Capacitor D	9983-1006798	179
Plate Capacitor S	9983-1003232	179
Plate for Metal Filings	9983-1010256	133
Platinum-Iridium Wire	9983-1012878	229
Plexiglas Plate	9983-1000880	179
Plotter Paper, Set	9983-1003361	61
Plug In Power Supply 24 V, 0.7 A (115V, 50/60 Hz)	9983-1000680	71, 246
Plug In Power Supply 24 V, 0.7 A (230 V, 50/60 Hz)	9983-1000681	71, 246
Plug In Power Supply TEL (115 V, 50/60 Hz)	9983-1000634	242h
Plug In Power Supply TEL (230 V, 50/60 Hz)	9983-1000635	242h
Plug-In Board for Components	9983-1012902	190
Plug-In Component System	–	190–191
Plug-In Power Supply 3 V DC (100-240 V, 50/60 Hz)	9983-1008659	156
Plug-In Power Supply, 12 V AC, 2000 mA (115 V, 50/60 Hz)	9983-1012899	246
Plug-In Power Supply, 12 V AC, 2000 mA (230 V, 50/60 Hz)	9983-1012900	246
Plug-In Power Supply, 12 V AC, 500 mA (115 V, 50/60 Hz)	9983-1009545	246
Plug-In Power Supply, 12 V AC, 700 mA (230 V, 50/60 Hz)	9983-1001014	246
Plumb with Line	9983-1002940	53
Pneumatic Lighter	9983-1003569	126
PNP Transistor, BC 560, P4W50	9983-1012977	192
PNP Transistor, BD 138, P4W50	9983-1012975	192
Pocket Measuring Tape, 2 m	9983-1002603	46
Pocket Spectroscope	9983-1003078	164–165
Pocket Thermometer -10–110°C	9983-1002881	112–113
Pohl's Torsion Pendulum	9983-1002956	71
Polarimeter	9983-1008696	161
Polarimeter Tube 100 mm	9983-1012883	161
Polarimeter Tube 200 mm	9983-1012884	161
Polarimeter with 4 LEDs (115 V, 50/60 Hz)	9983-1001056	160
Polarimeter with 4 LEDs (230 V, 50/60 Hz)	9983-1001057	160
Polarisation	–	160–161
Polarisation Filter	9983-1003152	158–159
Polarisation Filter (Glass)	9983-1003328	150
Polarisation Filter on Stem	9983-1008668	146
Polarisation Filters K, Pair	9983-1009929	139
Polarization Filter KL	9983-1008650	168–171
Pole Shoe Fitting	9983-1008525	212
Pole Shoes and Clamping Brackets for Hall Effect, Pair	9983-1009935	212
Pole Shoes, Pair	9983-1000978	212
Polyoxymethylene Test Block with Protractor Scale	9983-1002586	100
p-Orbitals, Set of 3	9983-1012841	232
Potentiometer 1 kΩ, 1 W, P4W50	9983-1012936	192
Potentiometer 10 kΩ, 1 W, P4W50	9983-1012937	192
Potentiometer 100 kΩ, 1 W, P4W50	9983-1012939	192
Potentiometer 220 Ω, 3 W, P4W50	9983-1012934	192
Potentiometer 4.7 kΩ, 1 W, P4W50	9983-1012938	192
Potentiometer 470 Ω, 1 W, P4W50	9983-1012935	192
Powder Tracing, Equipment Set	9983-1000739	62
Power and Energy Meter	–	257
Power and Energy Meter with Interface (115 V, 50/60 Hz)	9983-1003131	257
Power and Energy Meter with Interface (230 V, 50/60 Hz)	9983-1003132	257
Power Function Generator (115 V, 50/60 Hz)	9983-1001036	253
Power Function Generator (230 V, 50/60 Hz)	9983-1001037	253
Power Supplies	–	246–251
Power Supply for Millikan's Apparatus (115 V, 50/60 Hz)	9983-1002821	233
Power Supply for Millikan's Apparatus (230 V, 50/60 Hz)	9983-1002820	233
Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)	9983-1012818	236–237
Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)	9983-1012819	236–237
Precision Dynamometer 0.1 N	9983-1003102	48
Precision Dynamometer 0.2 N	9983-1003103	48
Precision Dynamometer 1 N	9983-1003104	48, 54
Precision Dynamometer 10 N	9983-1003107	48, 54
Precision Dynamometer 100 N	9983-1003110	48
Precision Dynamometer 2 N	9983-1003105	48, 54
Precision Dynamometer 20 N	9983-1003108	48
Precision Dynamometer 5 N	9983-1003106	48
Precision Hair Hygrometer	9983-1002877	110
Precision Resistor 1 kΩ	9983-1009887	186
Precision Resistor 1 MΩ	9983-1000687	186
Precision Resistor 1 Ω	9983-1009843	186
Precision Resistor 10 kΩ	9983-1000685	186
Precision Resistor 10 MΩ	9983-1000688	186
Precision Resistor 10 Ω	9983-1009844	186
Precision Resistor 100 kΩ	9983-1000686	186
Precision Resistor 100 Ω	9983-1009886	186
Precision Resistor 300 kΩ	9983-1000690	186

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Precision Sphereometer	9983-1002947	46
Pressure	–	78–80
Pressure Balance	9983-1002653	78
Pressure Container for Determining Weight of Air	9983-1000796	77
Pressure Sensor, ±100 hPa, Relative	9983-1000547	39
Pressure Sensor, ±1000 hPa, Relative	9983-1000548	39
Pressure Sensor, 2500 hPa, absolute	9983-1000546	39
Prism Table K	9983-1000876	138
Prism Table on Stem	9983-1003019	147
Prisms	–	153–154
Prisms, Set of 3	9983-1002863	153
Probe Microphone	9983-1003116	93
Projectile Launcher	9983-1002654	64
Projection Screen	9983-1000608	148
Projection Screen K, Transparent	9983-1000878	139
Projection Screen K, White	9983-1000879	139
Projection Screen N	9983-1012891	140
Protective Adapter, 2-Pole	9983-1009961	218
Protective Adapter, 3-Pole	9983-1009960	218
PTC Resistor, 100 Ω, P2W19	9983-1012942	191
Puck Guide	9983-1003359	61
Pulley Block with 1 Pulley	9983-1003216	56
Pulley Block with 2 Pulleys	9983-1003217	56
Pulley Block with 3 Pulleys	9983-1003218	56
Pulley Block with 3 Pulleys	9983-1003219	56
Pulley with Table Clamp	9983-1003221	56
Pulleys and Block and Tackle, Experiment Set	9983-1003224	55
Push Button Switch (NC) Sing. Pole P2W19	9983-1012989	191
Push Button Switch (NO) Sing. Pole P2W19	9983-1012988	191
PVC Tubing, 4 mm, 20 m	9983-1010124	278
PVC Tubing, 6 mm, 20 m	9983-1010160	278
Pythagorean Cup	9983-1002904	283
– Q –		
Quinhydrone Buffer Solution	9983-1002754	41
– R –		
Radiation Cartridge, ^{226}Ra, 4 kBq	9983-1006797	244
Radiation of Heat	–	121
Radioactivity	–	243–245
Radiography Accessories	9983-1000667	242b
Rail Supports, Pair	9983-1003044	141
Recording Tuning Fork, c 128 Hz	9983-1002606	94
Red LED on 3B Box	9983-1010190	184–185
Redox Sensor	9983-1000555	41
Reed Pipe	9983-1012893	96
Reflection Grating	9983-1003083	150
Regenerative Energies	–	32–33
Relative Pressure Sensor, ±100 hPa	9983-1000547	39
Relative Pressure Sensor, ±1000 hPa	9983-1000548	39
Relay	9983-1000566	42
Relay with Change-Over Contact, P4W50	9983-1012992	192
Replacement Bulb for Overhead Projector	9983-1003265	270
Resistance Apparatus	9983-1009949	186
Resistance Bridge	9983-1009885	186
Resistance Decade 1 kΩ	9983-1002733	187
Resistance Decade 1 Ω	9983-1002730	187
Resistance Decade 10 kΩ	9983-1002734	187
Resistance Decade 10 Ω	9983-1002731	187
Resistance Decade 100 Ω	9983-1002732	187
Resistance Decade, 1 Ω–10 kΩ	9983-1002735	187
Resistor 1 kΩ, 2 W, P2W19	9983-1012916	190
Resistor 1 MΩ, 0.5 W, P2W19	9983-1012932	190
Resistor 1 Ω, 2 W, P2W19	9983-1012903	190
Resistor 1,5 kΩ, 2 W, P2W19	9983-1012917	190
Resistor 10 kΩ, 0.5 W, P2W19	9983-1012922	190
Resistor 10 MΩ, 0.5 W, P2W19	9983-1012933	190
Resistor 10 Ω, 10 W, P2W19	9983-1012905	190
Resistor 10 Ω, 2 W, P2W19	9983-1012904	190
Resistor 100 kΩ, 0.5 W, P2W19	9983-1012928	190
Resistor 100 Ω, 2 W, P2W19	9983-1012910	190
Resistor 15 kΩ, 0.5 W, P2W19	9983-1012923	190
Resistor 150 Ω, 2 W, P2W19	9983-1012911	190
Resistor 2,2 kΩ, 2 W, P2W19	9983-1012918	190
Resistor 22 kΩ, 0.5 W, P2W19	9983-1012924	190
Resistor 22 Ω, 2 W, P2W19	9983-1012907	190
Resistor 220 kΩ, 0.5 W, P2W19	9983-1012929	190
Resistor 220 Ω, 2 W, P2W19	9983-1012912	190
Resistor 3,3 kΩ, 2 W, P2W19	9983-1012919	190
Resistor 33 kΩ, 0.5 W, P2W19	9983-1012925	190
Resistor 330 kΩ, 0.5 W, P2W19	9983-1012930	190
Resistor 330 Ω, 2 W, P2W19	9983-1012913	190
Resistor 4,7 kΩ, 2 W, P2W19	9983-1012920	190
Resistor 47 kΩ, 0.5 W, P2W19	9983-1012926	190
Resistor 47 Ω, 2 W, P2W19	9983-1012908	190
Resistor 470 kΩ, 0.5 W, P2W19	9983-1012931	190
Resistor 470 Ω, 2 W, P2W19	9983-1012914	190
Resistor 5,1 Ω, 2 W, P2W19	9983-1012906	190
Resistor 6,8 kΩ, 2 W, P2W19	9983-1012921	190
Resistor 68 kΩ, 0.5 W, P2W19	9983-1012927	190

Description	Art. No.	Page
Resistor 68 Ω, 2 W, P2W19	9983-1012909	190
Resistor 680 Ω, 2 W, P2W19	9983-1012915	190
Resonance Bowl	9983-1003206	283
Resonance Wire, Ring Shaped	9983-1000707	90
Response Box	9983-1000577	42
Rheostat 1 Ω	9983-1003062	187
Rheostat 10 Ω	9983-1003064	187
Rheostat 100 Ω	9983-1003066	187
Rheostat 1000 Ω	9983-1003068	187
Rheostat 3,3 Ω	9983-1003063	187
Rheostat 33 Ω	9983-1003065	187
Rheostat 330 Ω	9983-1003067	187
Rheostat 3300 Ω	9983-1003069	187
Riders for Rulers, Set	9983-1006494	46
Right Angled Prism	9983-1002990	135
Rings Demonstrating Flattening of the Earth	9983-1000750	67
Ripple Tank	9983-1003198	89
Riser Blocks, Set of 4	9983-1003360	59
Riser Tubes for Pressure Measurement	9983-1002573	104
Rocker Switch, Single Pole, P2W19	9983-1012990	191
Rod Clamp with Insulator	9983-1001054	183
Rod Thermometer -10–100°C	9983-1003526	112–113
Roman Arch Kit	9983-1009717	53
Rotary Motion Apparatus	9983-1010084	67
Rotary Vane Vacuum Pump PK 4 D (115V, 50/60 Hz)	9983-1002918	85
Rotary Vane Vacuum Pump PK 4 D (230 V, 50/60 Hz)	9983-1002919	85
Rotary-Vane Vacuum Pump, One-Stage	9983-1012855	84
Rotary-Vane Vacuum Pump, Two-Stage	9983-1003317	84
Rotating Object Holder on Stem	9983-1003016	147
Rotating System on Air Bed (115 V, 50/60 Hz)	9983-1000781	66
Rotating System on Air Bed (230 V, 50/60 Hz)	9983-1000782	66
Rotation Apparatus	9983-1006785	67
Rotational Motion	–	66–67
Round Cell, 200 mm	9983-1002885	161
Round Cell, 500 mm	9983-1002884	161
Round-Bottomed Flask, 250 ml	9983-1011768	282
Round-Bottomed Flask, 500 ml	9983-1011769	282
Rowland Grating	9983-1002917	150
Rubber Band	9983-1000702	90
Rubber Belt for Van de Graaff Generator	9983-1002965	176
Ruled gratings	9983-1000600	151
Ruler, 1 m	9983-1000742	46
– S –		
Safety Crocodile Clip 4 mm, Black	9983-1002845	280
Safety Crocodile Clip 4 mm, Red	9983-1009734	280
Safety Experiment Leads 100 cm, Black, Set of 5	9983-1010238	280
Safety Experiment Leads 25 cm, Black, Set of 5	9983-1010236	280
Safety Experiment Leads 25 cm, Red, Set of 5	9983-1010239	280
Safety Experiment Leads 25 cm, Red, Set of 5	9983-1010240	280
Safety Experiment Leads 25 cm, Red, Set of 5	9983-1010241	280
Safety Experiment Leads 50 cm, Black, Set of 5	9983-1010237	280
Safety Experiment Leads for Free Fall Apparatus, Set of 3	9983-1002848	280
Safety Experiment Leads, 75 cm, Pair	9983-1002849	280
Safety Experiment Leads, 75 cm, Set of 15	9983-1002843	280
Scanning Tunnelling Microscope	9983-1012782	229
Segner Turbine	9983-1003513	79
SEK Base Plate	9983-1000789	22
SEK Electricity and Magnetism	9983-1008532	23
SEK Heat	9983-1008528	21
SEK Mechanics	9983-1008527	20
SEK Optics (115 V, 50/60 Hz)	9983-1008530	24
SEK Optics (230 V, 50/60 Hz)	9983-1008531	24
SEK Power Supply (115 V, 50/60 Hz)	9983-1000997	22
SEK Power Supply (230 V, 50/60 Hz)	9983-1000998	22
SEK Radioactivity	9983-1006804	25
Semi Circular Body, f = +200 mm	9983-1002989	135
Semicircular Cell	9983-1003191	137
Sensor Holder for Stirling Engine G	9983-1008500	127
Sensors	–	36–43
Set 14 Bravais Lattices	9983-1012837	230–231
Set of "Conductors and Non-Conductors"	9983-1000948	183
Set of 10 O_2 Test Tubes, 6–24% by vol.	9983-1012527	30
Set of 10 Aluminum Plates	9983-1002716	195
Set of 10 Beakers, Low Form	9983-1002872	282
Set of 10 Beakers, Tall Form	9983-1002873	282
Set of 10 CO_2 Test Tubes, 0.03–1.00% by vol.	9983-1012524	30
Set of 10 CO_2 Test Tubes, 0.5–8.0% by vol.	9983-1012526	30
Set of 10 Cast Iron Bolts	9983-1000827	118
Set of 10 Copper Plates	9983-1002712	195
Set of 10 E10 Bulbs 12 V, 100 mA	9983-1010140	183
Set of 10 E10 Bulbs 12 V, 500 mA	9983-1010141	183
Set of 10 E10 Bulbs 3.5 V, 150 mA	9983-1010142	183
Set of 10 E10 Bulbs 3.5 V, 200 mA	9983-1010143	183
Set of 10 E10 Bulbs 6 V, 100 mA	9983-1010145	183
Set of 10 E10 Bulbs 6 V, 350 mA	9983-1010144	183
Set of 10 E10 Bulbs, 1.3 V, 60 mA	9983-1010199	183
Set of 10 E10 Bulbs, 3.8 V, 300 mA	9983-1010195	183

...going one step further
www.EngineeringBooksPDF.com

Description	Art. No.	Page
Set of 10 E10 Bulbs, 4 V, 40 mA	9983-1010196	183
Set of 10 E10 Bulbs, 6 V, 1 A	9983-1010198	183
Set of 10 E10 Bulbs, 6 V, 50 mA	9983-1010197	183
Set of 10 E10 Lamp Sockets	9983-1010137	183
Set of 10 Glass Stirrer	9983-1010110	282
Set of 10 Iron Plates	9983-1002714	195
Set of 10 Jumpers, P2W19	9983-1012985	191
Set of 10 Magnets	9983-1003351	59
Set of 10 Pairs of Protective Rubber Stoppers	9983-1012528	30
Set of 10 Tracing Compasses	9983-1003095	199
Set of 10 Watch Glass Dishes, 125 mm	9983-1002869	282
Set of 10 Watch Glass Dishes, 80 mm	9983-1002868	282
Set of 10 Weights, 10 g	9983-1000770	50
Set of 10 Weights, 20 g	9983-1000769	50
Set of 10 Weights, 50 g	9983-1000771	50
Set of 10 Wooden Rulers, 0.5 m	9983-1003234	47
Set of 10 Wooden Rulers, 1 m	9983-1003233	47
Set of 10 Zinc Plates	9983-1002713	195
Set of 100 Balloons	9983-1010125	82
Set of 12 Materials with 4 Different Masses Each	9983-1003500	77
Set of 15 Bodies with 2 Different Densities	9983-1003501	77
Set of 15 Experiment Leads, 75 cm 1 mm²	9983-1002840	279
Set of 15 Experiment Leads, 75 cm 2.5 mm²	9983-1002841	279
Set of 15 Safety Experiment Leads, 75 cm	9983-1002843	280
Set of 1-Litre Bodies	9983-1012882	47
Set of 2 Materials with 4 Different Masses Each	9983-1003499	77
Set of 20 Bumper Springs	9983-1003348	59
Set of 20 Nails for Nail Fusing Experiment	9983-1000983	211
Set of 20 Soft Bumper Springs	9983-1003349	59
Set of 3 Areometers	9983-1003012	76
Set of 3 Carbon Configurations	9983-1012836	230–231
Set of 3 Colour Filters, Primary Colours	9983-1003185	149
Set of 3 Colour Filters, Secondary Colours	9983-1003186	149
Set of 3 Conductivity Standards	9983-1000552	41
Set of 3 Cylinders	9983-1002588	101
Set of 3 Cylinders, Equal in Mass	9983-1000754	76
Set of 3 Cylinders, Equal in Volume	9983-1000752	76
Set of 3 Funnel Holders	9983-1010182	281
Set of 3 Induction Coils	9983-1000590	208
Set of 3 Monochord Strings	9983-1002960	96
Set of 3 p-Orbitals	9983-1012841	232
Set of 3 Prisms	9983-1002863	153
Set of 3 Safety Experiment Leads for Free Fall Apparatus	9983-1002848	280
Set of 3 Steel Balls	9983-4003748	63, 65
Set of 3 Weight Holders with Slotted Weights	9983-1000676	51
Set of 4 Calorimeter Cylinders	9983-1003253	116
Set of 4 Gratings	9983-1003081	151
Set of 4 Image Objects	9983-1000886	149
Set of 4 Pendulum Bobs	9983-1003230	69
Set of 4 Riser Blocks	9983-1003360	59
Set of 4 Velocity Flags	9983-1003350	59
Set of 5 Carbon Plates	9983-1002717	195
Set of 5 Density Bodies	9983-1000768	75
Set of 5 d-Orbitals	9983-1012840	232
Set of 5 Hole Diaphragms	9983-1000848	149
Set of 5 Metal Strips	9983-1000982	211
Set of 5 Nickel Plates	9983-1002715	195
Set of 5 Safety Experiment Leads 100 cm, Black	9983-1010238	280
Set of 5 Safety Experiment Leads 25 cm, Black	9983-1010236	280
Set of 5 Safety Experiment Leads 25 cm, Red	9983-1010239	280
Set of 5 Safety Experiment Leads 25 cm, Red	9983-1010240	280
Set of 5 Safety Experiment Leads 25 cm, Red	9983-1010241	280
Set of 5 Safety Experiment Leads 50 cm, Black	9983-1010237	280
Set of 5 Single Slits	9983-1000846	150
Set of 5 Slit and Hole Diaphragms	9983-1000607	149
Set of 6 Steel Balls	9983-1002939	57
Set of 60 Ecoflam Pellets	9983-1010255	133
Set of 7 Colour Filters	9983-1003084	149
Set of 7 Cubes for Determining Density	9983-1000766	77
Set of 7 f-Orbitals	9983-1012838	232
Set of 8 Fibre Optic Cables, Plain	9983-1010208	175
Set of 8 Fibre Optic Cables, Sheathed	9983-1010209	175
Set of 8 Test Tubes	9983-1001051	282
Set of Apparatus for Displaying Magnetic Fields	9983-1000925	201
Set of Bodies for Air Resistance and Buoyancy Experiments	9983-1000760	86
Set of Doppler Prisms and Flow Tubes	9983-1002572	104
Set of Drawing Instruments for Whiteboard	9983-1002593	275
Set of Electrodes for ECG/EMG	9983-5006578	40
Set of Experiment Leads for Electron Tube Experiments	9983-1002847	279
Set of Fluorescence Samples	9983-1012868	242h
Set of Fuses	9983-1012873	280
Set of Helical Springs for Hooke's Law	9983-1003376	49
Set of Optical Components	9983-1002993	137
Set of Plotter Paper	9983-1003361	61
Set of Riders for Rulers	9983-1006494	46
Set of Seals	9983-1002672	125
Set of Slotted Weights, 10x10 g	9983-1003227	50
Set of Slotted Weights, 10x10 g, Red and Grey	9983-1000773	50
Set of Slotted Weights, 20–100 g	9983-1003226	50
Set of Slotted Weights, 4x100 g, Red and Grey	9983-1000777	50
Set of Slotted Weights, 5x100 g	9983-1003229	50
Set of Slotted Weights, 5x50 g	9983-1003228	50
Set of Slotted Weights, 8x50 g, Red and Grey	9983-1000775	50
Set of Special Carbon Paper	9983-1003366	61
Set of Test Bodies for Torsion Axle	9983-1008663	74
Set of Tuning Forks for the C-Major Scale	9983-1002605	95
Set of Tuning Forks, C-Major Chord, on Resonance Boxes	9983-1002615	95
Set of Weights 1 g to 1000 g	9983-1003212	50, 54
Set of Weights 1 g to 50 g	9983-1003210	50
Set of Weights 1 g to 500 g	9983-1010189	51
Set of Weights 1 g to 500 g, Slotted	9983-1003211	50
Set of Weights 1 mg to 500 mg	9983-1010234	51
Set of Weights 10 g to 1000 g	9983-1003214	50
Set of Weights 100 g to 2000 g	9983-1001052	50
Set of Weights with Hooks	9983-1010168	51
Shadow Casting Bodies	9983-1002992	135
Shaker	9983-1000581	200
Silicon Diode, 1N 4007, P2W19	9983-1012964	191
Silicon Diode, BY 255, P2W19	9983-1012961	191
Simple Machines	–	55–56
Sine Wave Generator	9983-1001038	252
Single Breast Model with Benign Tumor	9983-1000345	102
Single Ray Projector	9983-1000682	134
Single Slit N	9983-4004002	140
Single Slits, Set of 5	9983-1000846	150
Single-Throw Switch on Acrylic Base	9983-1000961	182
Skin Resistance Box	9983-1000576	40
Sliding Rider D	9983-1002644	142
Slit and Hole Diaphragms, Set of 5	9983-1000607	149
Slits and Bars on Glass Plate	9983-1008665	152
Sodium Fluorescence Tube on Furnace Wall	9983-1000913	234
Soft Iron Bars	9983-1003090	197
Software for Fourier Analysis	9983-1012587	43
Solar Electric Motor	9983-1002696	106
Solar Energy	–	106
Solar Energy Basic Kit	9983-1000839	106
Solid-State Laser Physics	–	168–171
s-Orbital	9983-1012842	232
Sound	–	93–97
Sound Level Meter P5055	9983-1002778	263
Spare Bulb for Stroboscope	9983-1003332	266
Spare Bulbs for Halogen Lamp (115 V, 50/60 Hz)	9983-1003535	106
Spare Bulbs for Halogen Lamp (230 V, 50/60 Hz)	9983-1003536	106
Spare Glass Tube	9983-1003570	126
Spare Halogen Lamp, 12 V, 35 W	9983-1003199	89
Spare Halogen Lamp, 12 V, 50 W	9983-1002837	143
Spare Lamp for Light Box	9983-1003231	29
Spare Sodium Lamp	9983-1012885	161
Spare Tube for X-Ray Apparatus	9983-1000664	242a
Special Carbon Paper, Set	9983-1003366	61
Spectral Lamp Cd	9983-1003537	162
Spectral Lamp He	9983-1003539	162
Spectral Lamp Hg 100	9983-1003545	162
Spectral Lamp Hg/Cd	9983-1003546	162
Spectral Lamp Na	9983-1003541	162
Spectral Lamp Ne	9983-1003543	162
Spectral Lamp Tl	9983-1003544	162
Spectrometer-Goniometer	9983-1002912	164–165
Spectrometer-Goniometer S	9983-1008673	164–165
Spectrometers	–	164–166
Spectrometry Supplementary Set	9983-1008675	172
Spectrophotometer S	9983-1003061	164–165
Spectrophotometer, Digital	9983-1003160	166
Spectroscope in Cardboard Case	9983-1003183	164–165
Spectroscope in Metal Case	9983-1003184	164–165
Spectrum Tube Air	9983-1003402	162
Spectrum Tube Argon	9983-1003403	162
Spectrum Tube Bromine	9983-1003404	162
Spectrum Tube Carbon Dioxide	9983-1003405	162
Spectrum Tube Chlorine	9983-1003406	162
Spectrum Tube Deuterium	9983-1003407	162
Spectrum Tube Helium	9983-1003408	162
Spectrum Tube Hydrogen	9983-1003409	162
Spectrum Tube Iodine	9983-1003410	162
Spectrum Tube Krypton	9983-1003411	162
Spectrum Tube Mercury	9983-1003412	162
Spectrum Tube Neon	9983-1003413	162
Spectrum Tube Nitrogen	9983-1003414	162
Spectrum Tube Oxygen	9983-1003415	162
Spectrum Tube Power Supply (115V, 50/60 Hz)	9983-1000683	162
Spectrum Tube Power Supply (230V, 50/60 Hz)	9983-1000684	162
Spectrum Tube Water Vapor	9983-1003416	162
Spectrum Tube Xenon	9983-1003417	162
Spectrum Tubes and Spectrum Lamps	–	162–163

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Speed of Light	–	174
Speed of Light Meter (115 V, 50/60 Hz)	9983-1000882	174
Speed of Light Meter (230 V, 50/60 Hz)	9983-1000881	174
Sphere for Weighing Gases 1000 ml	9983-1003519	77
Spinthariscope	9983-1000918	244
Spirit Lamp	9983-1003565	132
Stability Apparatus	9983-1002950	53
Stable Tube-Type Thermometer -1–101°C	9983-1003013	112–113
Stainless Steel Rod 100 mm	9983-1002932	278
Stainless Steel Rod 1000 mm	9983-1002936	278
Stainless Steel Rod 1500 mm	9983-1002937	278
Stainless Steel Rod 250 mm	9983-1002933	278
Stainless Steel Rod 470 mm	9983-1002934	278
Stainless Steel Rod 750 mm	9983-1002935	278
Stainless Steel Rod, 280 mm, 10 mm diam.	9983-1012848	278
Stainless Steel Rod, 400 mm, 10 mm diam.	9983-1012847	278
Stand Base, A-Shaped 200 mm	9983-1001044	276
Stand Base, A-Shaped 280 mm	9983-1001043	276
Stand for Cylindrical Coils	9983-1000964	202
Stand with H-Shaped Base	9983-1001042	276
Stands, Clamps and Accessories	–	276–278
Statics	–	53
Steam Engine B	9983-1012801	131
Steam Engine G	9983-1002597	131
Steam Engine, Transparent	9983-1002997	132
Steam Generator (115 V, 50/60 Hz)	9983-1006769	119
Steam Generator (230 V, 50/60 Hz)	9983-1001049	119
Steel Balls, Set of 3	9983-4003748	63,65
Steel Balls, Set of 6	9983-1002939	57
Steel Safe for Radioactive Materials	9983-1000920	244
Stirling Engine D	9983-1000817	128
Stirling Engine G	9983-1002594	127
Stirling Engine S	9983-1003505	129
Stirling Engine, Transparent	9983-1003000	132
Storage Box	9983-1003571	139
Storing Base for Lenses	9983-1003034	147
Straight Conductor on Acrylic Base	9983-1000926	201
Striking Hammer, Hard	9983-1002610	95
Striking Hammer, Soft	9983-1002614	95
Student Experiment Kits (SEK)	–	20–25
Student Experiments	–	14–33
STUDENT *Kit* – Basic Set	9983-1000730	14
STUDENT *Kit* – Electrostatics	9983-1009883	18
STUDENT *Kit* – Heat	9983-1000732	16
STUDENT *Kit* – Mechanics	9983-1000731	15
STUDENT *Kit* – Optics (115 V, 50/60 Hz)	9983-1000733	17
STUDENT *Kit* – Optics (230 V, 50/60 Hz)	9983-1000734	17
Suction and Pressure Pump	9983-1003514	80
Supplemental Set “Optics with Laser Ray Box”	9983-1003050	136
Supplementary Kit for Rotating System on Air Bed	9983-1000783	66
Supplementary Set “Measuring without Instruments”	9983-1002695	33
Supplementary Set for Interference	9983-1009700	26–27
Supplementary Set for Polarisation	9983-1009701	26–27
Supplementary Set for Stirling Engine D	9983-1008516	128
Support for Optical Bench D	9983-1012399	143
Surface Tension	–	81
Surface Tension Ring	9983-1000797	81
Suspended Magnet	9983-1000943	196
SW Physical Pendulum Set	9983-1012853	73
SW Sensors Set (115 V, 50/60 Hz)	9983-1012851	43
SW Sensors Set (230 V, 50/60 Hz)	9983-1012850	43
SW Stand Equipment Set	9983-1012849	278
SW String Pendulum Set	9983-1012854	73
SW Ultrasonics Set (115 V, 50/60 Hz)	9983-1012846	105
SW Ultrasonics Set (230 V, 50/60 Hz)	9983-1012845	105
SW Wilberforce Pendulum Set	9983-1012844	73
Switch on 3B-Box	9983-1010139	184–185
Switch, Single, P4W50	9983-1012993	192
Swivel Joint for Optical Bench D	9983-1002632	143
Swivel Joint with Scale	9983-1003043	141
Syringe 100 ml	9983-1002886	282
Syringe 25 ml	9983-1002888	282
Syringe 50 ml	9983-1002887	282
– T –		
Table Clamp	9983-1002832	277
Table Top Stop Clock	9983-1002809	45
Tandem Pulley, 2 Pulleys	9983-1003222	56
Tandem Pulley, 3 Pulleys	9983-1003223	56
TaS_2 Sample	9983-1012876	229
$TaSe_2$ Sample	9983-1012875	229
TELTRON®	–	214–223
Temperature Sensor, Pt100	9983-1000550	38, 112–113
Temperature Sensor, Pt100 with Measurement Terminal	9983-1009922	38,13
Temperature Sensor, TC–K	9983-1000551	38, 112–113
Tension Ring DN 10/16 KF	9983-1002930	85
Tesla Transformer	9983-1000966	213
Teslameter 200 mT (115 V, 50/60 Hz)	9983-1003313	203
Teslameter 200 mT (230 V, 50/60 Hz)	9983-1003314	203
Teslameter E	9983-1008537	203
Test Bodies for Torsion Axle, Set	9983-1008663	74
Test Tubes, Set of 8	9983-1001051	282
Test Vessel, Complete	9983-1002578	98
Thermal Conductivity Equipment Kit	9983-1003497	121
Thermal Expansion	–	118–120
Thermometer	–	112–115
Thermometer +10–30°C	9983-1003527	112–113
Thermometer -10–150°C	9983-1003385	112–113
Thermometer -10°C–200°C	9983-1003525	112–113
Thermometer -20–110°C	9983-1003384	112–113
Thermometer -20–110°C / 0–230°F	9983-1003386	112–113
Thermometer -20–150°C / 0–300°F	9983-1003387	112–113
Thermometer Clip	9983-1003528	112–113
Thomson Tube S	9983-1000617	219
Thyristor, TYN 1012, P4W50	9983-1012979	192
Tilting Rider D	9983-1012467	142
Timer	9983-1003009	45
Toggle Switch on Acrylic Base	9983-1000960	182
Torsion Axle	9983-1008662	74
Total Reflection Apparatus on Stem	9983-1000857	146
T-Piece DN 16 KF	9983-1002925	85
T-Piece, BNC	9983-1002752	281
Tracing Compasses, Set of 10	9983-1003095	199
Training Oscilloscope	9983-1000902	225
Transformer	–	210–213
Transformer 12 V, 25 VA (115 V, 50/60 Hz)	9983-1000865	246
Transformer 12 V, 25 VA (230 V, 50/60 Hz)	9983-1000866	246
Transformer 12 V, 60 VA (115 V, 50/60 Hz)	9983-1006780	246
Transformer 12 V, 60 VA (230 V, 50/60 Hz)	9983-1000593	246
Transformer Core D	9983-1000976	210
Transformer Core S	9983-1001004	212
Transformer with Rectifier 1/ 2/ 3/–12 V, 6 A (115 V, 50/60 Hz)	9983-1001009	247
Transformer with Rectifier 1/ 2/ 3/–12 V, 6 A (230 V, 50/60 Hz)	9983-1001010	247
Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A (115 V, 50/60 Hz)	9983-1003557	247
Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A (230 V, 50/60 Hz)	9983-1003558	247
Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (115 V, 50/60 Hz)	9983-1003315	247
Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (230 V, 50/60 Hz)	9983-1003316	247
Transformer, Demountable	–	210–212
Transmission Grating 300 Lines/mm	9983-1003079	150
Transmission Grating 600 Lines/mm	9983-1003080	150
Transport Case KL	9983-1008651	168–171
Triac, BT 137/800, P4W50	9983-1012980	192
Triode D	9983-1000647	216
Triode S	9983-1000614	221
Triple/Quintuple Slit N	9983-4004057	140
Tripod Stand 150 mm	9983-1002835	276
Tripod Stand 185 mm	9983-1002836	276
Trolley Track	9983-1003318	57
Tube Holder D	9983-1008507	218
Tube Holder S	9983-1000610	223
Tube Thermometer, Graduated -10–110°C	9983-1002879	112–113
Tube Thermometer, not Graduated	9983-1002880	112–113
Tube with 6 Induction Coils	9983-1001005	207
Tubing	–	278
Tubing Clamps, Set of 3	9983-1002623	278
Tubing, Silicone 2 mm	9983-1002621	278
Tubing, Silicone 6 mm	9983-1002622	278
Tungsten Wire	9983-1009718	52
Tuning Fork 21 Hz with Plotter Pen	9983-1000805	94
Tuning Fork, 2000 Hz	9983-1002609	94
Tuning Fork, 440 Hz, on Resonance Box	9983-1002613	94
Tuning Weights, Pair	9983-1002611	95
Turn Table	9983-1003490	68
Two Stroke Engine, Transparent	9983-1002998	132
Two Way Ball Valve DN 16 KF	9983-1002923	85
Two-Channel Function Generator, 20 MHz	9983-1008677	253
Tyndall’s Bar Breaker	9983-1000829	118
Type K/IR Thermometer	9983-1002799	115
– U –		
U Core	9983-1000979	212
Ultrasonic Coupling Gel	9983-1008575	102
Ultrasonic cw Generator with Probe	9983-1002576	98
Ultrasonic Doppler Apparatus	9983-1002571	103
Ultrasonic Echoscope	9983-1002580	99
Ultrasonic Motion Sensor	9983-1000559	37
Ultrasonic Probe, 1 MHz	9983-1002581	100
Ultrasonic Probe, 2 MHz	9983-1002582	100
Ultrasonic Probe, 4 MHz	9983-1002583	100
Ultrasound	–	97–105
Ultrasound Transducer 40 kHz Equipment Kit	9983-1009888	97
Undoped Germanium on Printed Circuit Board	9983-1008522	242

www.EngineeringBooksPDF.com

Description	Art. No.	Page
Uniform Acceleration	–	63
Universal Areometer	9983-1002876	76
Universal Clamp	9983-1002830	277
Universal Holder on 3B Box	9983-1010156	184–185
Universal Jaw Clamp	9983-1002833	277
Universal Plug	9983-1003651	281
Universal Spirit Level, 250 mm	9983-1002604	53
Unknown Resistors in 3B Box	9983-1012699	184–185
USB Interface	9983-1003431	269
USB Oscilloscope 2x40 MHz	9983-1012879	256
U-Shaped Manometer D	9983-1009714	78
U-Tube Manometer S	9983-1000792	78
UV A/B Sensor	9983-1000567	38
– V –		
Vacuum	–	82–83
Vacuum Bell Jar	9983-1003167	83
Vacuum Chamber with Hand Pump	9983-1010126	82
Vacuum Experiment Plate	9983-1003166	83
Vacuum Hand Pump	9983-1012856	84
Vacuum Hose, 10 mm	9983-1002620	84, 278
Vacuum Hose, 4 mm	9983-1012831	84, 278
Vacuum Hose, 6 mm	9983-1012830	84, 278
Vacuum Hose, 8 mm	9983-1002619	84, 278
Vacuum Photocell	9983-1000915	235
Vacuum Pumps	–	84–85
Vacuum Recipient	9983-1009943	83
Vacuum Student Kit	9983-1003494	28
Van de Graaff Generator (115 V, 50/60 Hz)	9983-1002963	176
Van de Graaff Generator (230 V, 50/60 Hz)	9983-1002964	176
Vane Wheel	9983-1003101	121
Variable g Pendulum	9983-1000755	69
Variable Inductance Coil	9983-1003194	208
Variable-Focus Lens	9983-1003030	145
Velocity Flags, Set of 4	9983-1003350	59
Ventilation Valve DN 16 KF	9983-1002926	85
Vernier Model	9983-1002951	47
Vertical and Horizontal Trajectories	–	64–65
Vertical Ruler, 1 m	9983-1000743	46
Vessel with Overflow, Metal	9983-1009713	47
Vessel with Overflow, Transparent	9983-1003518	47
Vibration Generator	9983-1000701	90
Video Cameras	–	272–273
Viscosity	–	81
Vision Viewer	9983-1003436	272–273
Volta's Pile on 3B Box	9983-1010132	184–185
Voltage Regulating Transformer (230 V, 50/60 Hz)	9983-1002772	247
Voltmeter, AC	9983-1002789	258
Voltmeter, DC	9983-1002787	258
– W –		
Waltenhofen's Pendulum	9983-1000993	208
Wankel Engine, Transparent	9983-1002994	132
Warning Notice: "Radioactive"	9983-1000919	244
Watch Glass Dishes, 125 mm, Set of 10	9983-1002869	282
Watch Glass Dishes, 80 mm, Set of 10	9983-1002868	282
Water Bath	9983-1010037	274
Water Wave Channel	9983-1000807	89
Water Waves	–	89
Water-Jet Pump	9983-1003008	84
Watt's Governor	9983-1009695	67
Wave Machine, Manual	9983-1003524	92
Wave Optics	–	88, 155–156
Waveguide Optics, Equipment Set	9983-1003054	173
Waves and Particles	–	239
Waves and Sound	–	88–105
Weather	–	110–111
Weather Station, Wireless	9983-1010248	111
Wedge-Shaped Vessel	9983-1000794	81
Weight Holder, 50 g	9983-1003215	50
Weight Holders with Slotted Weights, Set of 3	9983-1000676	51
Weights with Hooks, Set	9983-1010168	51
Weights, 10 g, Set of 10	9983-1000770	50
Weights, 20 g, Set of 10	9983-1000769	50
Weights, 50 g, Set of 10	9983-1000771	50
Whiteboard 600x900 mm²	9983-1002591	135, 275
Whiteboard 900x1200 mm²	9983-1002592	135, 275
Whiteboards	–	275
Wick	9983-1001048	132
Wide-Band Loudspeaker	9983-1000812	97
Wimshurst Machine	9983-1002967	176
Wireless Weather Station	9983-1010248	111
Wooden Blocks for Friction Experiments	9983-1002944	54
Wooden Rulers, 0.5 m, Set of 10	9983-1003234	47
Wooden Rulers, 1 m, Set of 10	9983-1003233	47
WSe_2 Sample	9983-1012874	229
– X –		
X-Ray Apparatus (115 V, 50/60 Hz)	9983-1000660	242a
X-Ray Apparatus (230 V, 50/60 Hz)	9983-1000657	242a
X-Ray Energy Detector	9983-1008629	242f–g
X-Rays	–	242a–h
– Y –		
Yi Bell	9983-1003207	283
– Z –		
Zener Diode, ZPD 18, P2W19	9983-1012970	191
Zener Diode, ZPD 3,3, P2W19	9983-1012965	191
Zener Diode, ZPD 6,2, P2W19	9983-1012967	191
Zener Diode, ZPD 9,1, P2W19	9983-1012966	191
Zener Diode, ZPY 5,6, P2W19	9983-1012968	191
Zener Diode, ZPY 8,2, P2W19	9983-1012969	191
Zero Point Galvanometer CA 403	9983-1002726	259
Zinc Plates, Set of 10	9983-1002713	195

Art. No.	Page	Art. No.	Page	Art. No.	Page	Art. No.	Page	Art. No.	Page
9983-1000009	35	9983-1000558	38	9983-1000591	202	9983-1000619	221	9983-1000656	239
9983-1000011	220	9983-1000559	37	9983-1000592	202	9983-1000620	238	9983-1000657	242a
9983-1000259	175	9983-1000560	37	9983-1000593	246	9983-1000621	238	9983-1000660	242a
9983-1000345	102	9983-1000561	37	9983-1000596	151	9983-1000622	222	9983-1000661	242c
9983-1000536	234	9983-1000562	40	9983-1000597	151	9983-1000623	220, 239	9983-1000662	242c
9983-1000537	234	9983-1000563	36,45	9983-1000598	151	9983-1000624	223	9983-1000663	242c
9983-1000539	35	9983-1000564	36	9983-1000599	151	9983-1000628	242h	9983-1000664	242a
9983-1000540	35	9983-1000565	37	9983-1000600	151	9983-1000633	238	9983-1000665	242b
9983-1000541	35	9983-1000566	42	9983-1000601	151	9983-1000634	242h	9983-1000666	242b
9983-1000542	42	9983-1000567	38	9983-1000602	150	9983-1000635	242h	9983-1000667	242b
9983-1000543	42	9983-1000568	37	9983-1000603	151	9983-1000637	240–241	9983-1000668	242h
9983-1000544	34	9983-1000569	39	9983-1000604	135	9983-1000638	240–241	9983-1000669	242h
9983-1000545	39	9983-1000570	42	9983-1000605	59, 86	9983-1000640	240–241	9983-1000670	242h
9983-1000546	39	9983-1000571	42	9983-1000606	59, 86	9983-1000642	240–241	9983-1000672	78
9983-1000547	39	9983-1000572	189	9983-1000607	149	9983-1000644	218	9983-1000674	199
9983-1000548	39	9983-1000573	189	9983-1000608	148	9983-1000645	218	9983-1000675	144
9983-1000549	39	9983-1000575	40	9983-1000609	141	9983-1000646	216	9983-1000676	51
9983-1000550	38, 112–113	9983-1000576	40	9983-1000610	223	9983-1000647	216	9983-1000680	71, 246
9983-1000551	38, 112–113	9983-1000577	42	9983-1000611	222	9983-1000648	215	9983-1000681	71, 246
9983-1000552	41	9983-1000578	40	9983-1000613	221	9983-1000649	215	9983-1000682	134
9983-1000553	41	9983-1000579	40	9983-1000614	221	9983-1000650	215	9983-1000683	162
9983-1000554	39	9983-1000580	200	9983-1000615	220	9983-1000651	214	9983-1000684	162
9983-1000555	41	9983-1000581	200	9983-1000616	220	9983-1000653	216	9983-1000685	186
9983-1000556	41	9983-1000588	65	9983-1000617	219	9983-1000654	217	9983-1000686	186
9983-1000557	37	9983-1000590	208	9983-1000618	221	9983-1000655	214, 239	9983-1000687	186

www.EngineeringBooksPDF.com

Art. No.	Page
9983-1000688	186
9983-1000689	186
9983-1000690	186
9983-1000691	181
9983-1000694	53
9983-1000695	68
9983-1000698	68
9983-1000699	53
9983-1000700	94
9983-1000701	90
9983-1000702	90
9983-1000703	90
9983-1000704	122
9983-1000705	91
9983-1000706	91
9983-1000707	90
9983-1000730	14
9983-1000731	15
9983-1000732	16
9983-1000733	17
9983-1000734	17
9983-1000735	44
9983-1000738	63
9983-1000739	62
9983-1000740	65
9983-1000741	49
9983-1000742	46
9983-1000743	46
9983-1000747	70
9983-1000748	70
9983-1000750	67
9983-1000752	76
9983-1000754	76
9983-1000755	69
9983-1000756	69
9983-1000758	86
9983-1000760	86
9983-1000761	86
9983-1000762	69
9983-1000763	69
9983-1000764	69
9983-1000765	87
9983-1000766	77
9983-1000768	75
9983-1000769	50
9983-1000770	50
9983-1000771	50
9983-1000773	50
9983-1000775	50
9983-1000777	50
9983-1000779	62
9983-1000780	62
9983-1000781	66
9983-1000782	66
9983-1000783	66
9983-1000786	49
9983-1000789	22
9983-1000790	63
9983-1000791	75
9983-1000792	78
9983-1000793	78
9983-1000794	81
9983-1000796	77
9983-1000797	81
9983-1000798	84
9983-1000801	80
9983-1000804	96
9983-1000805	94
9983-1000806	96
9983-1000807	89
9983-1000808	91
9983-1000811	97
9983-1000812	97
9983-1000814	93
9983-1000815	93
9983-1000816	19
9983-1000817	128
9983-1000819	130
9983-1000820	130
9983-1000821	117
9983-1000822	117
9983-1000823	117
9983-1000824	107, 122
9983-1000827	118
9983-1000828	118
9983-1000829	118
9983-1000830	119
9983-1000831	118
9983-1000832	117
9983-1000833	117
9983-1000834	117

Art. No.	Page
9983-1000835	122
9983-1000837	107
9983-1000839	106
9983-1000840	107
9983-1000841	140
9983-1000842	140
9983-1000843	140
9983-1000844	140
9983-1000845	140
9983-1000846	150
9983-1000848	149
9983-1000850	138
9983-1000851	160
9983-1000852	163, 235
9983-1000853	148
9983-1000854	148
9983-1000855	146
9983-1000856	146
9983-1000857	146
9983-1000859	138
9983-1000862	138
9983-1000863	138
9983-1000865	246
9983-1000866	246
9983-1000868	139
9983-1000869	139
9983-1000871	139
9983-1000876	138
9983-1000878	139
9983-1000879	139
9983-1000880	179
9983-1000881	174
9983-1000882	174
9983-1000885	150
9983-1000886	149
9983-1000887	138
9983-1000889	151
9983-1000891	151
9983-1000893	106
9983-1000894	106
9983-1000895	154
9983-1000901	225
9983-1000902	225
9983-1000904	226
9983-1000906	207
9983-1000912	236–237
9983-1000913	234
9983-1000915	235
9983-1000916	235
9983-1000917	234
9983-1000918	244
9983-1000919	244
9983-1000920	244
9983-1000921	244
9983-1000923	177
9983-1000924	176
9983-1000925	201
9983-1000926	201
9983-1000927	201
9983-1000928	201
9983-1000929	196
9983-1000932	179
9983-1000933	179
9983-1000934	179
9983-1000936	179
9983-1000938	178
9983-1000942	200
9983-1000943	196
9983-1000946	182
9983-1000947	182
9983-1000948	183
9983-1000949	182
9983-1000950	182
9983-1000951	182
9983-1000953	182
9983-1000954	182
9983-1000955	182
9983-1000956	182
9983-1000957	182
9983-1000958	182
9983-1000959	182
9983-1000960	182
9983-1000961	182
9983-1000962	182
9983-1000963	197
9983-1000964	202
9983-1000965	202
9983-1000966	213
9983-1000967	213
9983-1000968	206
9983-1000970	181

Art. No.	Page
9983-1000972	178
9983-1000975	204
9983-1000976	210
9983-1000977	212
9983-1000978	212
9983-1000979	212
9983-1000980	211
9983-1000981	211
9983-1000982	211
9983-1000983	211
9983-1000984	210
9983-1000985	210
9983-1000986	210
9983-1000987	210
9983-1000988	210
9983-1000989	210
9983-1000990	210
9983-1000991	210
9983-1000992	211
9983-1000993	208
9983-1000994	188
9983-1000995	183
9983-1000997	22
9983-1000998	22
9983-1000999	212
9983-1001000	212
9983-1001001	212
9983-1001002	212
9983-1001003	212
9983-1001004	212
9983-1001005	207
9983-1001006	248
9983-1001007	248
9983-1001009	247
9983-1001010	247
9983-1001011	251
9983-1001012	251
9983-1001014	246
9983-1001015	267
9983-1001016	267
9983-1001021	267
9983-1001022	267
9983-1001024	178
9983-1001025	178
9983-1001026	178
9983-1001027	177
9983-1001028	267
9983-1001029	180
9983-1001030	180
9983-1001032	45, 243, 264
9983-1001033	45, 243, 264
9983-1001034	36,45
9983-1001035	243
9983-1001036	253
9983-1001037	253
9983-1001038	252
9983-1001040	203
9983-1001041	91
9983-1001042	276
9983-1001043	276
9983-1001044	276
9983-1001045	276
9983-1001046	276
9983-1001048	132
9983-1001049	119
9983-1001051	282
9983-1001052	50
9983-1001054	183
9983-1001055	55
9983-1001056	160
9983-1001057	160
9983-1002571	103
9983-1002572	104
9983-1002573	104
9983-1002574	102
9983-1002575	103
9983-1002576	98
9983-1002577	98
9983-1002578	98
9983-1002579	98
9983-1002580	99
9983-1002581	100
9983-1002582	100
9983-1002583	100
9983-1002584	100
9983-1002585	100
9983-1002586	100
9983-1002587	100
9983-1002588	101
9983-1002589	101
9983-1002590	101

Art. No.	Page
9983-1002591	135,275
9983-1002592	135,275
9983-1002593	275
9983-1002594	127
9983-1002597	131
9983-1002598	129
9983-1002599	129
9983-1002600	46
9983-1002601	46
9983-1002602	46
9983-1002603	46
9983-1002604	53
9983-1002605	95
9983-1002606	94
9983-1002607	94
9983-1002608	94
9983-1002609	94
9983-1002610	95
9983-1002611	95
9983-1002612	95
9983-1002613	94
9983-1002614	95
9983-1002615	95
9983-1002619	84, 278
9983-1002620	84, 278
9983-1002621	278
9983-1002622	278
9983-1002623	278
9983-1002627	110
9983-1002628	142
9983-1002629	142
9983-1002630	142
9983-1002632	143
9983-1002635	142
9983-1002637	142
9983-1002639	142
9983-1002644	142
9983-1002646	143
9983-1002649	148
9983-1002651	167
9983-1002652	167
9983-1002653	78
9983-1002654	64
9983-1002655	64
9983-1002656	65
9983-1002657	64
9983-1002658	116
9983-1002659	116
9983-1002660	205
9983-1002661	205
9983-1002662	205
9983-1002663	209, 266
9983-1002664	275
9983-1002665	275
9983-1002670	124
9983-1002671	125
9983-1002672	125
9983-1002689	108
9983-1002690	32
9983-1002692	108
9983-1002693	33
9983-1002695	33
9983-1002696	106
9983-1002698	48
9983-1002699	48
9983-1002700	48
9983-1002701	48
9983-1002702	49
9983-1002703	49
9983-1002704	49
9983-1002705	157
9983-1002707	178
9983-1002708	178
9983-1002709	178
9983-1002710	278
9983-1002711	195
9983-1002712	195
9983-1002713	195
9983-1002714	195
9983-1002715	195
9983-1002716	195
9983-1002717	195
9983-1002719	193
9983-1002720	193
9983-1002721	161
9983-1002722	243
9983-1002726	259
9983-1002727	254–255
9983-1002728	254–255
9983-1002729	254–255
9983-1002730	187

Art. No.	Page
9983-1002731	187
9983-1002732	187
9983-1002733	187
9983-1002734	187
9983-1002735	187
9983-1002736	187
9983-1002737	187
9983-1002743	253
9983-1002744	253
9983-1002745	254–255
9983-1002746	281
9983-1002748	281
9983-1002749	281
9983-1002750	281
9983-1002751	281
9983-1002752	281
9983-1002753	41
9983-1002754	41
9983-1002760	250
9983-1002761	250
9983-1002762	250
9983-1002763	250
9983-1002769	248
9983-1002771	250
9983-1002772	247
9983-1002775	248
9983-1002776	248
9983-1002777	254–255
9983-1002778	263
9983-1002779	263
9983-1002780	263
9983-1002781	260
9983-1002783	260
9983-1002784	260
9983-1002785	260
9983-1002786	258
9983-1002787	258
9983-1002788	258
9983-1002789	258
9983-1002790	258
9983-1002791	115
9983-1002793	115
9983-1002794	115
9983-1002795	110
9983-1002796	188
9983-1002797	188
9983-1002799	115
9983-1002802	263
9983-1002803	112–113
9983-1002804	112–113
9983-1002805	112–113
9983-1002806	274
9983-1002807	274
9983-1002808	274
9983-1002809	45
9983-1002810	45
9983-1002811	45
9983-1002819	233
9983-1002820	233
9983-1002821	233
9983-1002826	129
9983-1002827	277
9983-1002828	277
9983-1002829	277
9983-1002830	277
9983-1002831	277
9983-1002832	277
9983-1002833	277
9983-1002834	276
9983-1002835	276
9983-1002836	276
9983-1002837	143
9983-1002838	279
9983-1002839	279
9983-1002840	279
9983-1002841	279
9983-1002843	280
9983-1002844	279
9983-1002845	280
9983-1002847	279
9983-1002848	280
9983-1002849	280
9983-1002850	279
9983-1002851	280
9983-1002858	153
9983-1002859	153
9983-1002860	153
9983-1002861	153
9983-1002862	154
9983-1002863	153
9983-1002864	153

www.EngineeringBooksPDF.com

Art. No.	Page
9983-1002865	153
9983-1002866	168–171
9983-1002867	75
9983-1002868	282
9983-1002869	282
9983-1002870	117, 282
9983-1002871	75, 282
9983-1002872	282
9983-1002873	282
9983-1002874	76
9983-1002875	76
9983-1002876	76
9983-1002877	110
9983-1002878	110
9983-1002879	112–113
9983-1002880	112–113
9983-1002881	112–113
9983-1002882	122
9983-1002884	161
9983-1002885	161
9983-1002886	282
9983-1002887	282
9983-1002888	282
9983-1002889	120
9983-1002890	79
9983-1002891	79
9983-1002892	80
9983-1002894	126
9983-1002895	126
9983-1002897	195
9983-1002898	194
9983-1002899	194
9983-1002903	121
9983-1002904	283
9983-1002905	224
9983-1002906	160
9983-1002911	164–165
9983-1002912	164–165
9983-1002917	150
9983-1002918	85
9983-1002919	85
9983-1002923	85
9983-1002924	85
9983-1002925	85
9983-1002926	85
9983-1002927	85
9983-1002928	85
9983-1002929	85
9983-1002930	85
9983-1002931	85
9983-1002932	278
9983-1002933	278
9983-1002934	278
9983-1002935	278
9983-1002936	278
9983-1002937	278
9983-1002939	57
9983-1002940	53
9983-1002941	276
9983-1002942	276
9983-1002943	276
9983-1002944	54
9983-1002945	49
9983-1002946	49
9983-1002947	46
9983-1002950	53
9983-1002951	47
9983-1002952	75, 76
9983-1002953	75, 76
9983-1002954	75, 76
9983-1002955	75, 76
9983-1002956	71
9983-1002957	80
9983-1002959	96
9983-1002960	96
9983-1002963	176
9983-1002964	176
9983-1002965	176
9983-1002967	176
9983-1002969	183
9983-1002970	183
9983-1002975	200
9983-1002976	200
9983-1002977	119
9983-1002978	119
9983-1002981	123
9983-1002983	157
9983-1002984	135
9983-1002985	135
9983-1002986	135
9983-1002987	135
9983-1002988	135
9983-1002989	135
9983-1002990	135
9983-1002992	135
9983-1002993	137
9983-1002994	132
9983-1002995	132
9983-1002996	132
9983-1002997	132
9983-1002998	132
9983-1003000	132
9983-1003006	144
9983-1003007	144
9983-1003008	84
9983-1003009	45
9983-1003010	114
9983-1003011	110
9983-1003012	76
9983-1003013	112–113
9983-1003014	112–113
9983-1003016	147
9983-1003017	147
9983-1003019	147
9983-1003022	145
9983-1003023	145
9983-1003024	145
9983-1003025	145
9983-1003026	145
9983-1003027	145
9983-1003028	145
9983-1003029	145
9983-1003030	145
9983-1003031	145
9983-1003032	145
9983-1003033	145
9983-1003034	147
9983-1003036	141
9983-1003038	143
9983-1003039	141
9983-1003040	141
9983-1003041	141
9983-1003042	141
9983-1003043	141
9983-1003044	141
9983-1003045	125
9983-1003048	177
9983-1003049	136
9983-1003050	136
9983-1003051	136
9983-1003052	136
9983-1003053	155
9983-1003054	173
9983-1003055	173
9983-1003056	136
9983-1003057	137
9983-1003058	137
9983-1003059	156
9983-1003061	164–165
9983-1003062	187
9983-1003063	187
9983-1003064	187
9983-1003065	187
9983-1003066	187
9983-1003067	187
9983-1003068	187
9983-1003069	187
9983-1003073	258
9983-1003074	258
9983-1003078	164–165
9983-1003079	150
9983-1003080	150
9983-1003081	151
9983-1003082	150
9983-1003083	150
9983-1003084	149
9983-1003085	196
9983-1003086	196
9983-1003088	196
9983-1003089	196
9983-1003090	197
9983-1003091	197
9983-1003092	200
9983-1003093	199
9983-1003095	199
9983-1003096	198
9983-1003097	228
9983-1003098	228
9983-1003101	121
9983-1003102	48
9983-1003103	48
9983-1003104	48,54
9983-1003105	48,54
9983-1003106	48
9983-1003107	48,54
9983-1003108	48
9983-1003109	49
9983-1003110	48
9983-1003112	196
9983-1003114	196
9983-1003115	93
9983-1003116	93
9983-1003117	93
9983-1003122	265
9983-1003123	265
9983-1003131	257
9983-1003132	257
9983-1003137	257
9983-1003140	251
9983-1003141	251
9983-1003152	158–159
9983-1003157	163
9983-1003158	163
9983-1003159	163
9983-1003160	166
9983-1003161	163
9983-1003162	163
9983-1003163	163
9983-1003164	147
9983-1003165	144
9983-1003166	83
9983-1003167	83
9983-1003169	83
9983-1003170	83
9983-1003177	150
9983-1003178	151
9983-1003179	151
9983-1003180	151
9983-1003181	151
9983-1003182	164–165
9983-1003183	164–165
9983-1003184	164–165
9983-1003185	149
9983-1003186	149
9983-1003187	137
9983-1003188	143
9983-1003189	157
9983-1003190	282
9983-1003191	137
9983-1003192	199
9983-1003193	202
9983-1003194	208
9983-1003195	162
9983-1003196	162
9983-1003197	162
9983-1003198	89
9983-1003199	89
9983-1003201	144
9983-1003202	144
9983-1003203	146
9983-1003204	152
9983-1003206	283
9983-1003207	283
9983-1003208	82
9983-1003209	29
9983-1003210	50
9983-1003211	50
9983-1003212	50, 54
9983-1003213	56
9983-1003214	50
9983-1003215	50
9983-1003216	56
9983-1003217	56
9983-1003218	56
9983-1003219	56
9983-1003221	56
9983-1003222	56
9983-1003223	56
9983-1003224	55
9983-1003226	50
9983-1003227	50
9983-1003228	50
9983-1003229	50
9983-1003230	69
9983-1003231	29
9983-1003232	179
9983-1003233	47
9983-1003234	47
9983-1003235	72
9983-1003236	126
9983-1003237	202
9983-1003251	204
9983-1003252	206
9983-1003253	116
9983-1003254	116
9983-1003255	116
9983-1003256	116
9983-1003257	116
9983-1003258	116
9983-1003263	270
9983-1003264	270
9983-1003265	270
9983-1003307	251
9983-1003308	251
9983-1003309	251
9983-1003310	251
9983-1003311	250
9983-1003312	250
9983-1003313	203
9983-1003314	203
9983-1003315	247
9983-1003316	247
9983-1003317	84
9983-1003318	57
9983-1003321	135
9983-1003322	135
9983-1003323	134
9983-1003324	134
9983-1003328	150
9983-1003330	266
9983-1003331	266
9983-1003332	266
9983-1003334	114
9983-1003335	114
9983-1003337	52
9983-1003338	174
9983-1003339	174
9983-1003340	72
9983-1003341	58
9983-1003342	59
9983-1003344	59
9983-1003345	59
9983-1003346	59
9983-1003347	59
9983-1003348	59
9983-1003349	59
9983-1003350	59
9983-1003351	59
9983-1003352	59
9983-1003354	59
9983-1013210	60
9983-1003359	61
9983-1003360	59
9983-1003361	61
9983-1003362	61
9983-1003363	61
9983-1003364	61
9983-1003366	61
9983-1003367	63
9983-1003368	45
9983-1003369	45
9983-1003370	48
9983-1003371	48
9983-1003372	48
9983-1003373	48
9983-1003374	48
9983-1003375	48
9983-1003376	49
9983-1003378	75
9983-1003382	118
9983-1003383	121
9983-1003384	112–113
9983-1003385	112–113
9983-1003386	112–113
9983-1003387	112–113
9983-1003402	162
9983-1003403	162
9983-1003404	162
9983-1003405	162
9983-1003406	162
9983-1003407	162
9983-1003408	162
9983-1003409	162
9983-1003410	162
9983-1003411	162
9983-1003412	162
9983-1003413	162
9983-1003414	162
9983-1003415	162
9983-1003416	162
9983-1003417	162
9983-1003419	268
9983-1003420	268
9983-1003421	268
9983-1003426	269
9983-1003427	269
9983-1003428	269
9983-1003429	269
9983-1003431	269
9983-1003433	268
9983-1003434	268
9983-1003436	272–273
9983-1003489	68
9983-1003490	68
9983-1003491	92
9983-1003492	92
9983-1003493	197
9983-1003494	28
9983-1003495	80
9983-1003496	82
9983-1003497	121
9983-1003498	76
9983-1003499	77
9983-1003500	77
9983-1003501	77
9983-1003502	28
9983-1003505	129
9983-1003507	194
9983-1003508	194
9983-1003509	81
9983-1003510	79
9983-1003511	120
9983-1003512	121
9983-1003513	79
9983-1003514	80
9983-1003515	49
9983-1003516	92
9983-1003518	47
9983-1003519	77
9983-1003520	96
9983-1003521	96
9983-1003522	96
9983-1003523	96
9983-1003524	92
9983-1003525	112–113
9983-1003526	112–113
9983-1003527	112–113
9983-1003528	112–113
9983-1003531	164–165
9983-1003532	138
9983-1003533	138
9983-1003534	281
9983-1003535	106
9983-1003536	106
9983-1003537	162
9983-1003539	162
9983-1003541	162
9983-1003543	162
9983-1003544	162
9983-1003545	162
9983-1003546	162
9983-1003549	236–237
9983-1003550	236–237
9983-1003554	196
9983-1003555	199
9983-1003556	196
9983-1003557	247
9983-1003558	247
9983-1003559	249
9983-1003560	249
9983-1003561	248
9983-1003562	248
9983-1003565	132
9983-1003566	132
9983-1003568	281
9983-1003569	126
9983-1003570	126
9983-1003571	139
9983-1003593	249
9983-1003651	281
9983-1003767	175
9983-1003768	175
9983-1005047	175
9983-1005278	230–231
9983-1005279	230–231
9983-1005290	230–231
9983-1005291	230–231
9983-1005401	271
9983-1005402	271
9983-1005408	144
9983-1006494	46
9983-1006769	119
9983-1006780	246
9983-1006784	87
9983-1006785	67

www.EngineeringBooksPDF.com

Art. No.	Page
9983-1006790	140
9983-1006791	140
9983-1006794	236–237
9983-1006795	236–237
9983-1006796	234
9983-1006797	244
9983-1006798	179
9983-1006799	199
9983-1006804	25
9983-1006809	261
9983-1006810	259
9983-1006811	259
9983-1006813	178
9983-1006889	47
9983-1008500	127
9983-1008505	227
9983-1008506	238
9983-1008507	218
9983-1008508	242c
9983-1008513	53
9983-1008516	128
9983-1008518	139
9983-1008519	139
9983-1008521	224
9983-1008522	242
9983-1008524	182
9983-1008525	212
9983-1008527	20
9983-1008528	21
9983-1008530	24
9983-1008531	24
9983-1008532	23
9983-1008534	181, 249
9983-1008535	181, 249
9983-1008537	203
9983-1008539	56
9983-1008540	90
9983-1008575	102
9983-1008629	242f–g
9983-1008630	115
9983-1008631	261
9983-1008632	168–171
9983-1008633	168–171
9983-1008634	168–171
9983-1008635	168–171
9983-1008636	168–171
9983-1008637	168–171
9983-1008638	168–171
9983-1008639	168–171
9983-1008640	168–171
9983-1008641	168–171
9983-1008642	168–171
9983-1008643	168–171
9983-1008644	168–171
9983-1008645	168–171
9983-1008646	168–171
9983-1008647	168–171
9983-1008648	168–171
9983-1008649	168–171
9983-1008650	168–171
9983-1008651	168–171
9983-1008652	154
9983-1008653	125
9983-1008654	125
9983-1008659	156
9983-1008661	52
9983-1008662	74
9983-1008663	74
9983-1008664	152
9983-1008665	152
9983-1008666	152
9983-1008667	146
9983-1008668	146
9983-1008669	148
9983-1008670	148
9983-1008671	148
9983-1008672	148
9983-1008673	164–165
9983-1008674	172
9983-1008675	172
9983-1008676	256
9983-1008677	253
9983-1008681	153
9983-1008686	283
9983-1008687	92
9983-1008690	249
9983-1008691	249
9983-1008692	213, 249
9983-1003593	213, 249
9983-1008695	254–255
9983-1008696	161
9983-1008699	109
9983-1008700	109
9983-1008702	109
9983-1008703	31
9983-1008707	245
9983-1008708	245
9983-1009497	168–171
9983-1009498	168–171
9983-1009545	246
9983-1009695	67
9983-1009696	138
9983-1009699	138
9983-1009700	26–27
9983-1009701	26–27
9983-1009710	198
9983-1009713	47
9983-1009714	78
9983-1009715	78
9983-1009716	209
9983-1009717	53
9983-1009718	52
9983-1009733	143
9983-1009734	280
9983-1009738	48
9983-1009739	48
9983-1009740	48
9983-1009741	48
9983-1009760	242
9983-1009764	107
9983-1009765	200
9983-1009772	269
9983-1009810	242
9983-1009811	153
9983-1009843	186
9983-1009844	186
9983-1009861	139
9983-1009863	139
9983-1009864	139
9983-1009865	139
9983-1009866	139
9983-1009883	18
9983-1009884	181
9983-1009885	186
9983-1009886	186
9983-1009887	186
9983-1009888	97
9983-1009922	38, 130
9983-1009924	96
9983-1009926	138
9983-1009927	139
9983-1009929	139
9983-1009931	26–27
9983-1009932	26–27
9983-1009934	242
9983-1009935	212
9983-1009941	38
9983-1009942	54
9983-1009943	83
9983-1009945	140
9983-1009946	140
9983-1009948	227
9983-1009949	186
9983-1009950	88
9983-1009951	88
9983-1009954	36
9983-1009955	36
9983-1009956	252
9983-1009957	252
9983-1009959	209
9983-1009960	218
9983-1009961	218
9983-1009962	177
9983-1009963	177
9983-1009964	177
9983-1010028	153
9983-1010029	153
9983-1010030	152
9983-1010031	152
9983-1010034	274
9983-1010035	274
9983-1010036	274
9983-1010037	274
9983-1010038	274
9983-1010083	277
9983-1010084	67
9983-1010110	282
9983-1010113	282
9983-1010114	282
9983-1010121	47
9983-1010124	278
9983-1010125	82
9983-1010126	82
9983-1010131	194
9983-1010132	184–185
9983-1010137	183
9983-1010138	184–185
9983-1010139	184–185
9983-1010140	183
9983-1010141	183
9983-1010142	183
9983-1010143	183
9983-1010144	183
9983-1010145	183
9983-1010146	184–185
9983-1010152	184–185
9983-1010154	184–185
9983-1010155	184–185
9983-1010156	184–185
9983-1010157	184–185
9983-1010158	184–185
9983-1010160	278
9983-1010164	209
9983-1010168	51
9983-1010175	156
9983-1010181	281
9983-1010182	281
9983-1010189	51
9983-1010190	184–185
9983-1010191	184–185
9983-1010192	184–185
9983-1010194	156
9983-1010195	183
9983-1010196	183
9983-1010197	183
9983-1010198	183
9983-1010199	183
9983-1010204	47
9983-1010205	47
9983-1010206	47
9983-1010207	209
9983-1010208	175
9983-1010209	175
9983-1010210	29
9983-1010214	47
9983-1010217	46
9983-1010219	114
9983-1010225	262
9983-1010229	274
9983-1010232	111
9983-1010233	110
9983-1010234	51
9983-1010236	280
9983-1010237	280
9983-1010238	280
9983-1010239	280
9983-1010240	280
9983-1010241	280
9983-1010248	111
9983-1010250	111
9983-1010252	133
9983-1010253	133
9983-1010254	133
9983-1010255	133
9983-1010256	133
9983-1010300	139
9983-1011346	184–185
9983-1011739	274
9983-1011768	282
9983-1011769	282
9983-1012328	68
9983-1012399	143
9983-1012400	142
9983-1012401	142
9983-1012402	142
9983-1012403	271
9983-1012467	142
9983-1012504	30
9983-1012510	85
9983-1012514	85
9983-1012524	30
9983-1012526	30
9983-1012527	30
9983-1012528	30
9983-1012569	60
9983-1012587	43
9983-1012643	272–273
9983-1012694	184–185
9983-1012695	184–185
9983-1012696	184–185
9983-1012697	184–185
9983-1012698	184–185
9983-1012699	184–185
9983-1012741	111
9983-1012774	269
9983-1012782	229
9983-1012801	131
9983-1012816	262
9983-1012817	262
9983-1012818	236–237
9983-1012819	236–237
9983-1012820	234
9983-1012821	156
9983-1012827	81
9983-1012828	272–273
9983-1012830	84, 278
9983-1012831	84, 278
9983-1012832	265
9983-1012833	265
9983-1012834	272–273
9983-1012835	272–273
9983-1012836	230–231
9983-1012837	230–231
9983-1012838	232
9983-1012840	232
9983-1012841	232
9983-1012842	232
9983-1012844	73
9983-1012845	105
9983-1012846	105
9983-1012847	278
9983-1012848	278
9983-1012849	278
9983-1012850	43
9983-1012851	43
9983-1012853	73
9983-1012854	73
9983-1012855	84
9983-1012856	84
9983-1012857	250
9983-1012858	250
9983-1012859	211
9983-1012860	154
9983-1012861	154
9983-1012862	119
9983-1012863	147
9983-1012865	261
9983-1012868	242h
9983-1012869	102
9983-1012870	126
9983-1012871	242d–e
9983-1012872	51
9983-1012873	280
9983-1012874	229
9983-1012875	229
9983-1012876	229
9983-1012877	229
9983-1012878	229
9983-1012879	256
9983-1012880	104
9983-1012881	270
9983-1012882	47
9983-1012883	161
9983-1012884	161
9983-1012885	161
9983-1012886	131
9983-1012887	131
9983-1012888	195
9983-1012889	195
9983-1012890	195
9983-1012891	140
9983-1012892	203
9983-1012893	96
9983-1012894	244
9983-1012899	246
9983-1012900	246
9983-1012902	190
9983-1012903	190
9983-1012904	190
9983-1012905	190
9983-1012906	190
9983-1012907	190
9983-1012908	190
9983-1012909	190
9983-1012910	190
9983-1012911	190
9983-1012912	190
9983-1012913	190
9983-1012914	190
9983-1012915	190
9983-1012916	190
9983-1012917	190
9983-1012918	190
9983-1012919	190
9983-1012920	190
9983-1012921	190
9983-1012922	190
9983-1012923	190
9983-1012924	190
9983-1012925	190
9983-1012926	190
9983-1012927	190
9983-1012928	190
9983-1012929	190
9983-1012930	190
9983-1012931	190
9983-1012932	190
9983-1012933	190
9983-1012934	192
9983-1012935	192
9983-1012936	192
9983-1012937	192
9983-1012938	192
9983-1012939	192
9983-1012940	191
9983-1012941	191
9983-1012942	191
9983-1012943	190
9983-1012944	190
9983-1012945	190
9983-1012946	190
9983-1012947	190
9983-1012948	190
9983-1012949	190
9983-1012950	190
9983-1012951	190
9983-1012952	190
9983-1012953	190
9983-1012954	190
9983-1012955	190
9983-1012956	190
9983-1012957	190
9983-1012958	190
9983-1012959	190
9983-1012960	190
9983-1012961	191
9983-1012962	191
9983-1012963	191
9983-1012964	191
9983-1012965	191
9983-1012966	191
9983-1012967	191
9983-1012968	191
9983-1012969	191
9983-1012970	191
9983-1012971	191
9983-1012972	191
9983-1012973	191
9983-1012974	192
9983-1012975	192
9983-1012976	192
9983-1012977	192
9983-1012978	192
9983-1012979	192
9983-1012980	192
9983-1012981	192
9983-1012982	192
9983-1012983	191
9983-1012984	191
9983-1012985	191
9983-1012986	191
9983-1012987	191
9983-1012988	191
9983-1012989	191
9983-1012990	191
9983-1012991	192
9983-1012992	192
9983-1012993	192
9983-1012994	191
9983-1012995	191
9983-1013123	198
9983-1013131	207
9983-1013132	207
9983-1013311	158–159
9983-4000036	281
9983-4003748	63, 65
9983-4003876	54
9983-4003987	140
9983-4004002	140
9983-4004057	140
9983-5006578	40
9983-5006663	154

...going one step further
www.EngineeringBooksPDF.com

NEW

Noise Level Indicator SPL
9983-1012741

Page 111



9983-1012741



9983-1012821

"Addition of Colours" School Apparatus
9983-1012821

Page 156



9983-1009941

Magnetic Field Sensor ±2000 mT
9983-1009941

Page 38



9983-1012855

Rotary-Vane Vacuum Pump, One-Stage
9983-1012855

Page 84



9983-1009922

Temperature Sensor, Pt100 with Measurement Terminal
9983-1009922

Page 38

www.EngineeringBooksPDF.com

NEW

Steam Engine B
9983-1012801

Page 131

9983-1012801



Monocular Polarisation Microscope
9983-1012403

Page 271

9983-1012403



9983-1010252



LAB2 Electrical Burner (230 V, 50 Hz)
9983-1010252

Page 133

www.EngineeringBooksPDF.com

NEW

Glass Inset for Newton's Ring Experiments
9983-1008669

Page 148

9983-1008669





9983-1009717

Roman Arch Kit
9983-1009717

Page 53

Orbit™ Tellurium
9983-1008661

Page 52

9983-1008661



Protective Adapter, 3-Pole
9983-1009960

Protective Adapter, 2-Pole
9983-1009961

Page 218



9983-1009960



9983-1009961



9983-1008652

Fresnel Biprism
9983-1008652

Page 154

New Products

www.EngineeringBooksPDF.com

NEW



9983-1009710

"Oersted's Needle" Device

9983-1009710

Page 198



9983-1009955
9983-1009954

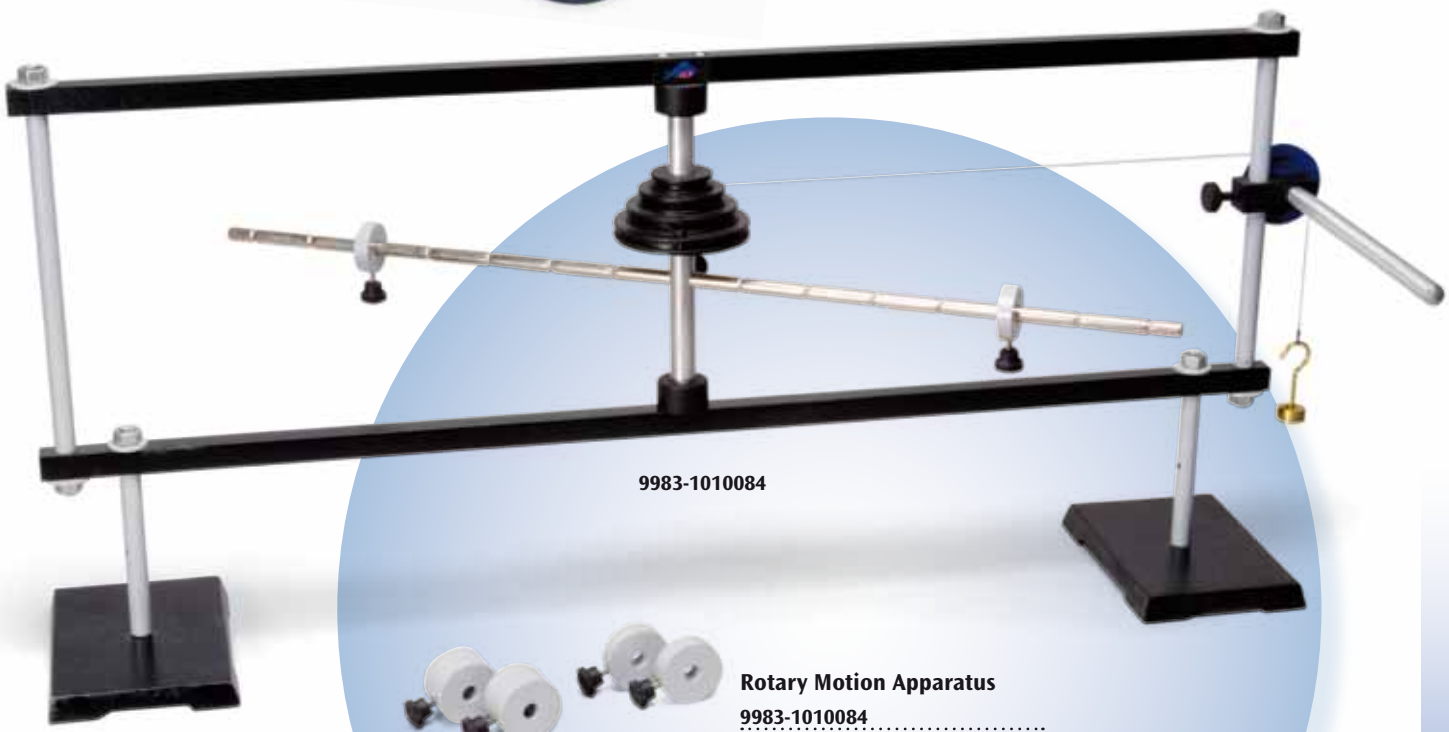
Connector Box (230 V, 50/60 Hz)

9983-1009955

Connector Box (115 V, 50/60 Hz)

9983-1009954

Page 36



9983-1010084

Rotary Motion Apparatus

9983-1010084

Page 67

www.EngineeringBooksPDF.com

NEW

Induction Torch
9983-1010207

Page 209



9983-1010207



Bicycle Dynamo, Transparent
9983-1010164

Page 209

9983-1010164



9983-1010194

Newton's Colour Disc, with DC Motor
9983-1010175

Page 156



9983-1010175

Newton's Colour Disc, with Crank
9983-1010194

Page 156

www.EngineeringBooksPDF.com

Interactive Atomic Model According to Bohr for your Physics, Chemistry and Biology Classes

This didactically excellent training model greatly simplifies the teaching and understanding of Bohr's model of the atom. The practical hands-on model illustrating the underlying theory allows students to comprehend the topic more directly. Science classes automatically become more 'real', easier to grasp and fun to do!

Learning content:

- **Atoms, isotopes, ions, noble gas configurations, structure of the elements, covalent bonds, ionic bonds**
- **Elements, atomic mass, atomic number and the periodic table**

Each class kit (9983-1005318/9983-1005319) contains eight student training models (9983-1005320) as well as two demonstration atoms for the teacher. With this completely magnetic demonstration atom you will be able to clearly and quite easily explain Bohr's atomic model to your students on the blackboard. Using the training atom your students will be able to construct their own atoms, isotopes, and even ions. In this manner natural science teaching becomes concrete, simple and lots of fun! Each student training model includes a flat round plastic container holding 30 protons, neutrons and electrons. The lid and the turned-over lower part of the container each represent an atom with orbits.

All the benefits at a glance:

- **Inter-disciplinary learning game**
- **Suitable for individual, partner and group work**
- **Playful learning of natural science subjects**
- **Easy understanding of processes and structures at the atomic level**
- **Simple and lots of fun to use**
- **Appealing 3D design**
- **Convenient storage**



2 completely magnetic demonstration models for the teacher

Class Kit for Whiteboard

Each class kit for 1 teacher and 8 student groups comes with 2 completely magnetic demonstration models for the teacher (1 white background sheet to be hung up, 2 black atomic nuclei, each with 8 black orbits, 20 protons, electrons and neutrons), 8 student training models each with 2 atoms, 30 protons, 30 neutrons and 30 electrons, instructions.

D/E/S/F/I/P

9983-1005318

Class Kit for Blackboard

Each class kit for 1 teacher and 8 student groups comes with 2 completely magnetic demonstration models for the teacher (1 black background sheet to be hung up, 2 white atomic nuclei, each with 8 white orbits, 20 protons, electrons and neutrons), 8 student training models ach with 2 atoms, 30 protons, 30 neutrons and 30 electrons, instructions

D/E/S/F/I/P

9983-1005319

Student Training Model

Supplied with 2 atoms, 30 protons, 30 neutrons and 30 electrons

9983-1005320



Student training model

www.EngineeringBooksPDF.com

Sensory Physiology Kit

Very interesting experiments for the secondary level of education
This sensory physiology kit allows students to conduct various experiments in the fields of hearing, seeing and feeling. All the contents of the kit are supplied. The experiments and the underlying principles are of course described in detail in the supplied instruction manual.

Experiment topics:

- Sense of touch (tactile sense)
- Perception of distances between tactile spots
- Heat and cold perception of the skin
- Blind spot
- Optical and haptic illusions Colour vision
- Flicker colours and motion after-effect
- Inversion of the image in the brain using inverting goggles
- Directional hearing
- Hearing own body noises

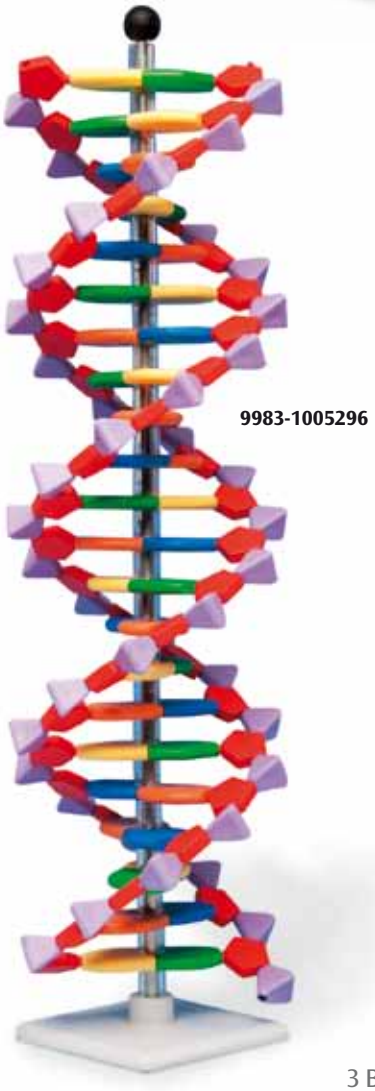
Supplied with: Carrying case with foam inserts, instrument for directional hearing, resonance tube, calipers, tactile hair, cold/hot probe, 4 transparent plastic cards for geometrical-optical illusions, “blind spot” test card, light-proof goggles with 8 attachments, 2 inversion prisms for the goggles, controllable motor with wall plug transformer, 3 pattern discs, experiment instructions on CD-ROM (pdf file) in German or English.
38x29x11 cm

D/E

9983-1005071



9983-1005071



9983-1005296

BEST SELLER

miniDNA™ 22 Layer Molecular Model

The miniDNA™ system comprises abstract shaped colour coded parts to represent the nitrogenous bases, pentagonal sugar & pyramidal phosphate parts required to make the Double helix model of DNA.

Contents:

11 Thymine (orange)
11 Adenine (blue)
11 Guanine (green)
11 Cytosine (yellow)
44 Deoxyribose (red)
44 Phosphate (purple)
Supplied with assembly instructions and its own stand.
Packed in a plastic box.
44 cm; diam 11 cm

E

9983-1005296

www.EngineeringBooksPDF.com

Nerves of Steel – Great experiments for simulating the conduction of impulses along nerve fibres according to Prof. Dr. Matthias Ducci / Prof. Dr. Marco Oetken

Exciting experiments for interdisciplinary teaching of year 11 to 13 classes. A model system for simulating the conduction of impulses is now finally available! Many biology teachers have complained about the lack of suitable model systems for simulating the conduction of impulses along nerve fibres, considering that neurophysiology is an established component of the advanced level syllabus. We have developed a unique electrochemical model experiment for effective illustration of this complex topic, in cooperation with Prof. Dr. Matthias Ducci (teacher training college PH Karlsruhe) and Prof. Dr. Marco Oetken (teacher training college PH Freiburg). Try it – you'll love it!

Nerves of Steel
The model experiments are based on the property of iron to develop a protective oxide coating in acid solutions under specific conditions. This impressive analogical model is based on the reversibility of the process of passivation and the appearance of a reactivation along a long iron rod. The materials provided allow the students to use the model to demonstrate continuous and saltatory conduction as well as the principle of transmission of neurotransmitters.

The following experiments can be carried out:
- **Simulation of continuous conduction along non-myelinated axons**
- **Simulation of salutatory conduction by means of a model experiment**
- **Transmission of information by neurotransmitters**

The set includes:
1 plexiglas trough,
sand paper,
3 iron rods,
1 zinc electrode,
15 jackets for isolation of sections of the iron rod,
detailed experimental instructions.

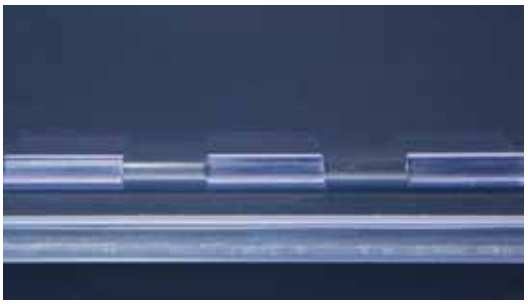
The necessary chemicals (hydrogen peroxide, sulphuric acid, sodium chloride solution) are not included.
12x12x35 cm; 0.5 kg
D/E/P
9983-1000538



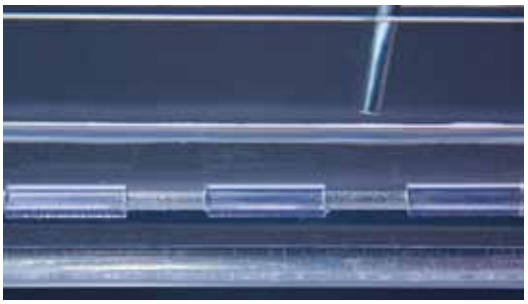
9983-1000538



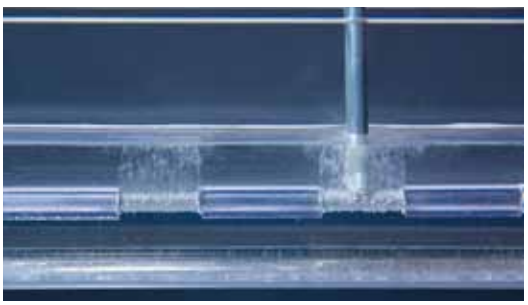
Prof. Dr. Matthias Ducci



Starting position of the simulation of salutatory conduction



The zinc electrode is put into the electrolytic solution



After the zinc electrode contacts the iron rod a reaction can be seen through the bubbles which represents the conduction of impulses of nerve fibres

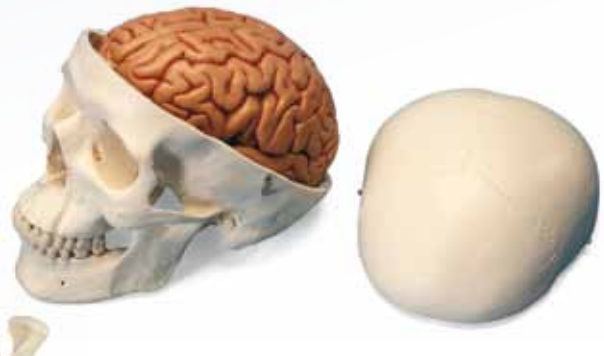
www.EngineeringBooksPDF.com



3B Scientific® Skull Kit – Didactic Version, 22-part
9983-1000069



Dental Disease, magnified 2 times, 21 parts
9983-1000016



Classic Skull with Brain, 8-part
9983-1000049



Ossicles – magnified 20 times
9983-1009697



Sam Deluxe Skeleton, on 5-feet roller stand with brake
9983-1000033



Disc-Torso, 15 slices
9983-1001237



Cancellous bone
9983-1009698

Classic Unisex Torso, 14-part
9983-1000190



3B BONElike™ Vertebral Column
9983-1000157

Further Information: www.3bscientific.com

NEW

www.EngineeringBooksPDF.com

3B Scientific History



The international 3B Scientific group of companies is the world's largest and most experienced manufacturer of anatomical teaching aids. The oldest production site was set up as early as 1819 in Budapest, Hungary. The continuously growing success of 3B Scientific is the result of global expansion, based on the production and sales of high-quality medical and scientific teaching aids available at fair prices. The internationally registered brand name 3B Scientific® can be found around the world in the fields of natural sciences, medical training and patient education. The product range includes products for lectures in physics and biology as well as anatomical models, software and charts, medical simulators, acupuncture and other therapy products. The company has been awarded the DIN EN ISO 9001:2008 certification for the excellent quality of its services, products and organizational structures. This official step towards quality management emphasizes the continuing process of innovation, product improvement and customer orientation that is associated with the brand name 3B Scientific®.

3B stands for: ***Best Quality*** ***Best Value*** ***Best Service***



1819 Calderoni founded in Budapest, Hungary

1912 Training Workshops of the German Hygiene Museum founded in Dresden

1948 Paul Binhold Lehrmittelfabrik founded in Hamburg

1950 Production of the first plastic skeleton

1952 First skeleton manufacturing plant opened

1963 New headquarters at Rudorffweg, Hamburg

1965 Introduction of the Torso product line

1970 Introduction of the Binhold company logo

1979 Anatomical models first exported to the USA

1983 First manufacturing of injection moulded skeleton parts

1986 Care simulators added to the product range

1988 Anatomical models first exported to Japan

1991 DHM Lehrmittelfabrik GmbH founded in Dresden

1993 Acquisition of Calderoni and foundation of Biocalderoni in Hungary

1995 American 3B Scientific founded in Atlanta, USA

1996 New logo for the 3B Scientific Group

1997 Nihon 3B Scientific founded in Niigata, Japan

1998 France 3B Scientific founded in Bartenheim, France

1998 Merger of Paul Binhold Lehrmittelfabrik GmbH and DHM Lehrmittelfabrik to form 3B Scientific GmbH

1999 China 3B Scientific founded in Suzhou, China

2000 DIN EN ISO 9001 certification

2001 Introduction of the full 3B Scientific® product range for physics

2002 Italy 3B Scientific founded in Bologna, Italy

2003 España 3B Scientific founded in Valencia, Spain

2003 UK 3B Scientific founded in Weston-super-Mare, United Kingdom

2004 All-European distributor of SEIRIN® acupuncture needles

2004 Acquisition of ELWE Didactic GmbH in Klingenthal

2005 Acquisition of TELTRON® brand name and production

2005 Russia 3B Scientific founded in St. Petersburg.

2006 Brasil 3B Scientific founded in Joinville, Brasil.

2007 Thai 3B Scientific Co Ltd., founded in Bangkok, Thailand

2009 DIN EN ISO 9001:2008 certification

2011 Implementation of SAP as business controlling software

...going one step further

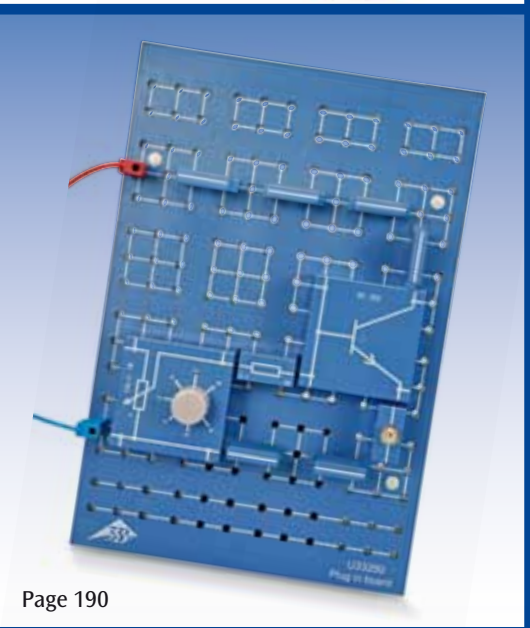
www.EngineeringBooksPDF.com



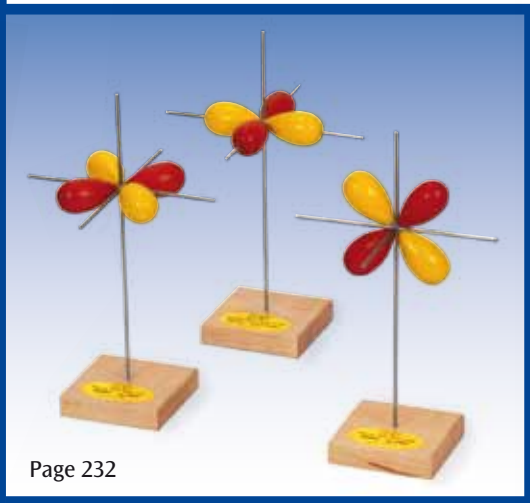
Page 242



Page 104



Page 190



Page 232



Page 227



Page 102



Page 73



Page 81

www.EngineeringBooksPDF.com