LIBRARY OF PHYSICO-CHEMICAL PROPERTY DATA

Handbook of Thermodynamic Diagrams

Volume 1

Organic Compounds C_1 to C_4

Carl L. Yaws

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CONTENTS

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DISCLAIMER

PREFACE

Thermodynamic property data are important in many engineering applications in the chemical processing and petroleum refining industries. The objective of this book is to provide the engineer with such data. The data are presented in thermodynamic diagrams (graphs) covering a wide range of pressures and temperatures to enable the engineer to quickly determine values at points of interest. The contents of the book are arranged in the following order: graphs, references, and appendixes.

The graphs are arranged by carbon number and chemical formula to provide ease of use. English units are used for the property values. For those involved in SI and metric usage, each graph displays a conversion factor to provide the SI and metric units.

The graphs provide wide coverage for volume and enthalpy as a function of temperature and pressure, including the following:

- two-phase region for saturated liquid and vapor
- superheated gas region for gases above saturation temperature
- subcooled liquid region for liquids below saturation temperature
- supercritical region for temperatures and pressures above critical point

The graphs for enthalpy also contain lines of constant entropy to permit engineering usage for 2nd law problems such as adiabatic expansion and compression of fluids.

The coverage encompasses a wide range of organic compounds including hydrocarbons, such as alkanes, olefins, acetylenes, and cycloalkanes; oxygenates, such as alcohols, aldehydes, ketones, acids, ethers, glycols, and anhydrides; halogenates, such as chlorinated, brominated, fluorinated, and iodinated compounds; nitrogenates, such as nitriles, amines, cyanates, and amides; sulfur compounds, such as mercaptans, sulfides, and sulfates; silicon compounds, such as silanes and chlorosilanes; and many other chemical types.

The range of coverage for pressure is from 10 to 10,000 psia. Very limited experimental data are available at pressures above 1,000 to 2,000 psia. Thus, values at the higher pressures should be considered rough approximations. Values at lower pressures are more accurate.

The graphs are based on the Peng-Robinson equation of state (1) as improved by Stryjek and Vera (2, 3). The equations for thermodynamic properties using the Peng-Robinson equation of state are given in the appendix for volume, compressibility factor, fugacity coefficient, residual enthalpy, and residual entropy. Critical constants and ideal gas heat capacities for use in the equations are from the data compilations of DIPPR (8) and Yaws (28, 29, 30).

The literature has been carefully searched in construction of the graphs. References for sources used in preparing the work are given in the section following the graphs near the end of the book.

For the graphs, some of the compounds may undergo thermal decomposition (reaction) at the higher temperatures. For such cases of thermal decomposition, the graphs are useful for ascertaining property values of the pure compound which is contained in the reaction mixture. Chemistry handbooks and DIPPR (8) notes may be used for specifics regarding thermal decomposition.

A list of compounds is given near the end of the book to aid the user in quickly locating compounds of interest from knowledge of the chemical formula or name.

An executable computer program, complete with data files, is available for calculation of thermodynamic properties. For information on the program, contact Carl L. Yaws, Ph.D., P. O. Box 10053, Beaumont, Texas 77710, phone/fax (409) 880-8787.

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Volume 1

Organic Compounds C_1 to C_4

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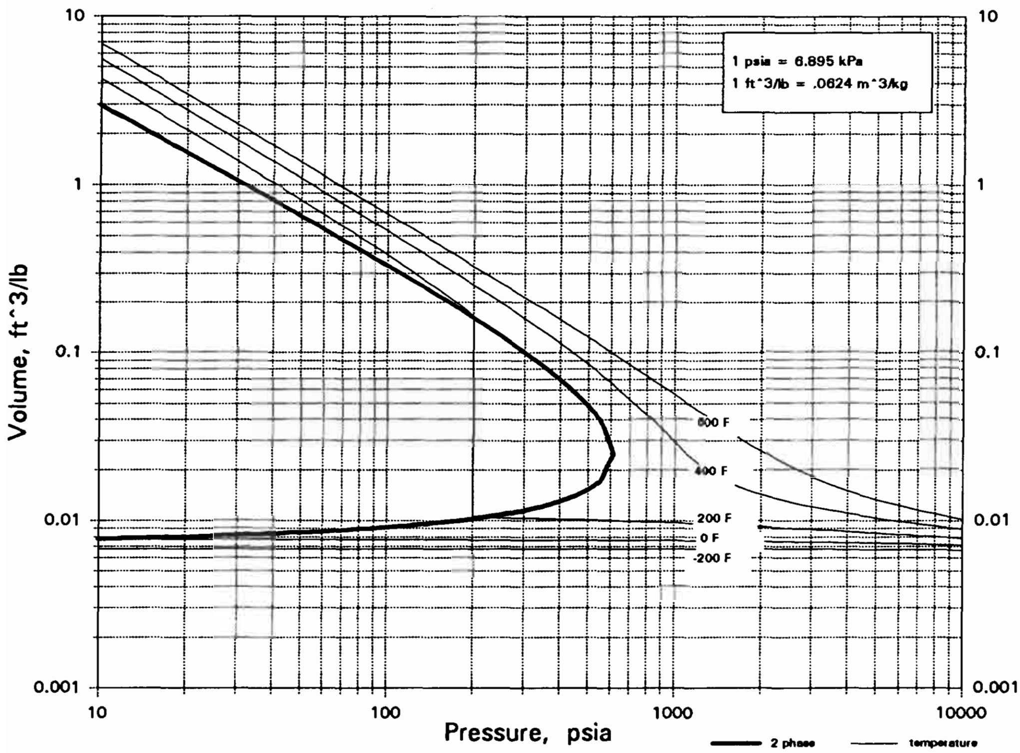
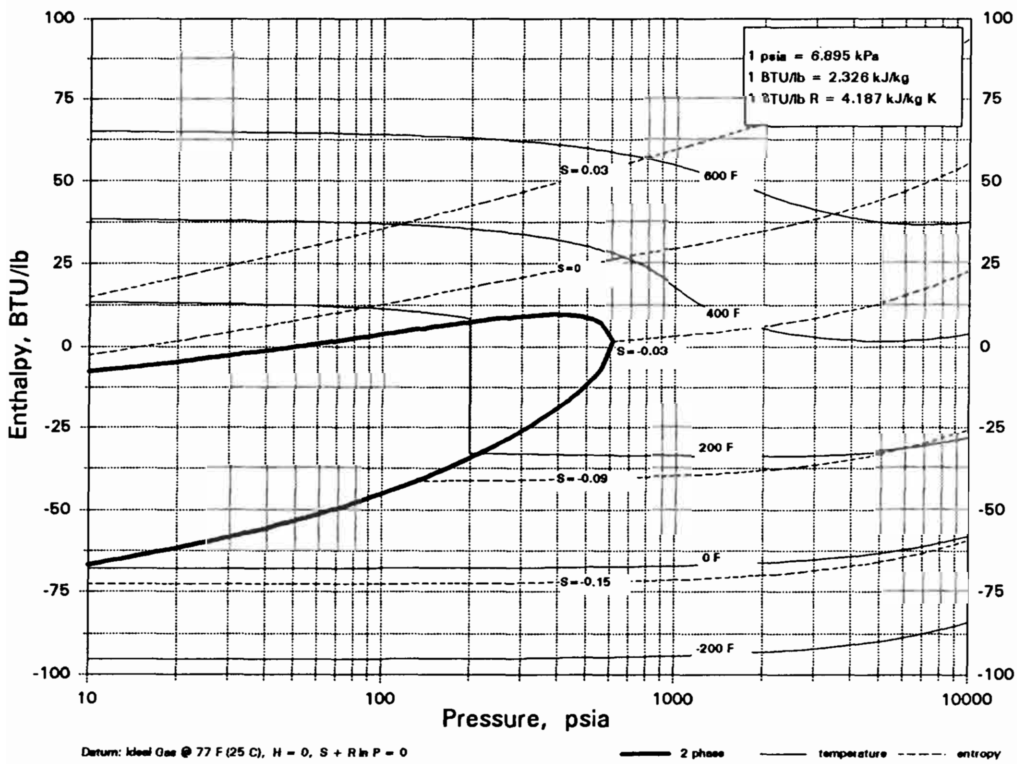
CBrClF2 BROMOCHLORODIFLUOROMETHANE





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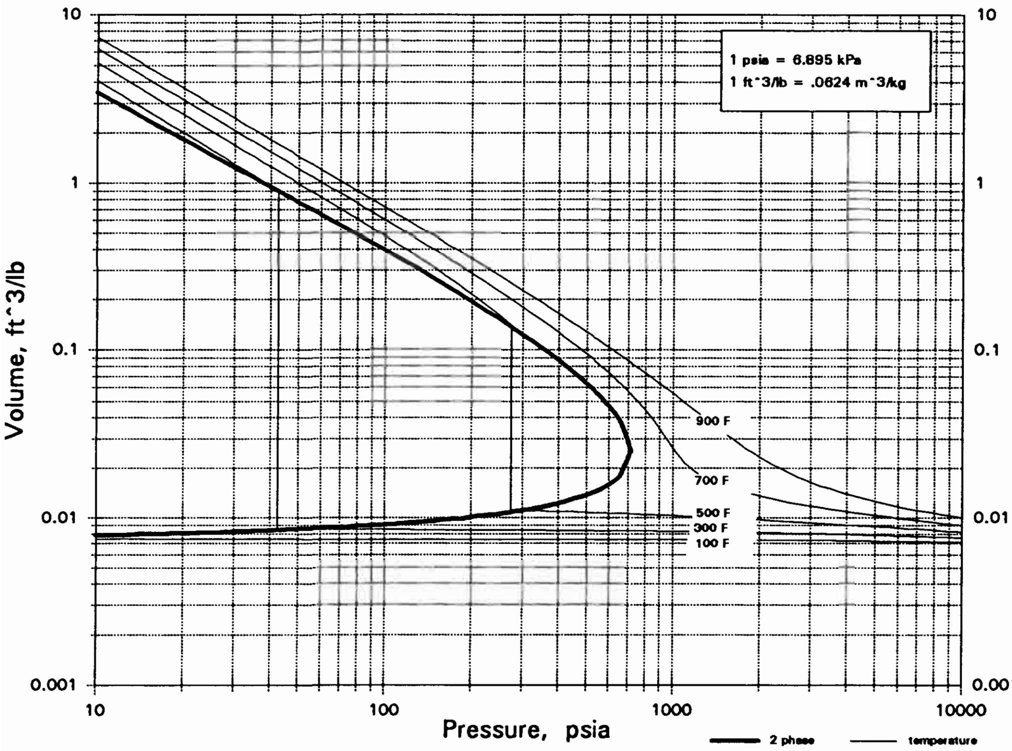
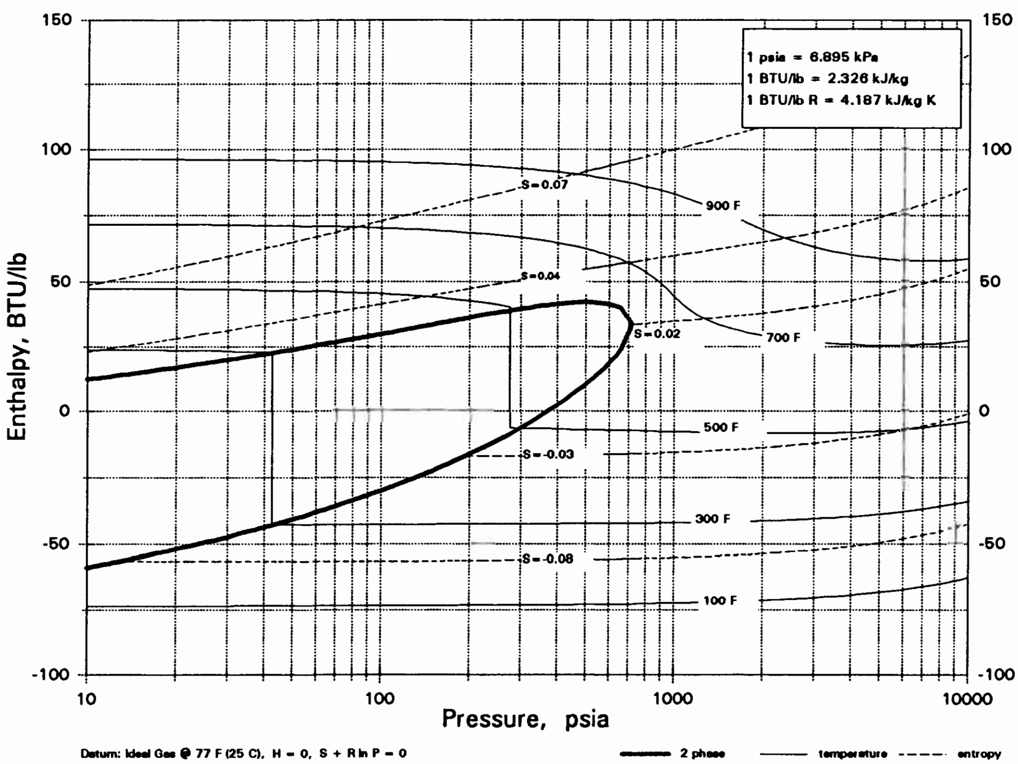
CBrCl3 BROMOTRICHLOROMETHANE





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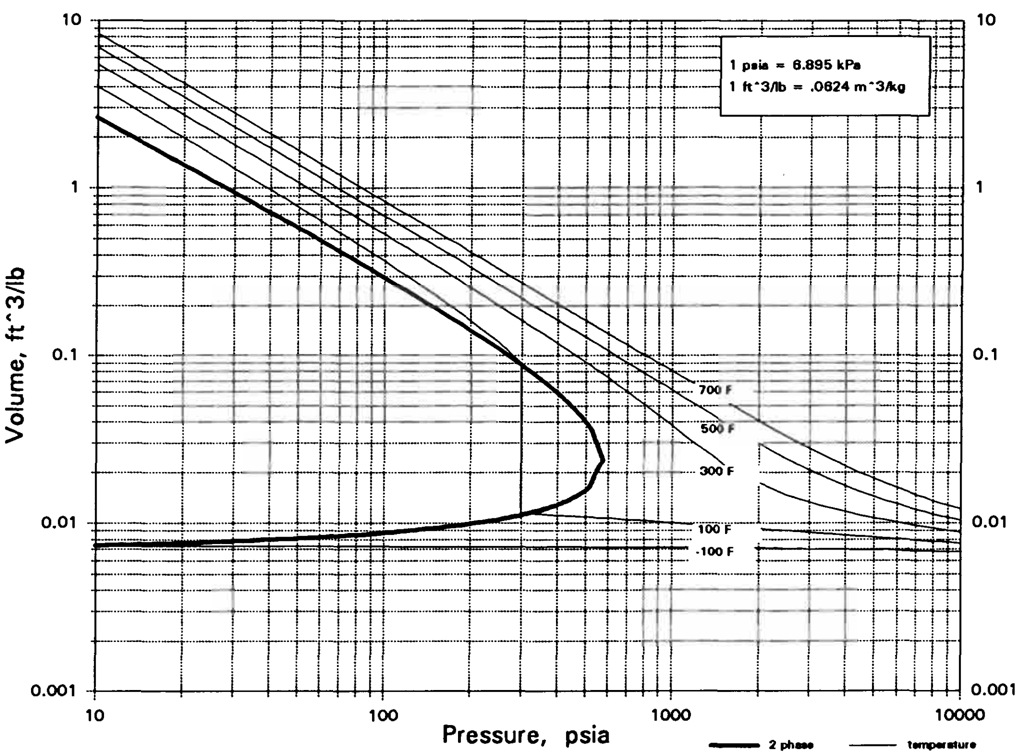

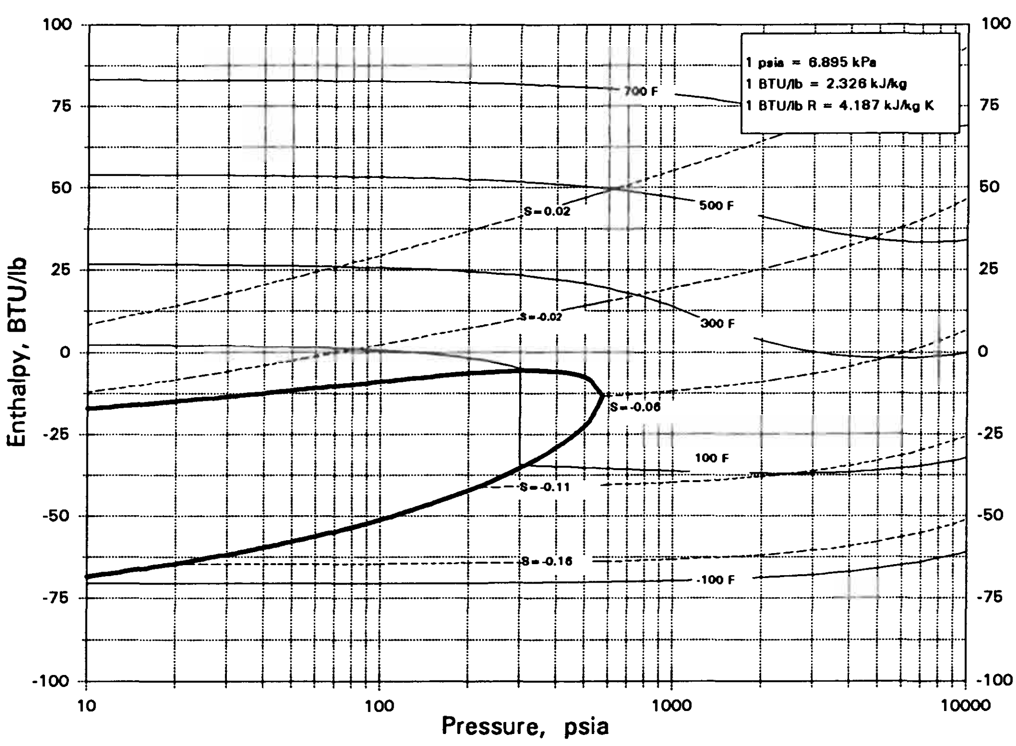

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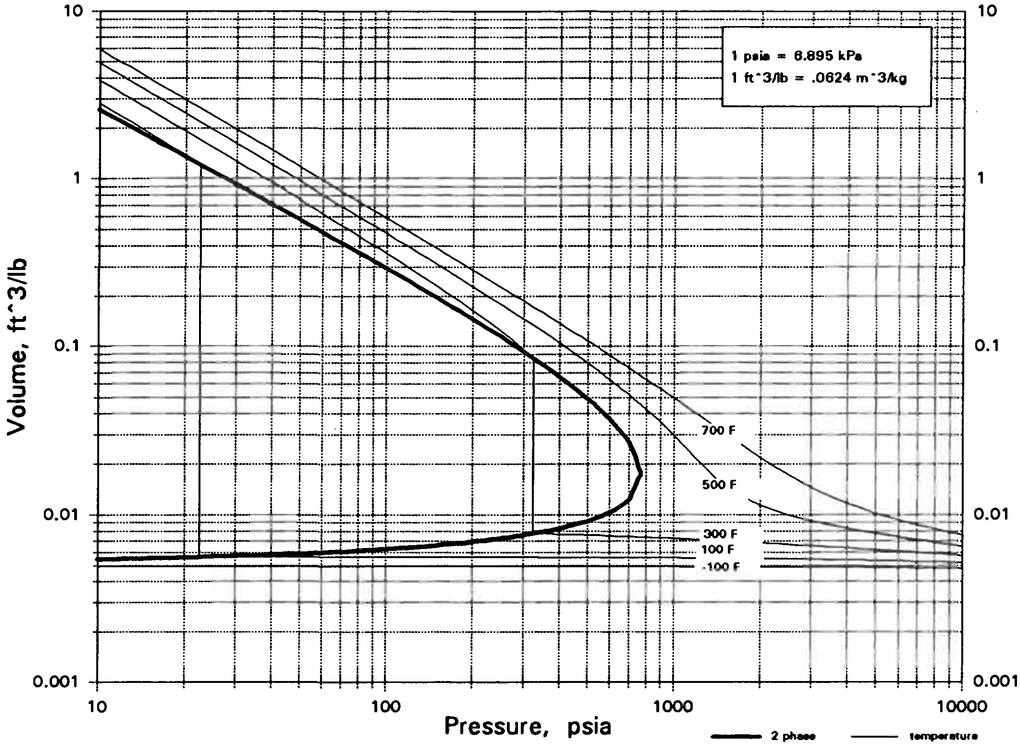
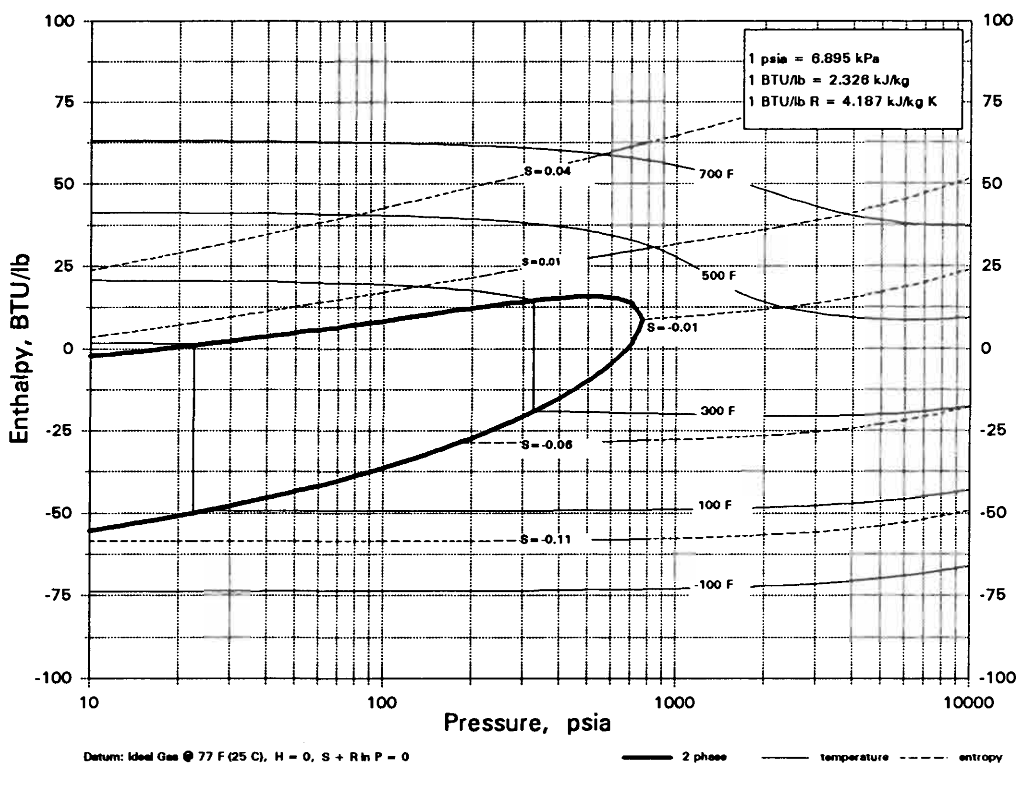
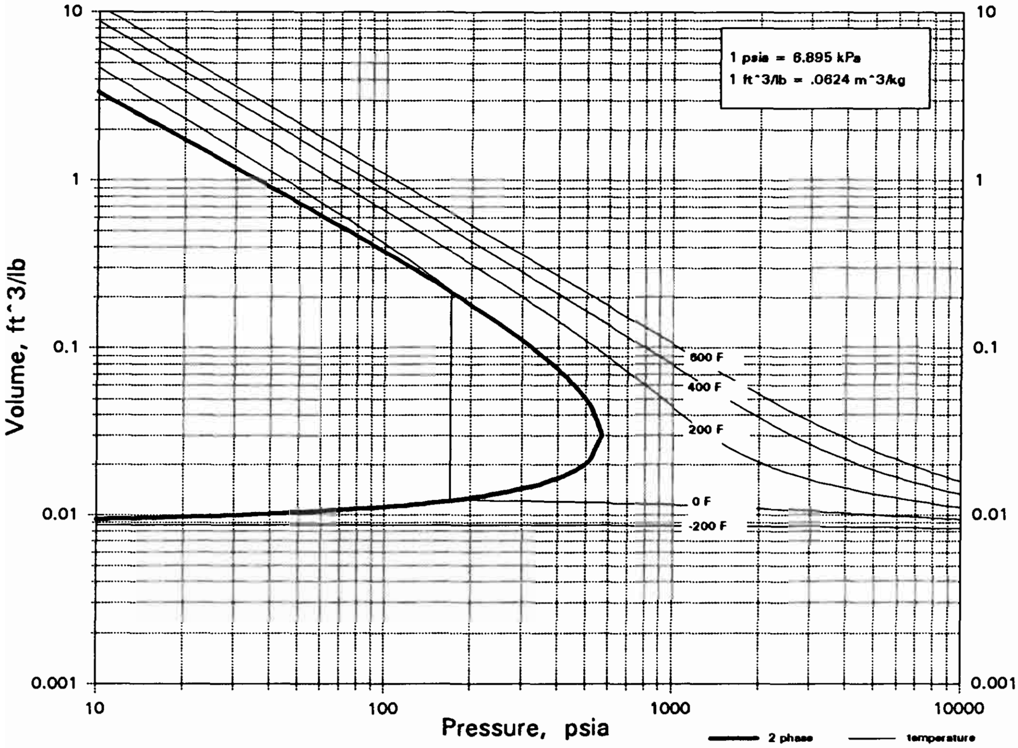
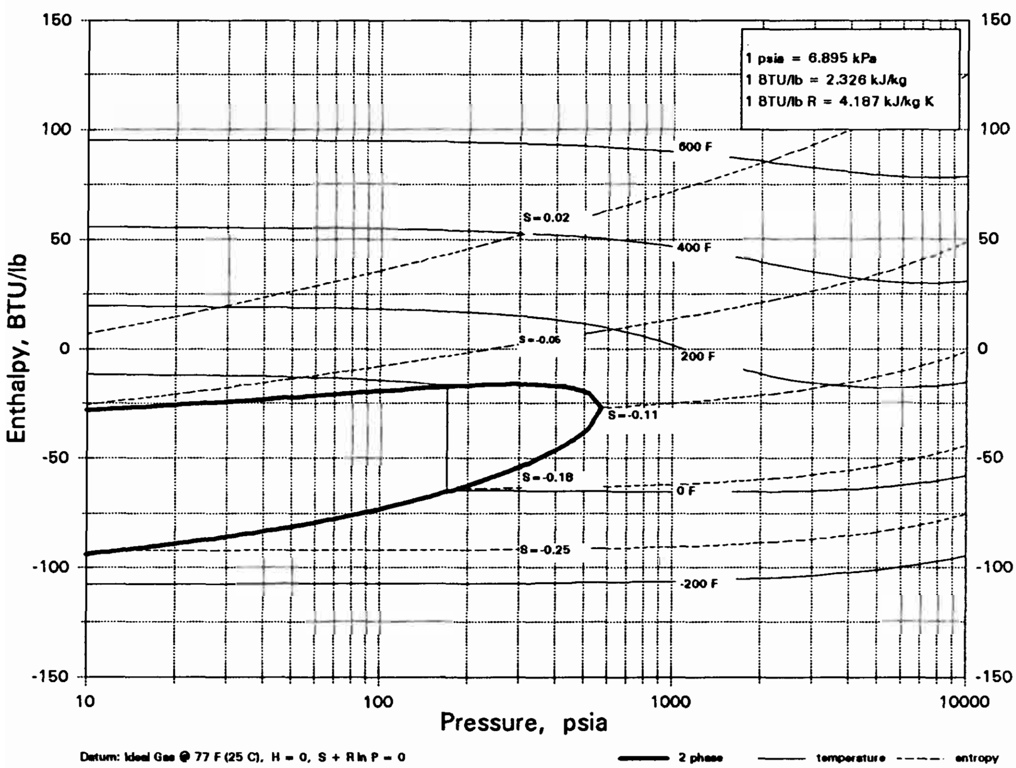




CClF3 CHLOROTRIFLUOROMETHANE





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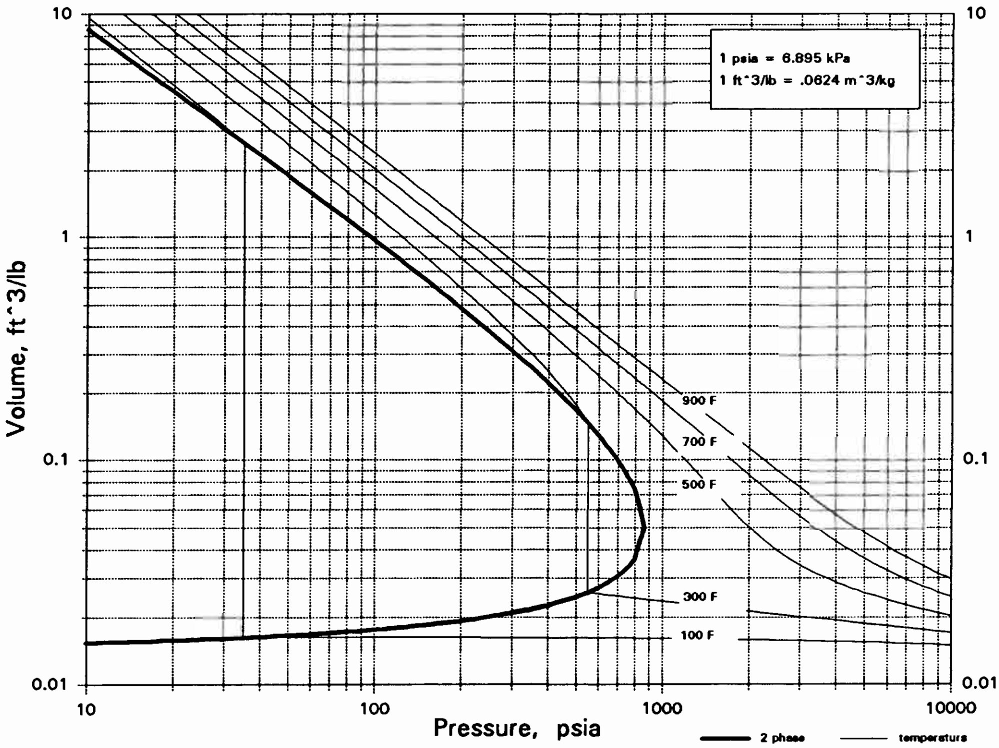

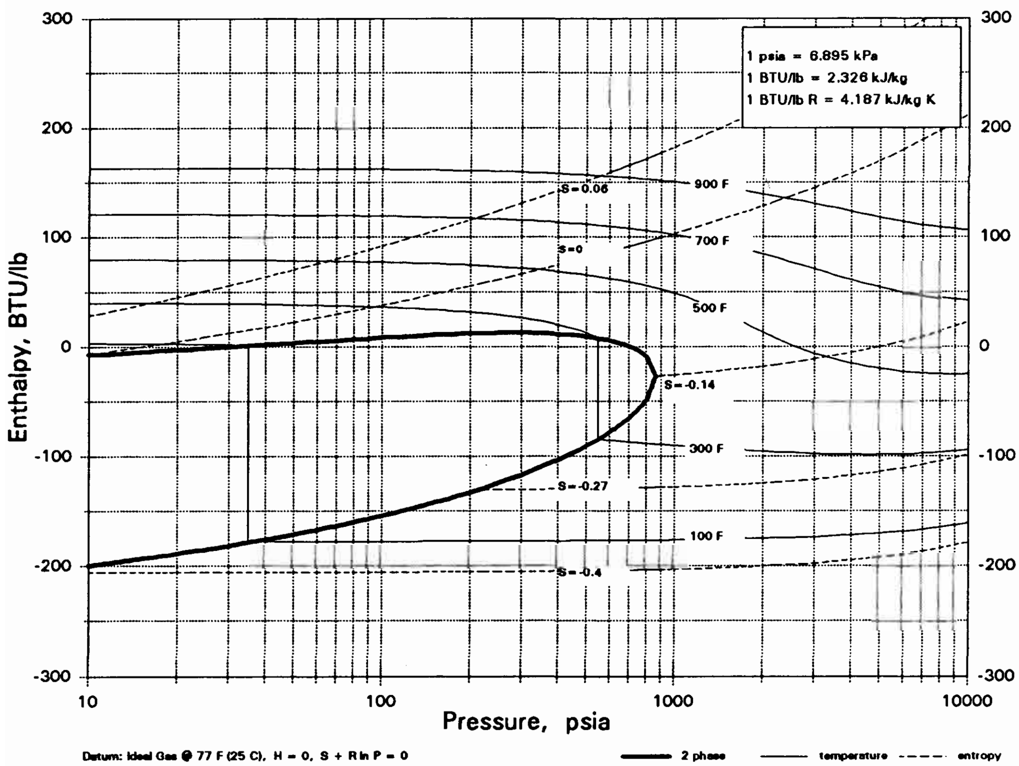

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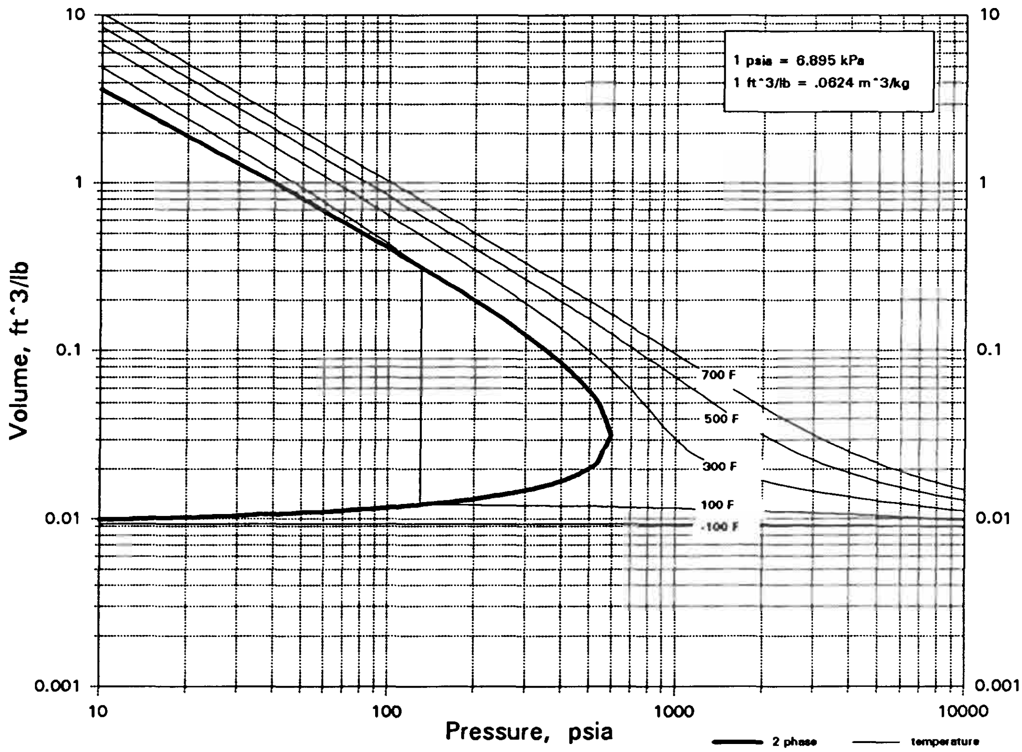

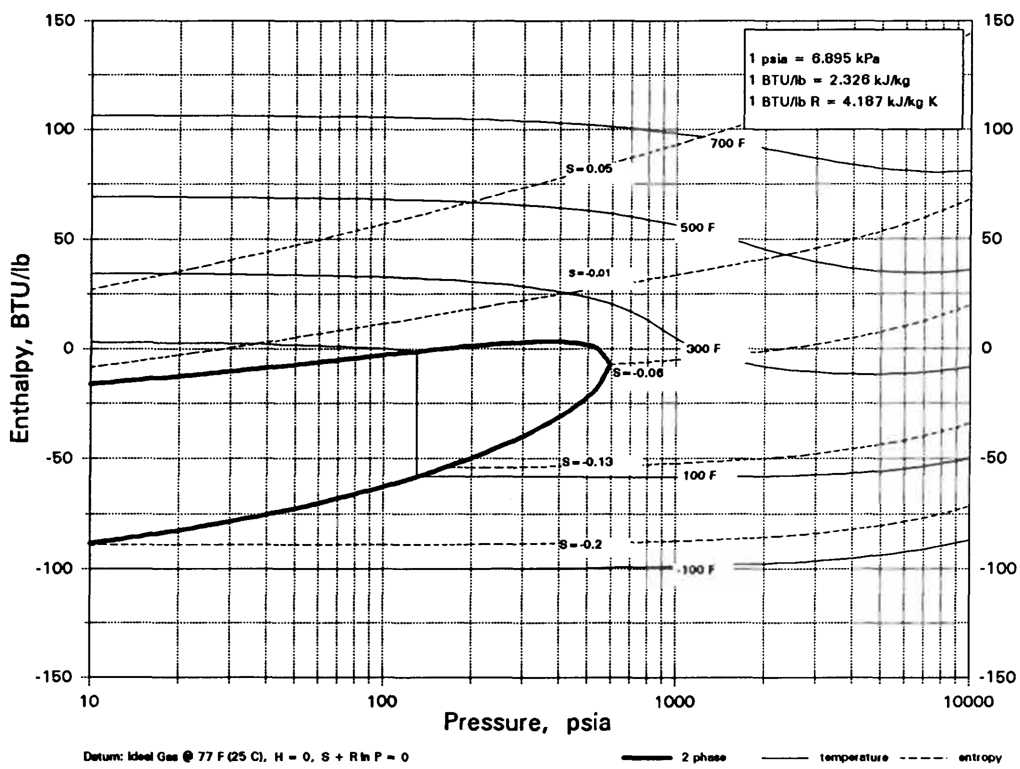

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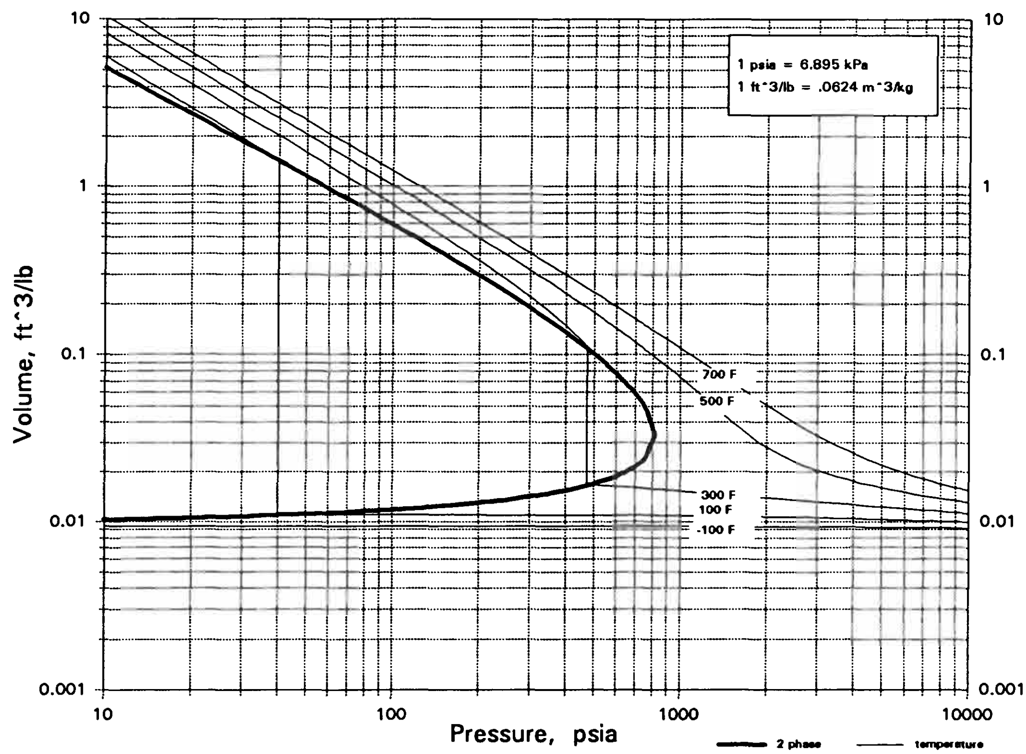
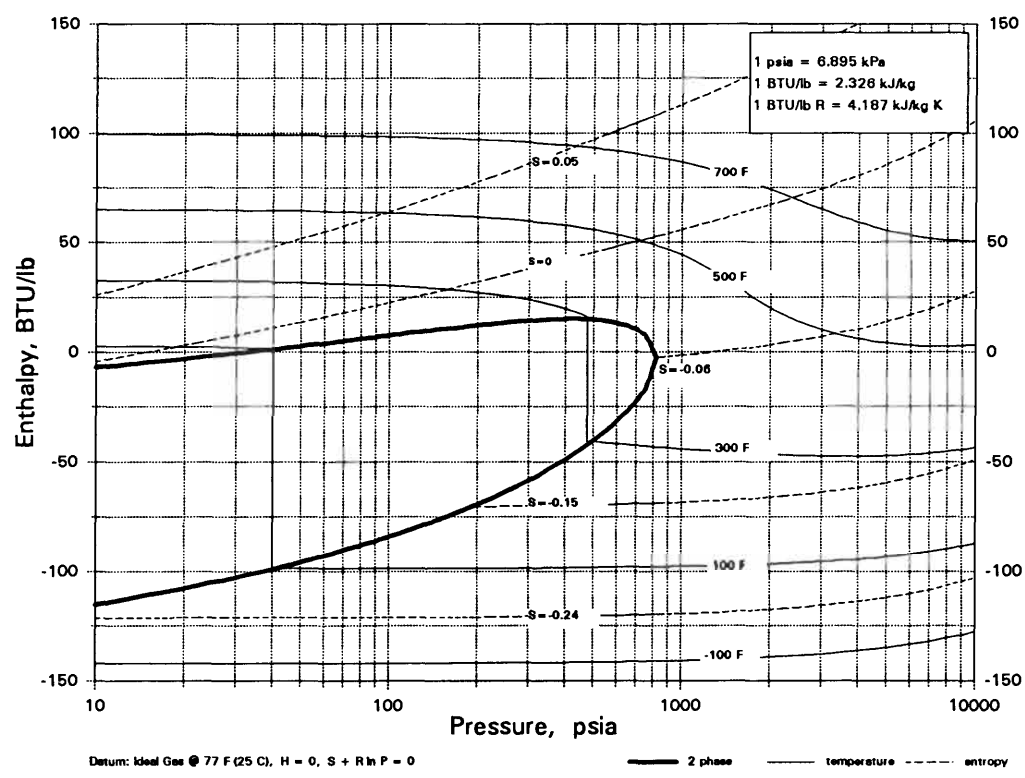
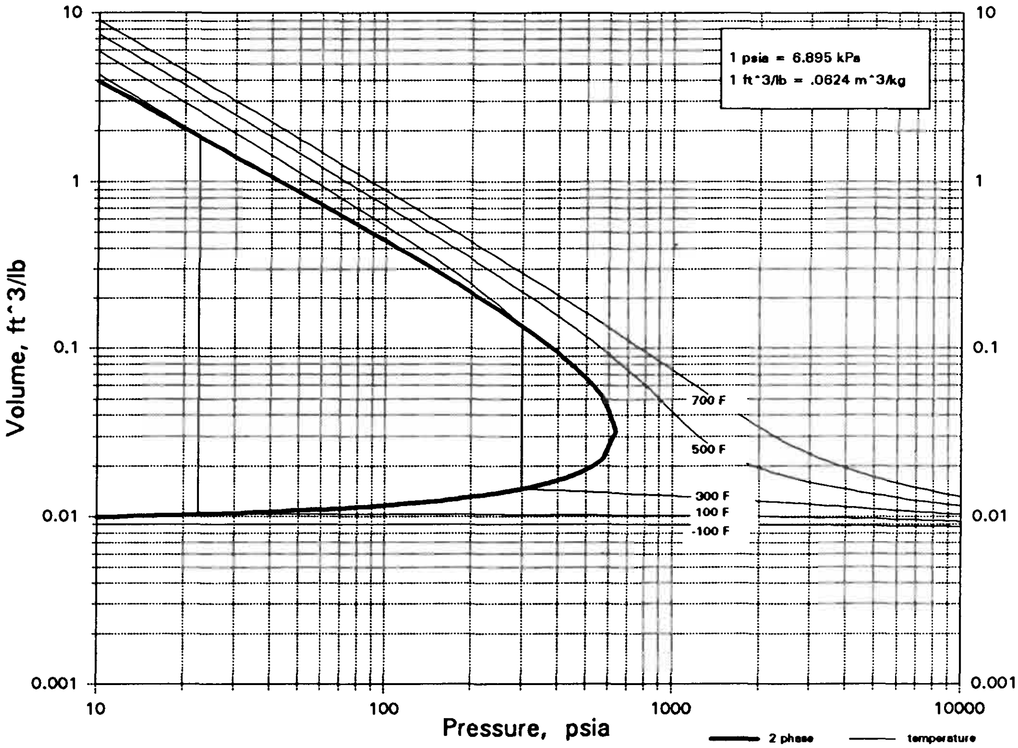
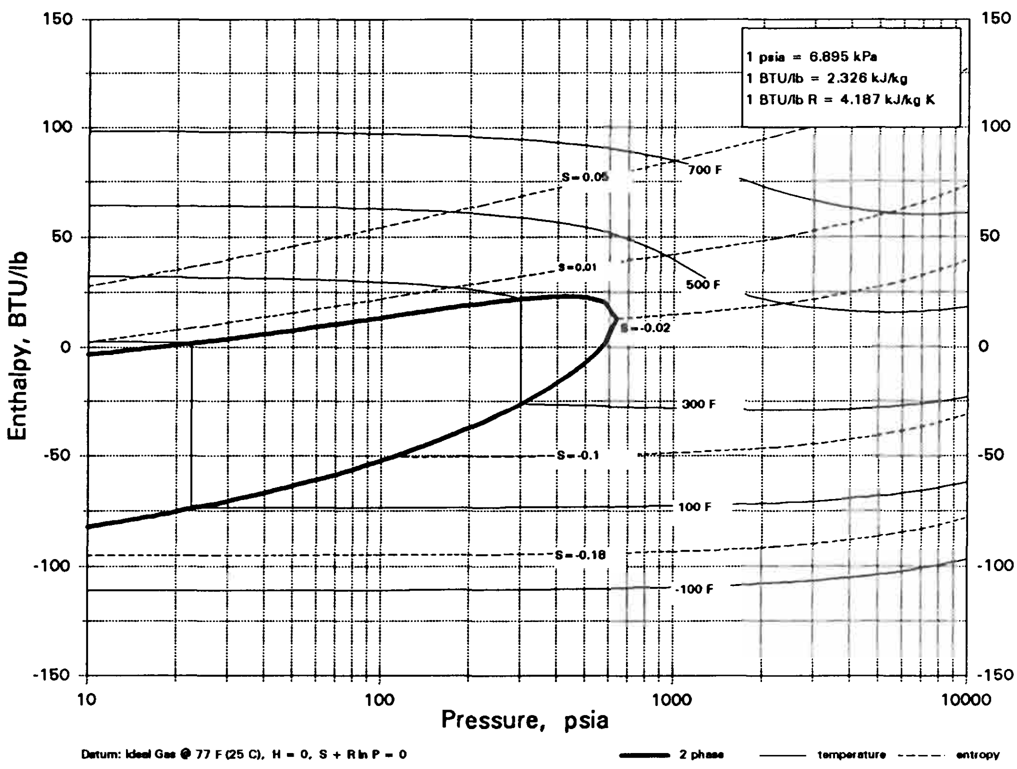
CCl2O PHOSGENE



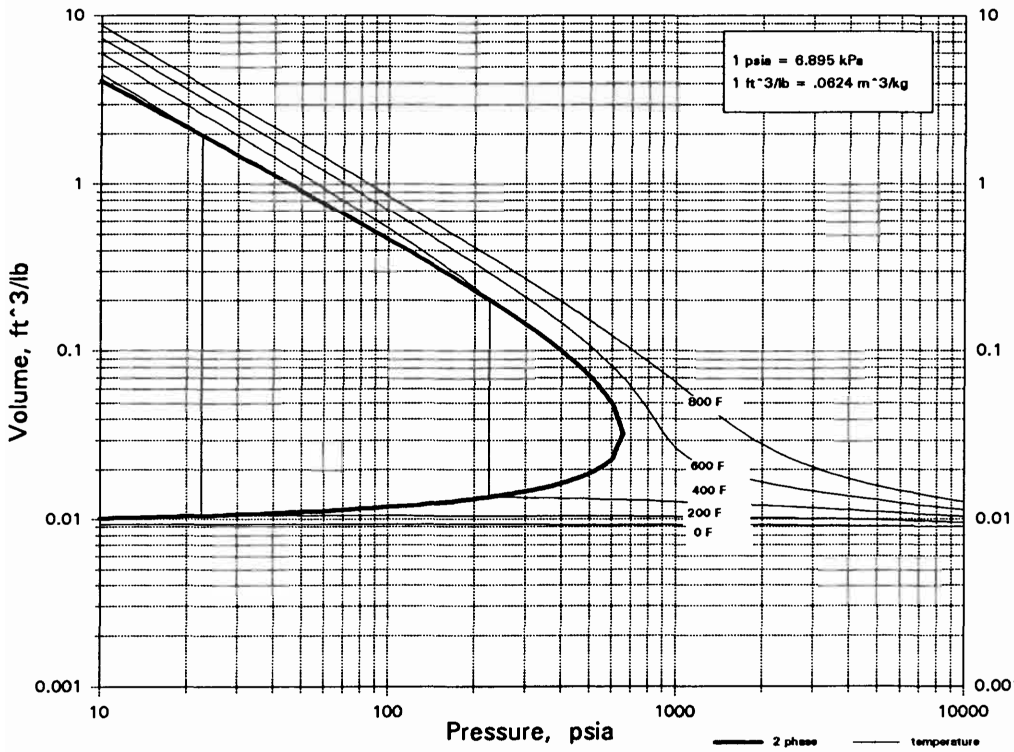


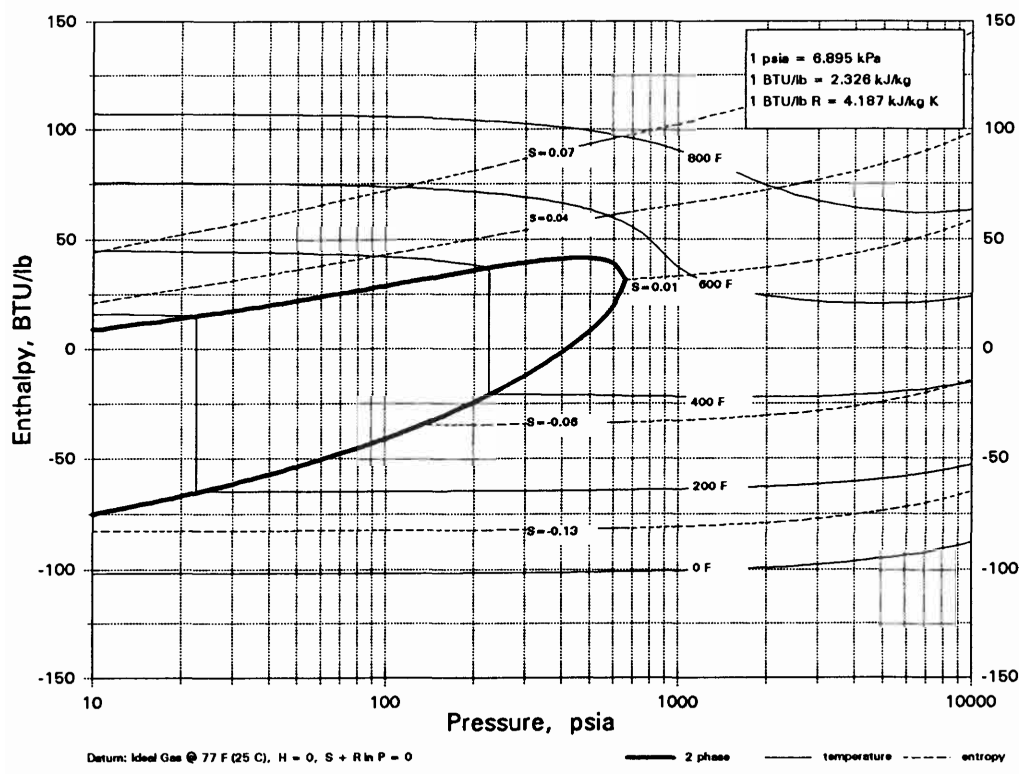
CCl3F TRICHLOROFLUOROMETHANE



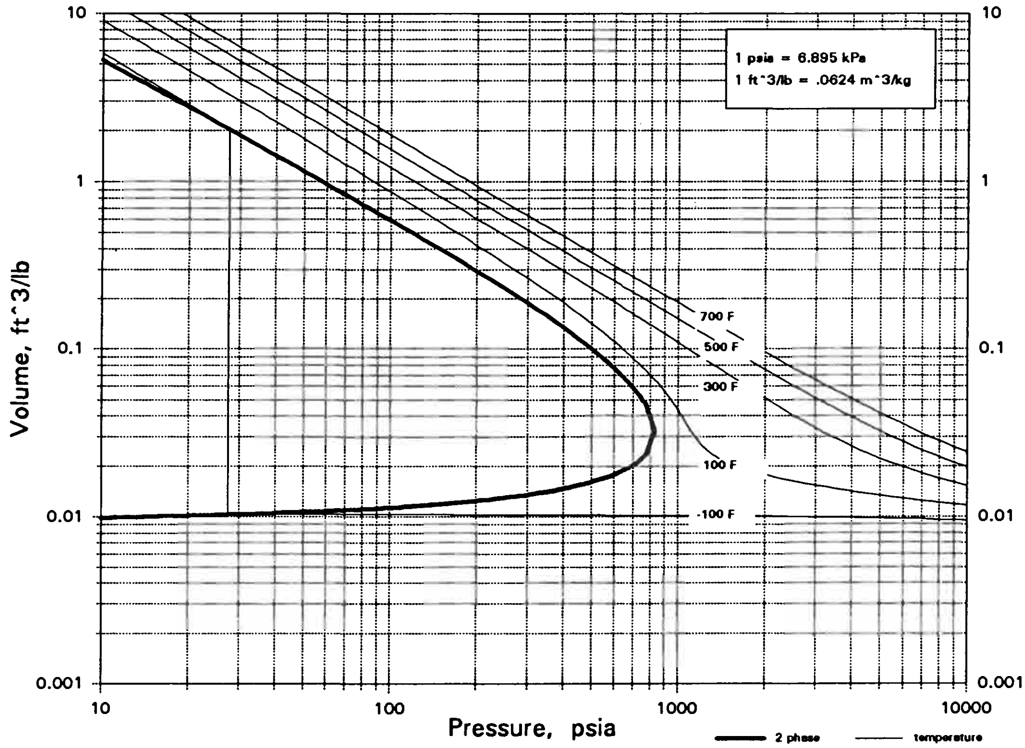


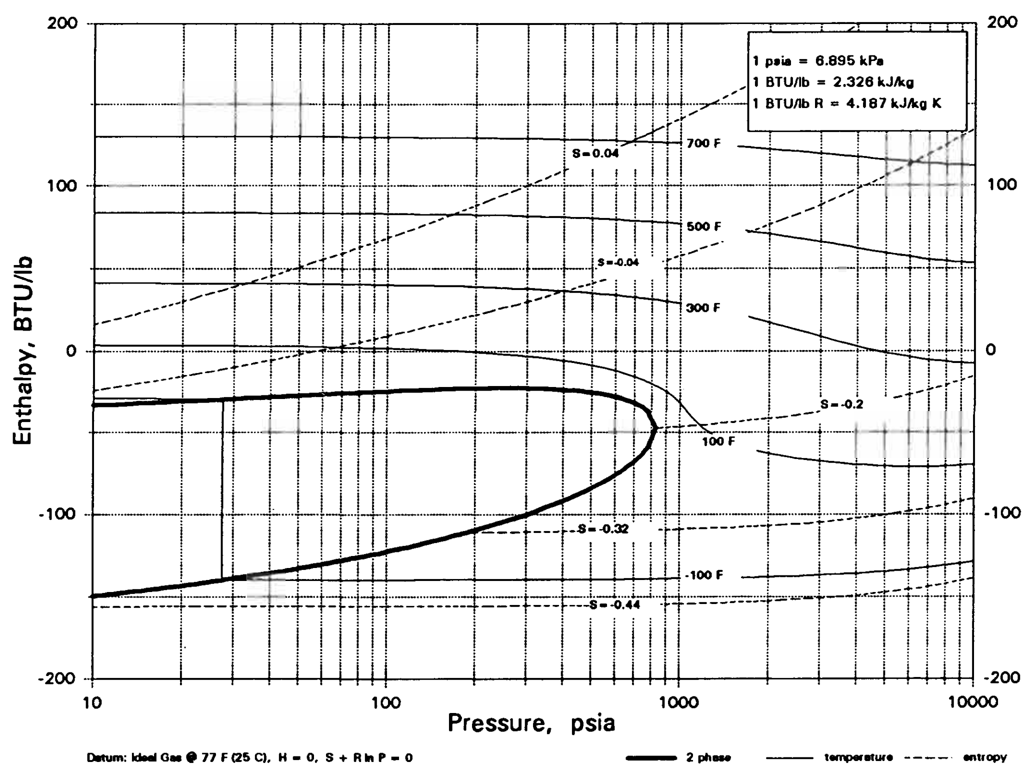
CCl4	CARBON TETRACHLORIDE



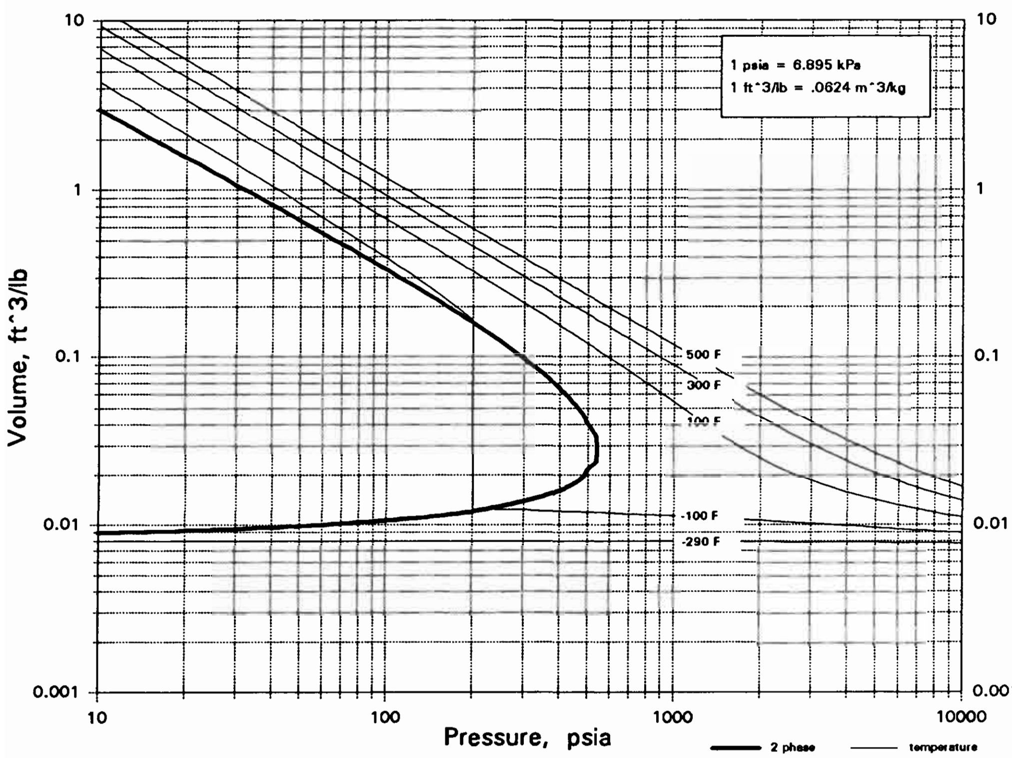


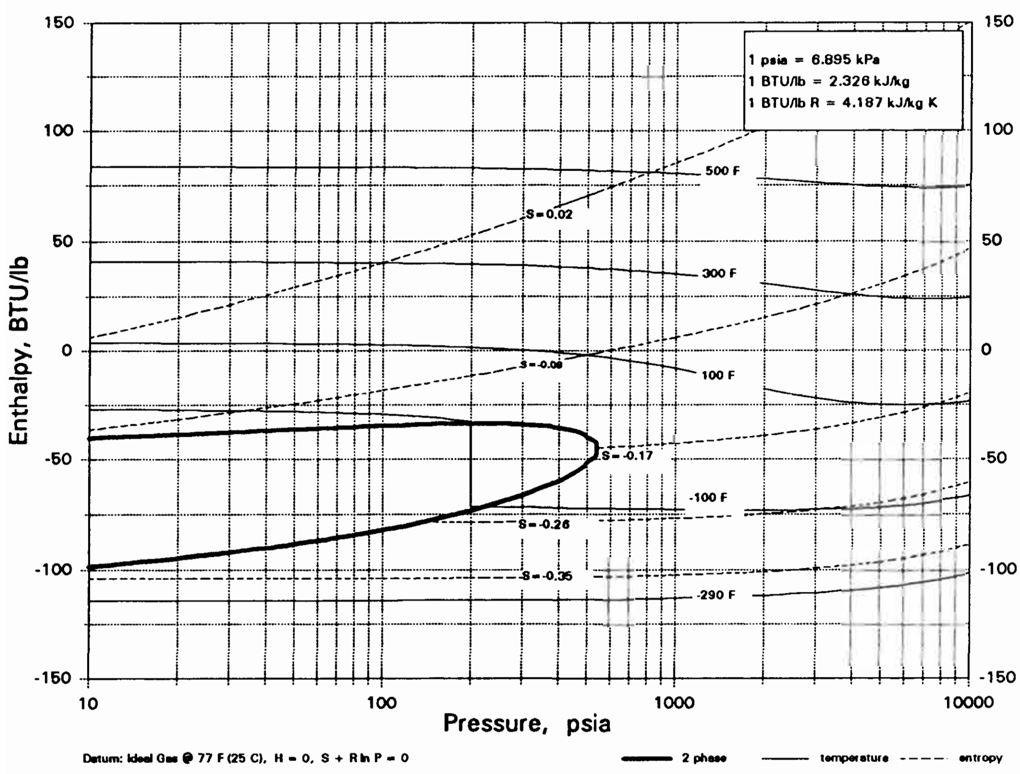
CF2O	CARBONYL FLUORIDE





CF4 CARBON TETRAFLUORIDE





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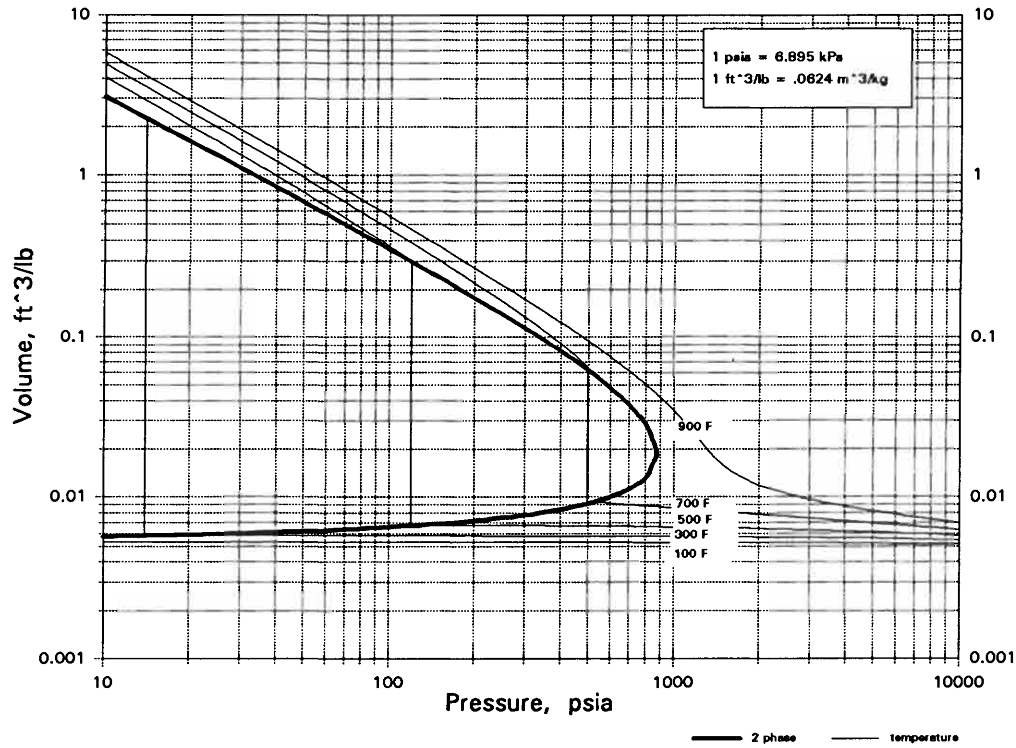
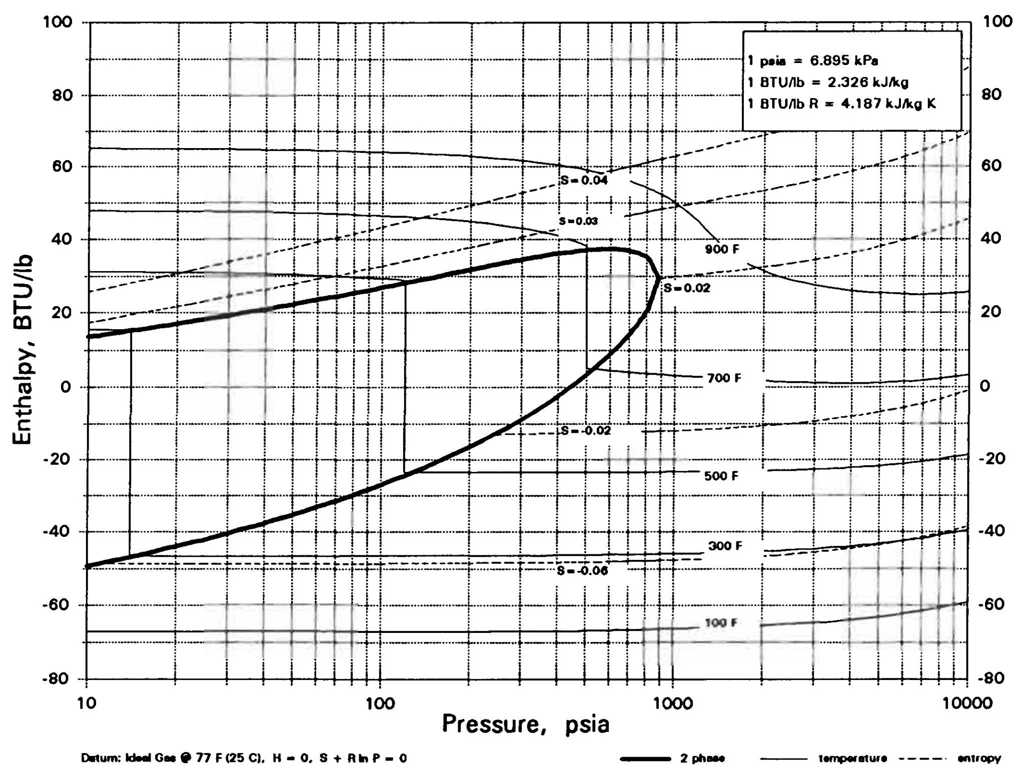
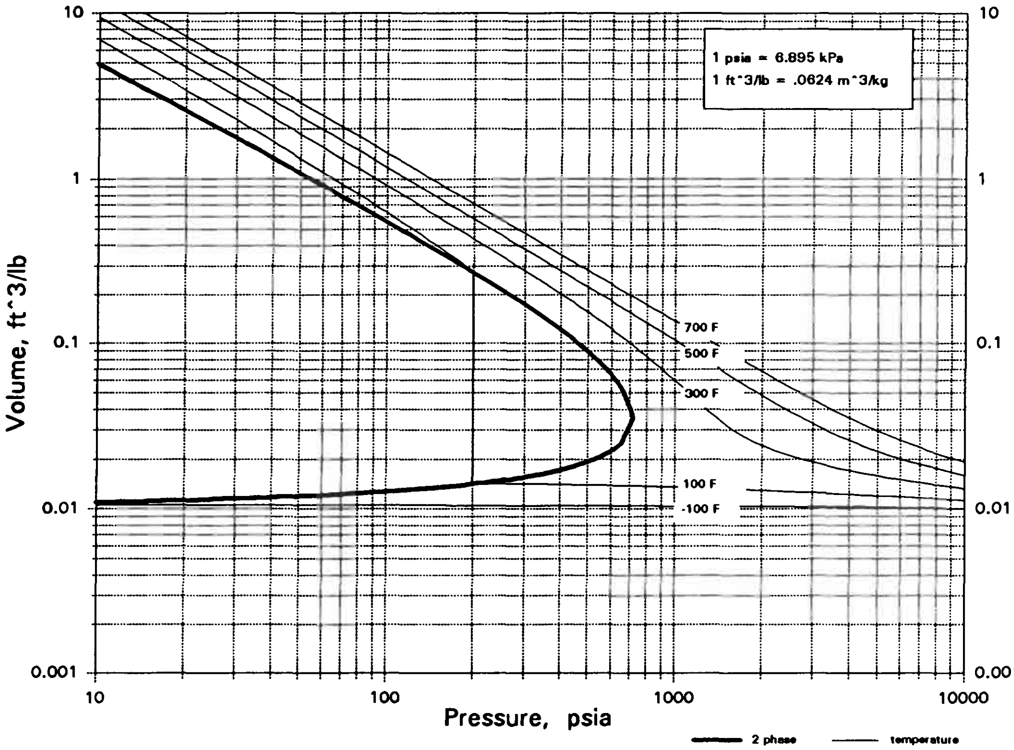
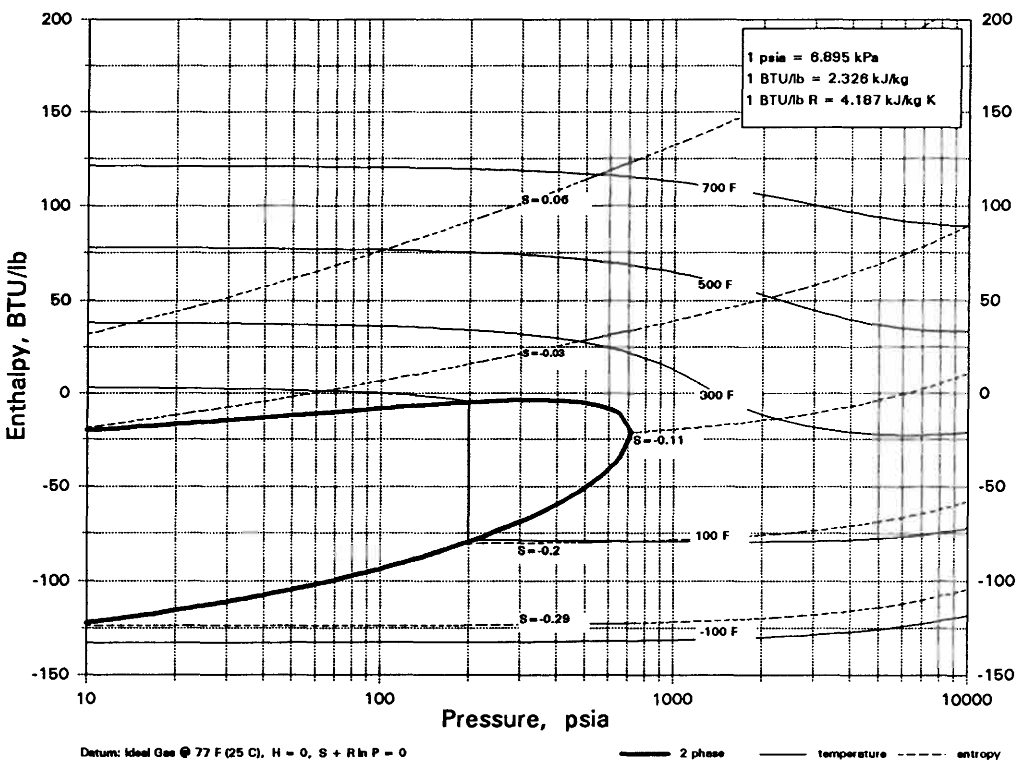


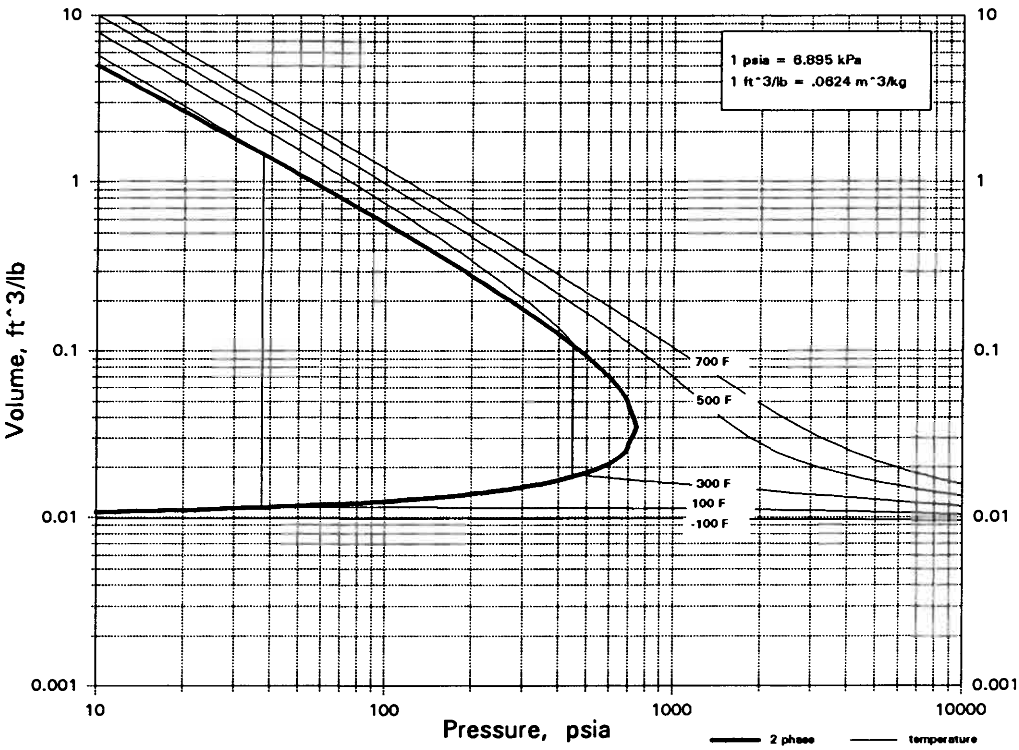


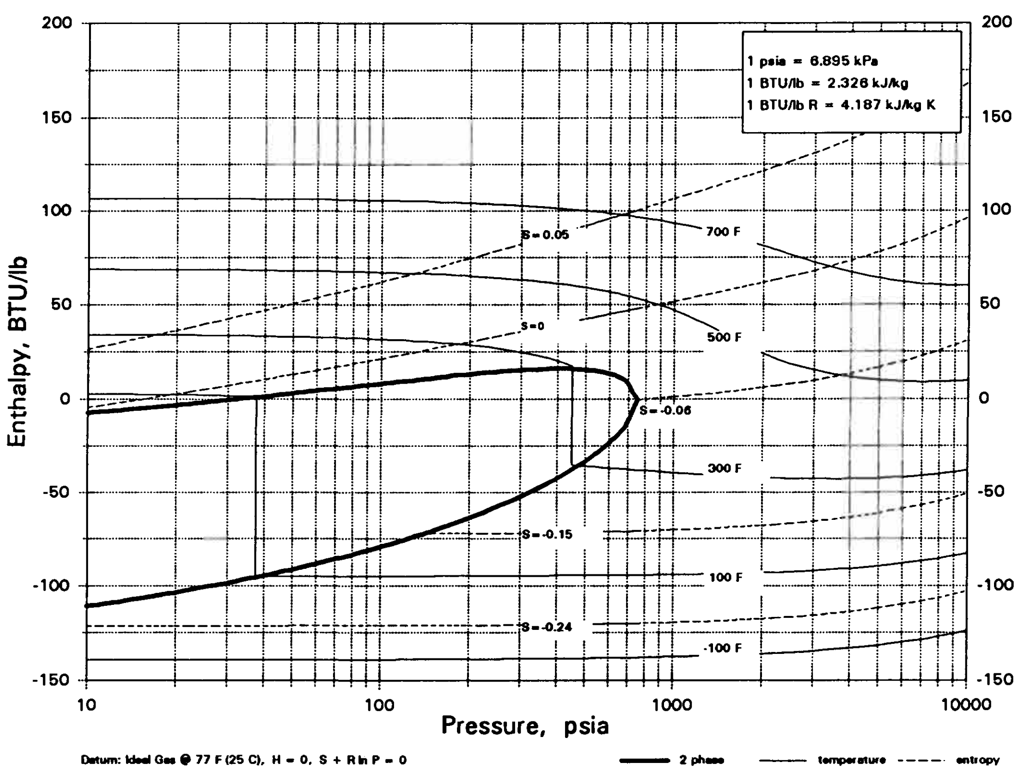
CHClF2 CHLORODIFLUOROMETHANE





CHCl2F DICHLOROFLUOROMETHANE





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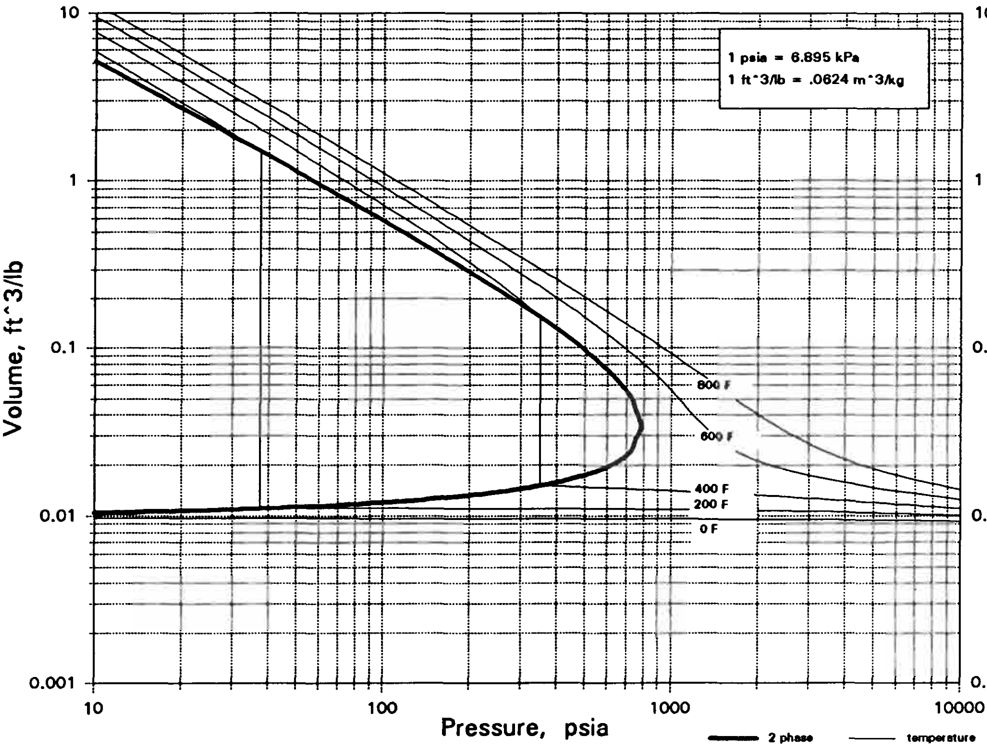

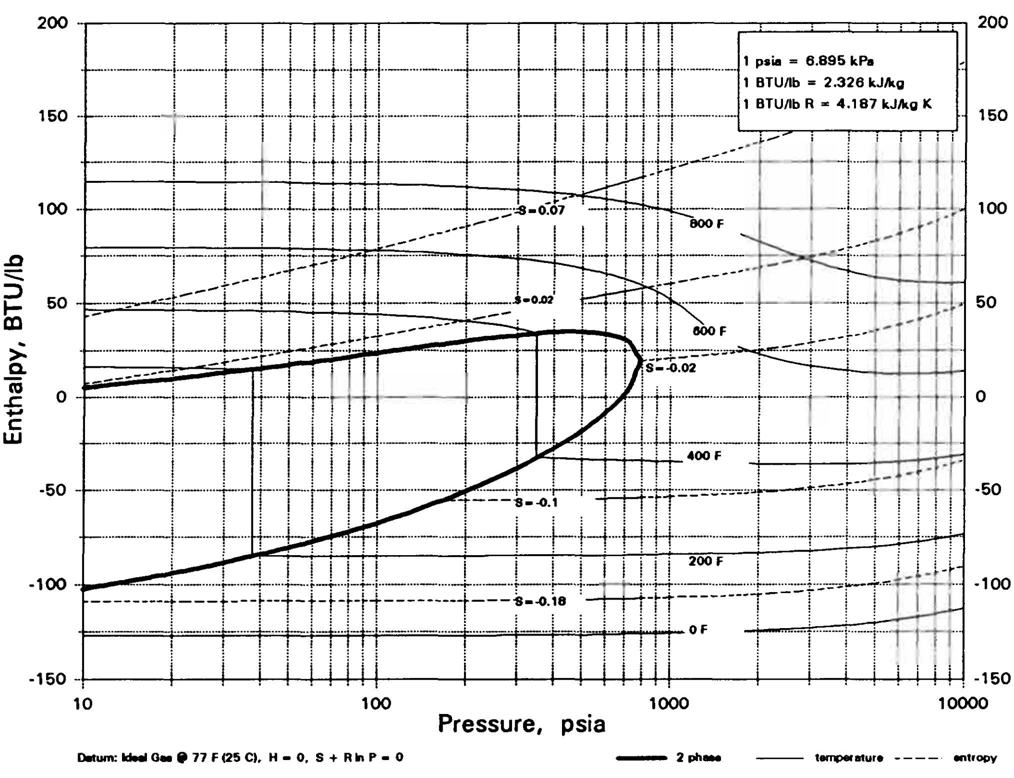

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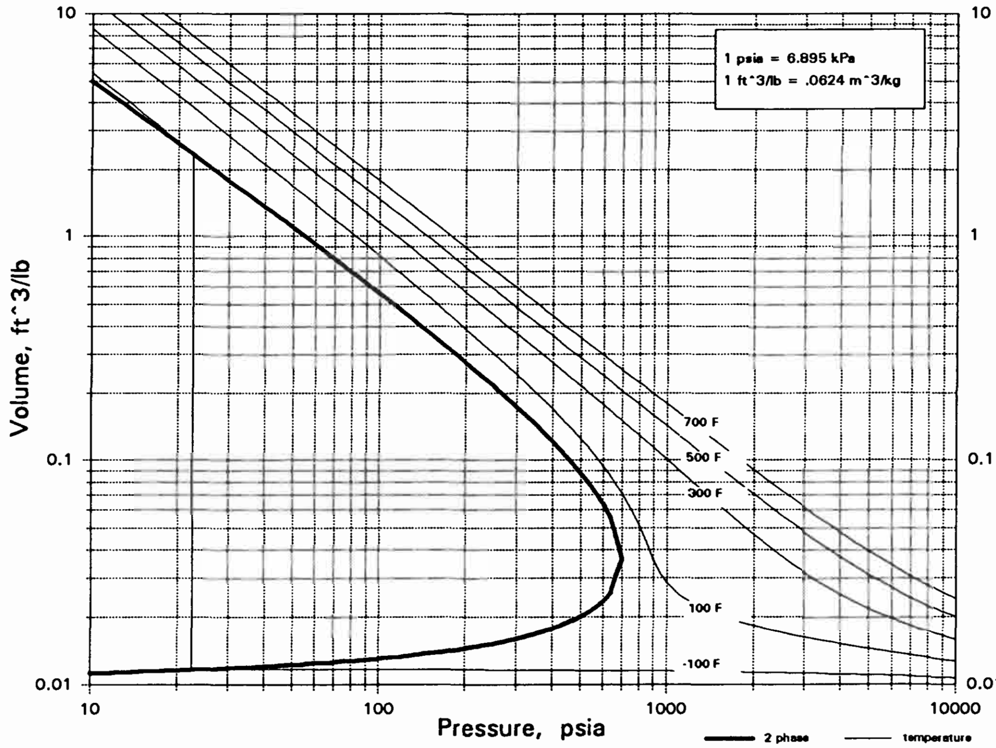
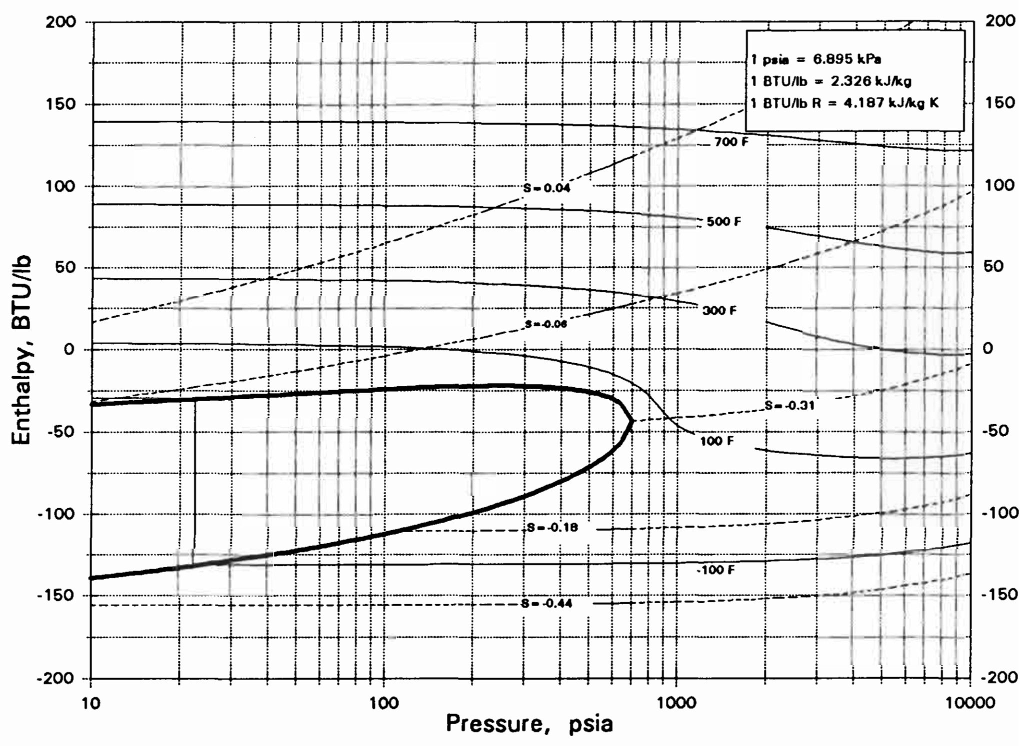
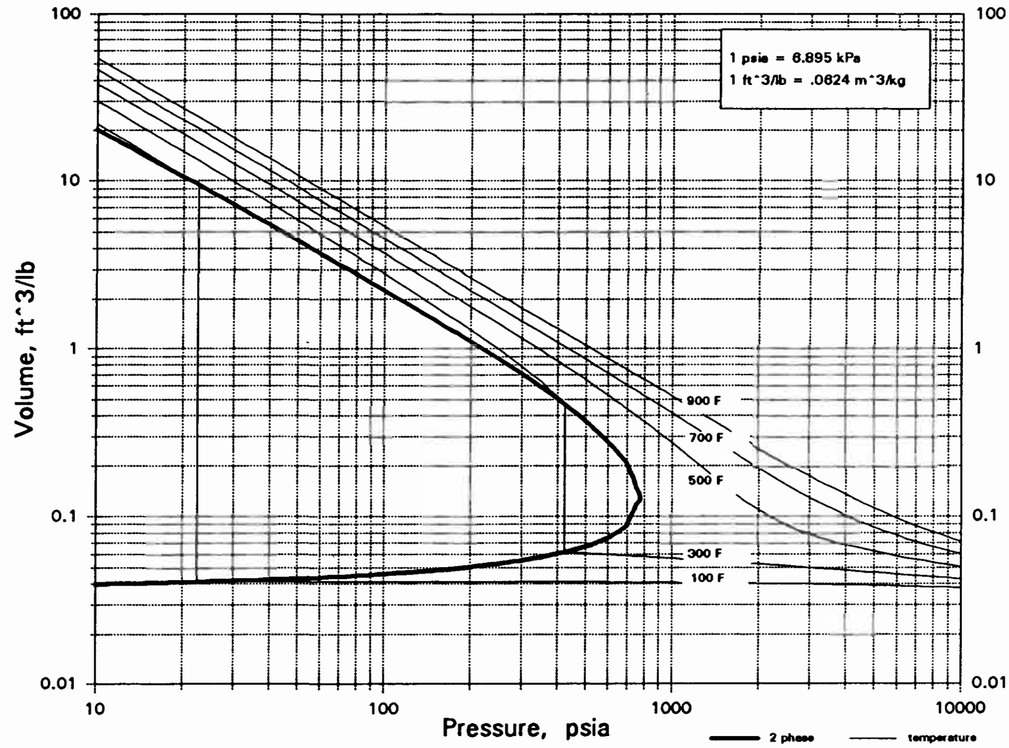
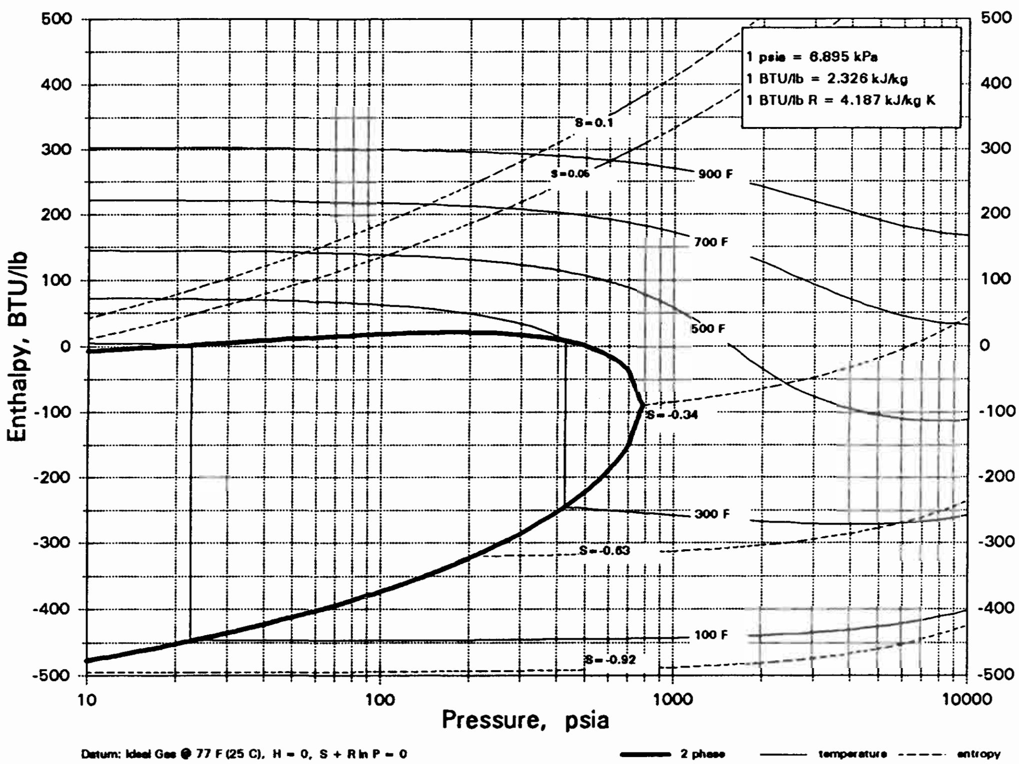




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

CHN HYDROGEN CYANIDE





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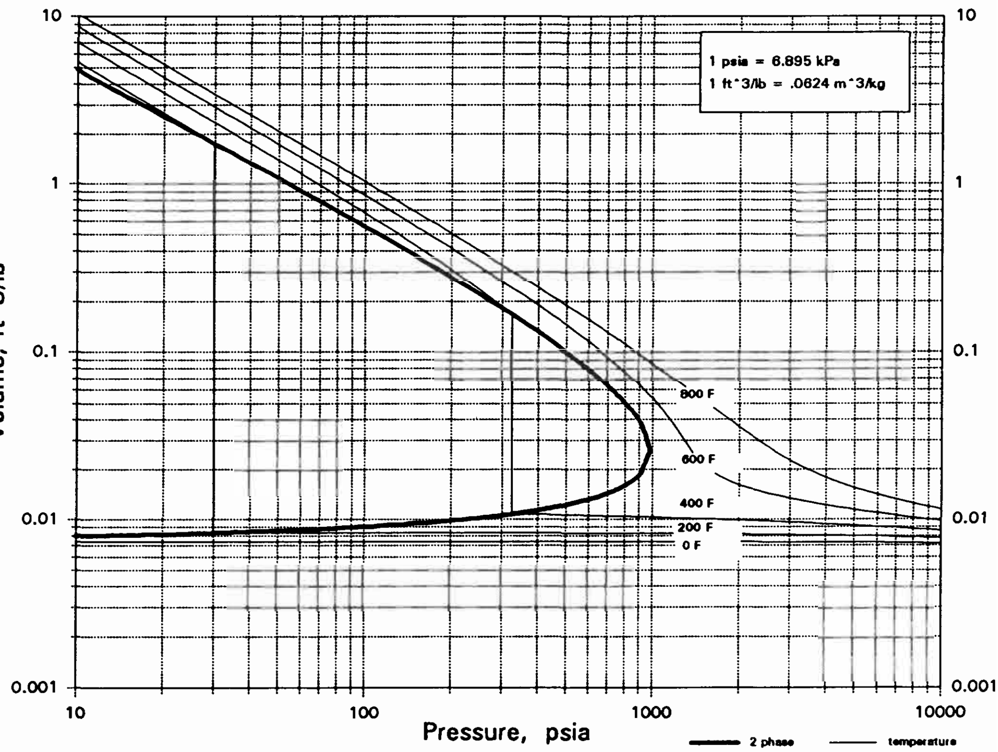

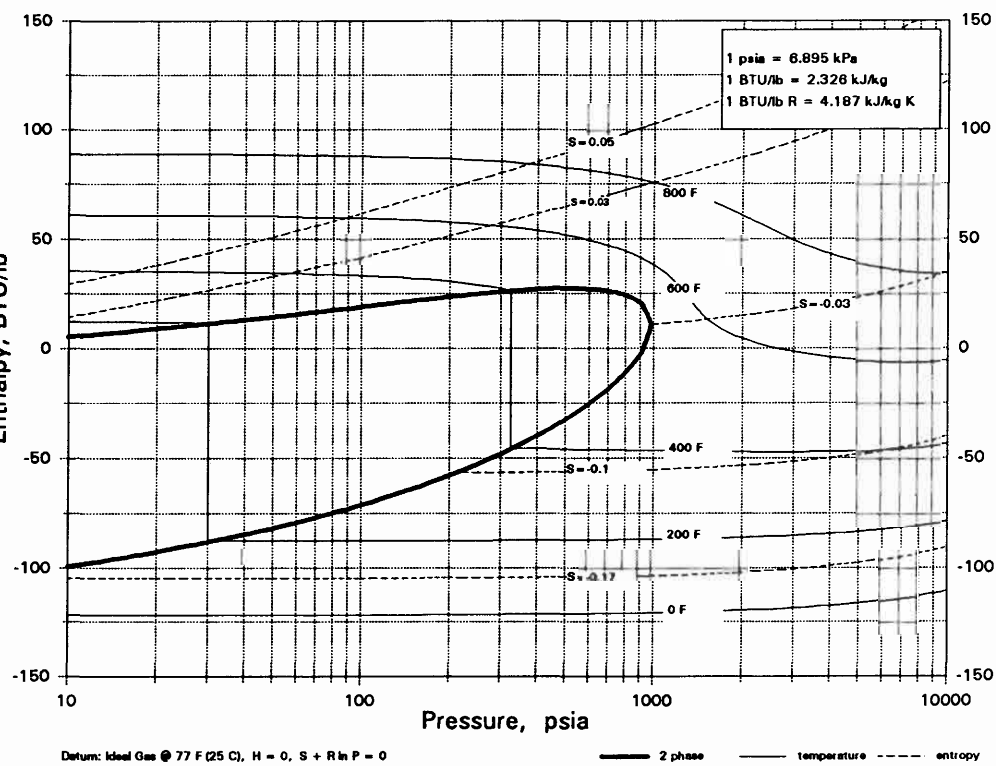

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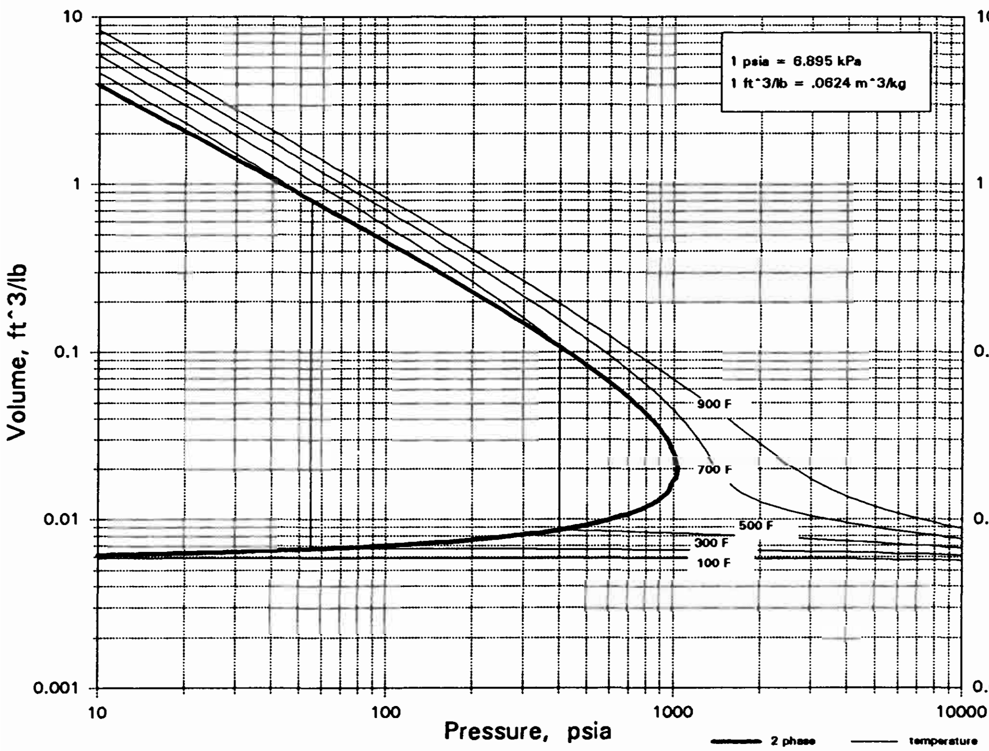

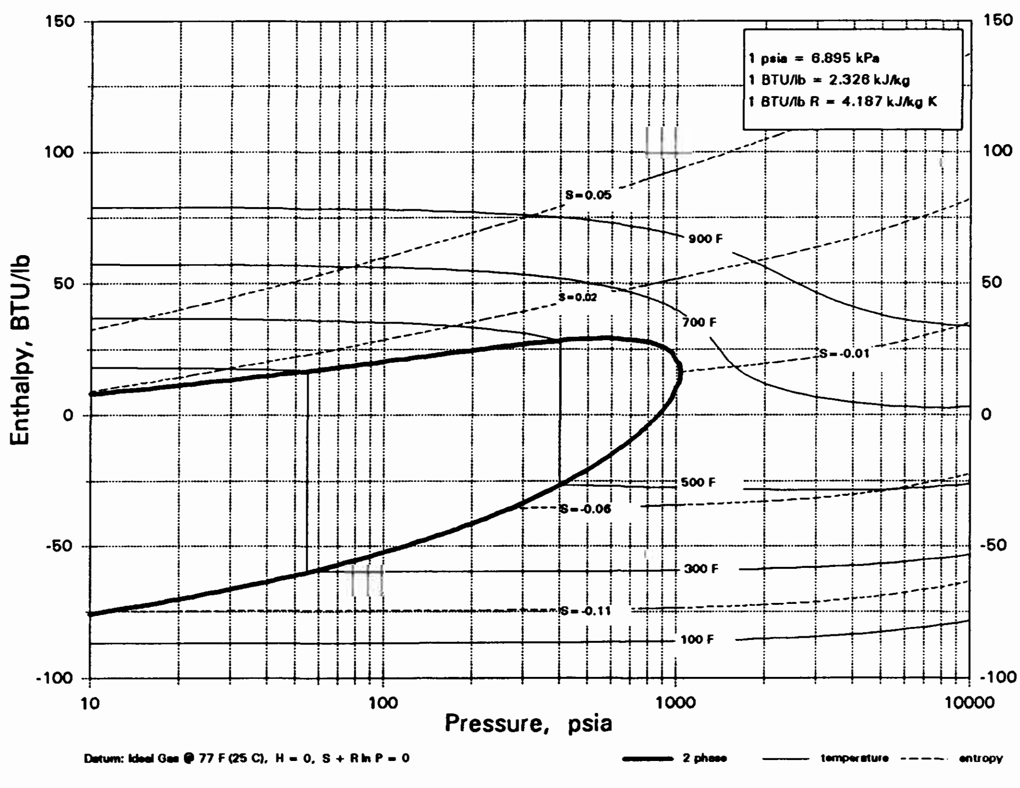

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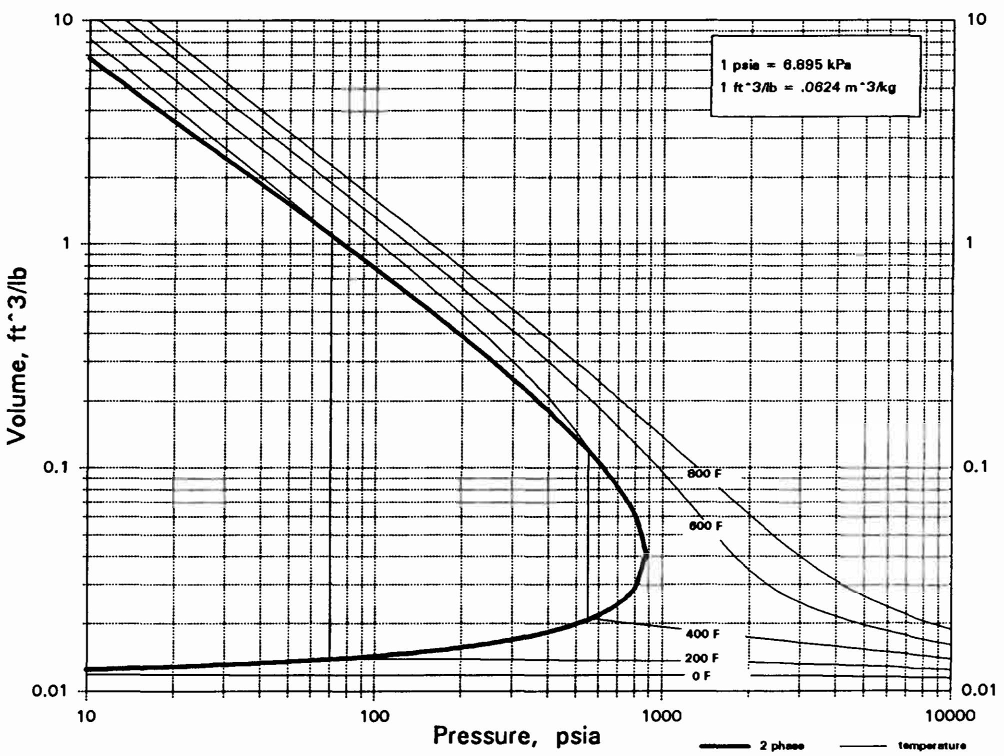

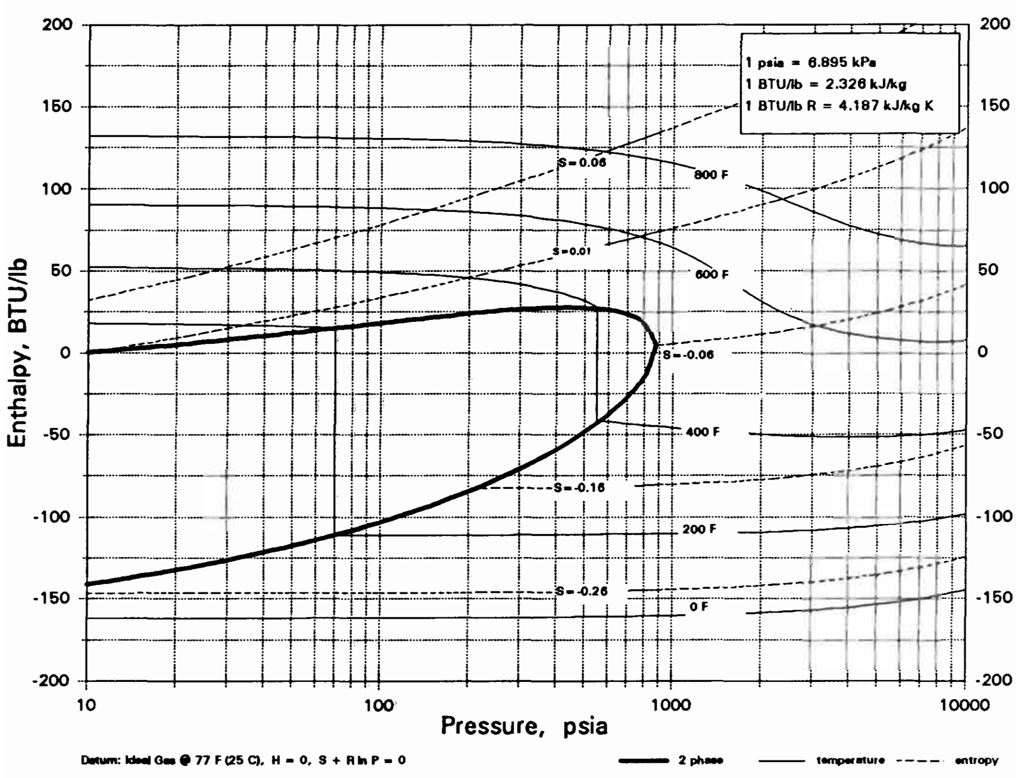

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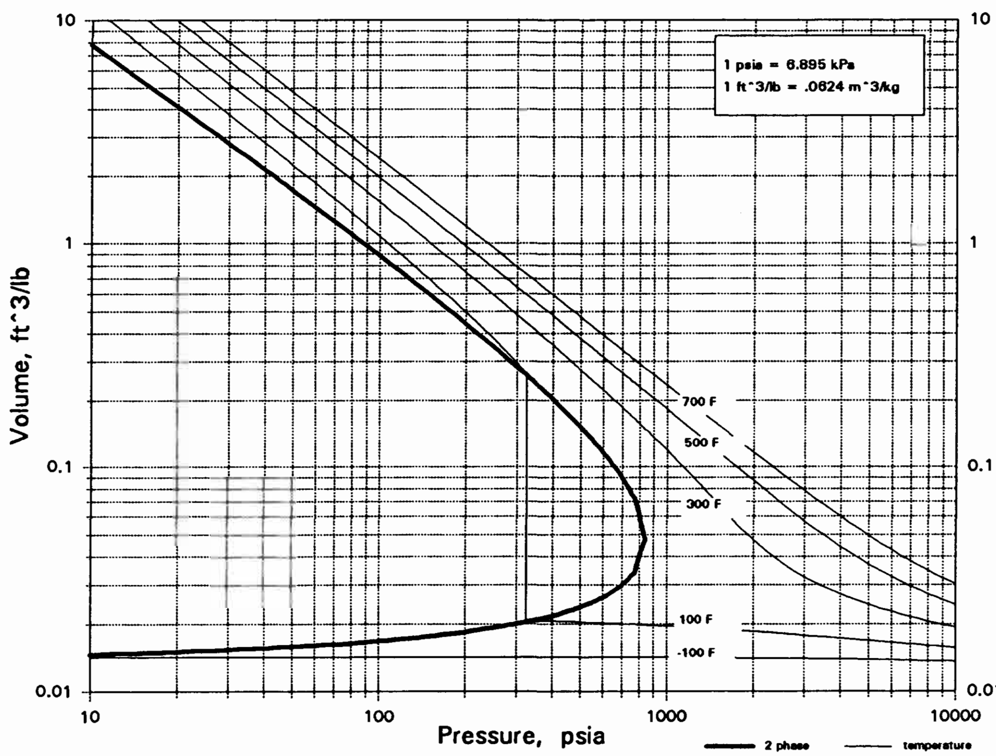

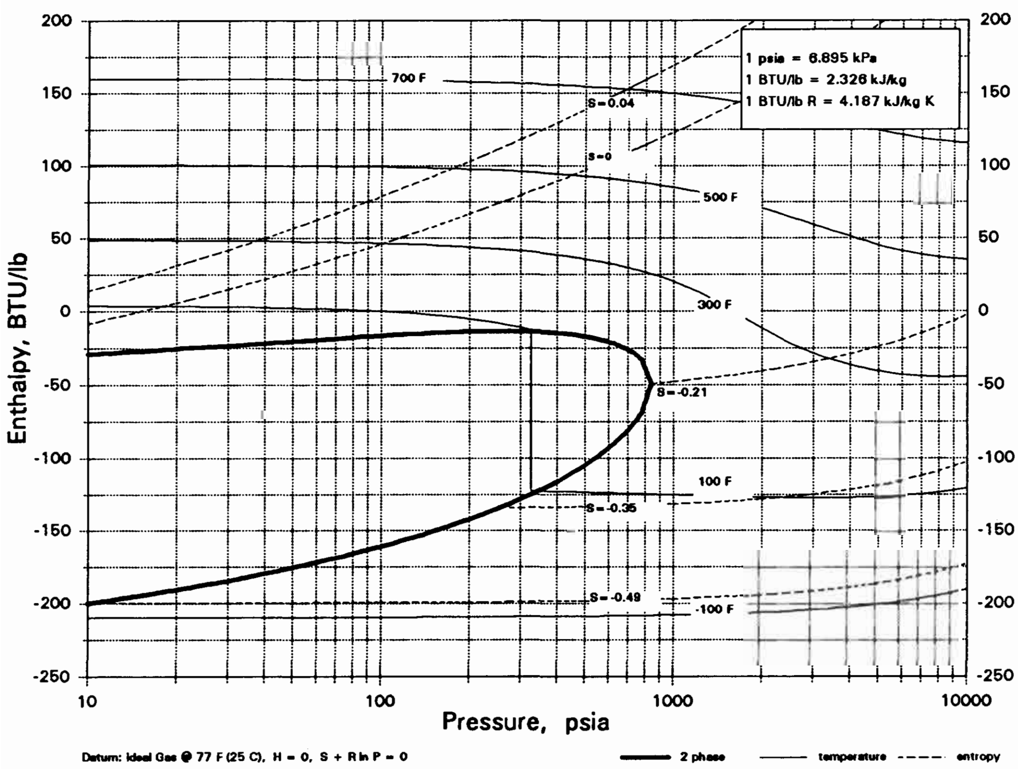

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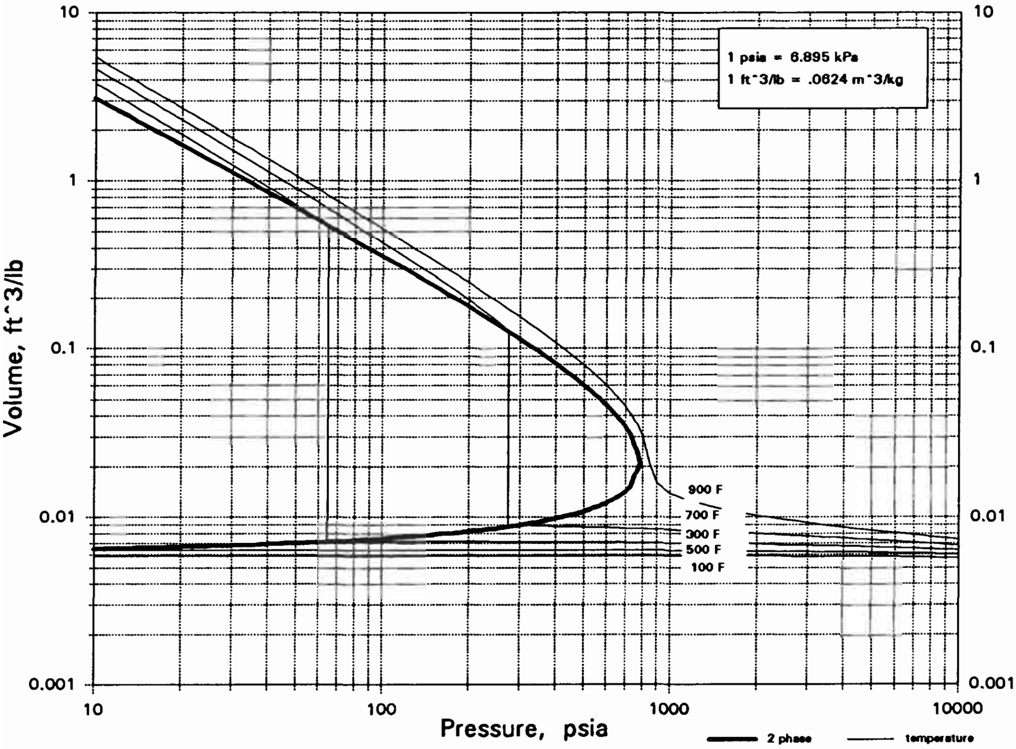

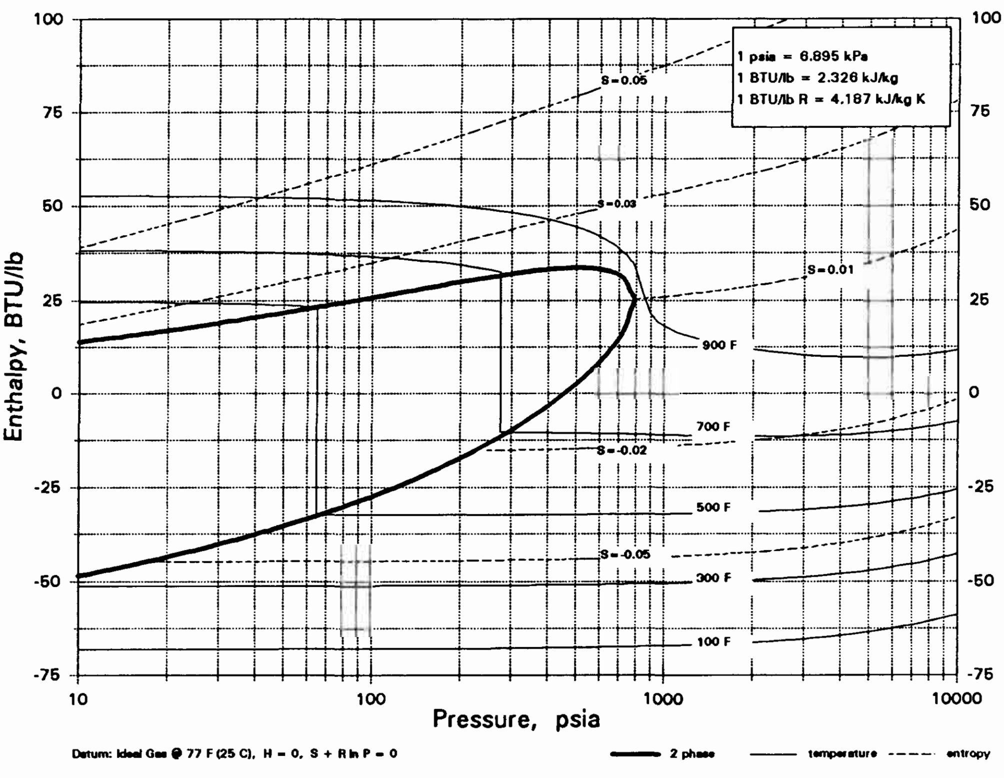

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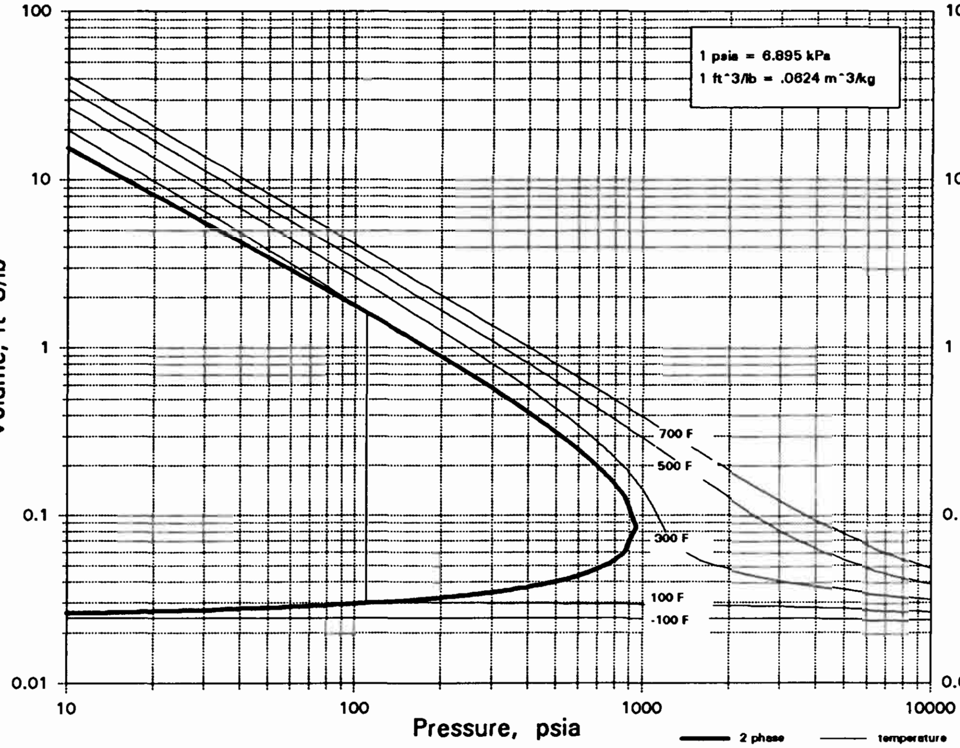

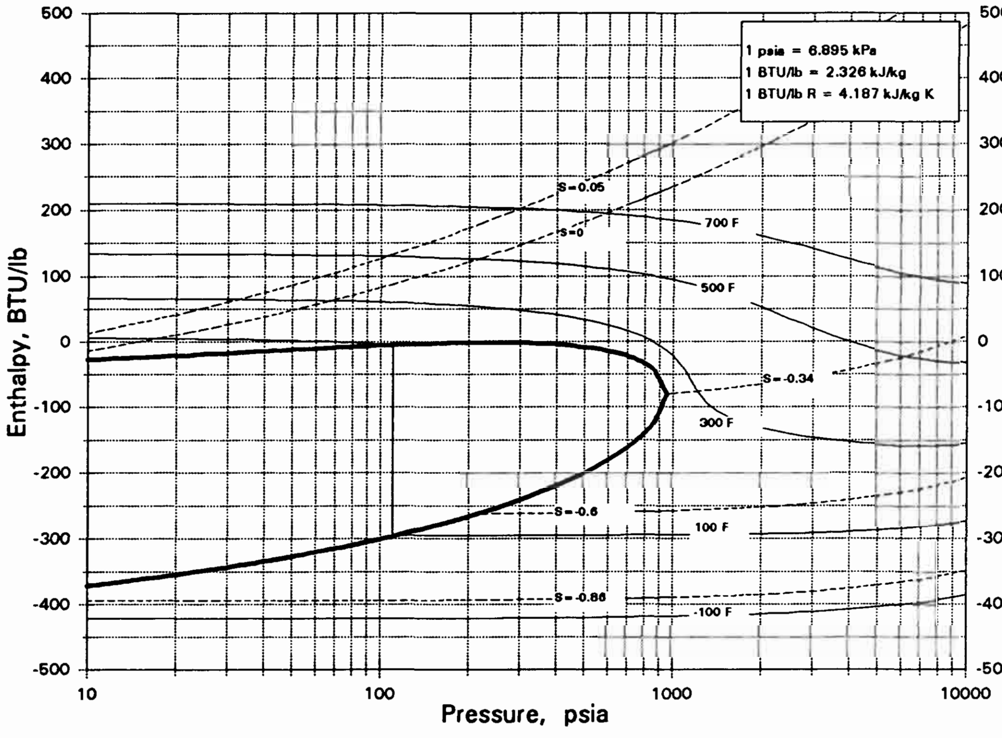

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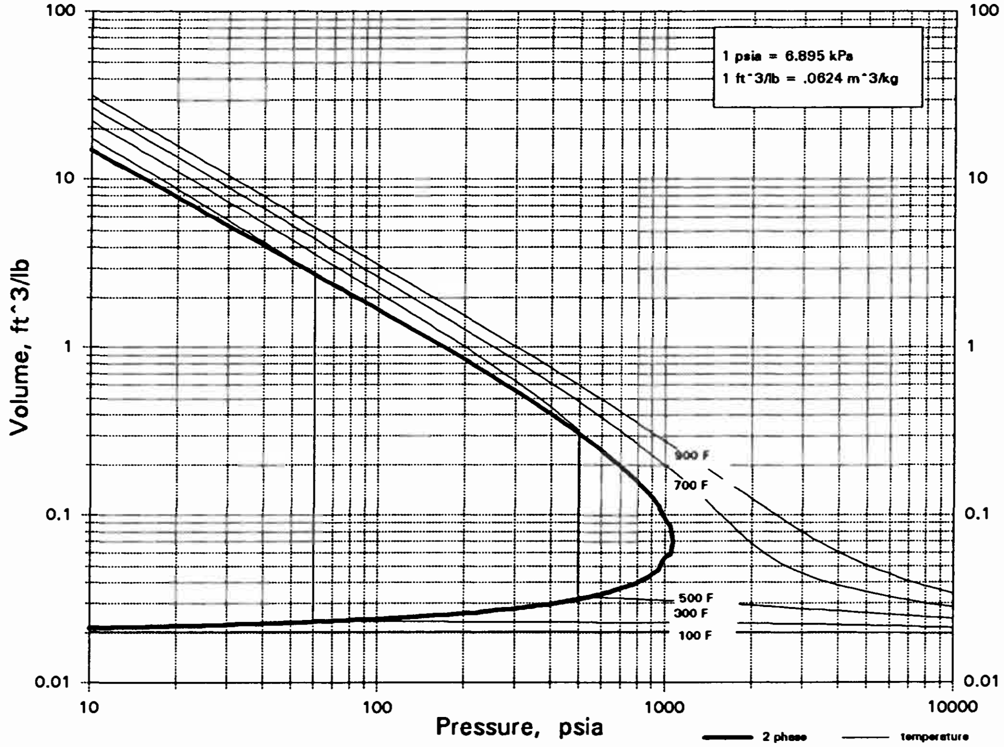

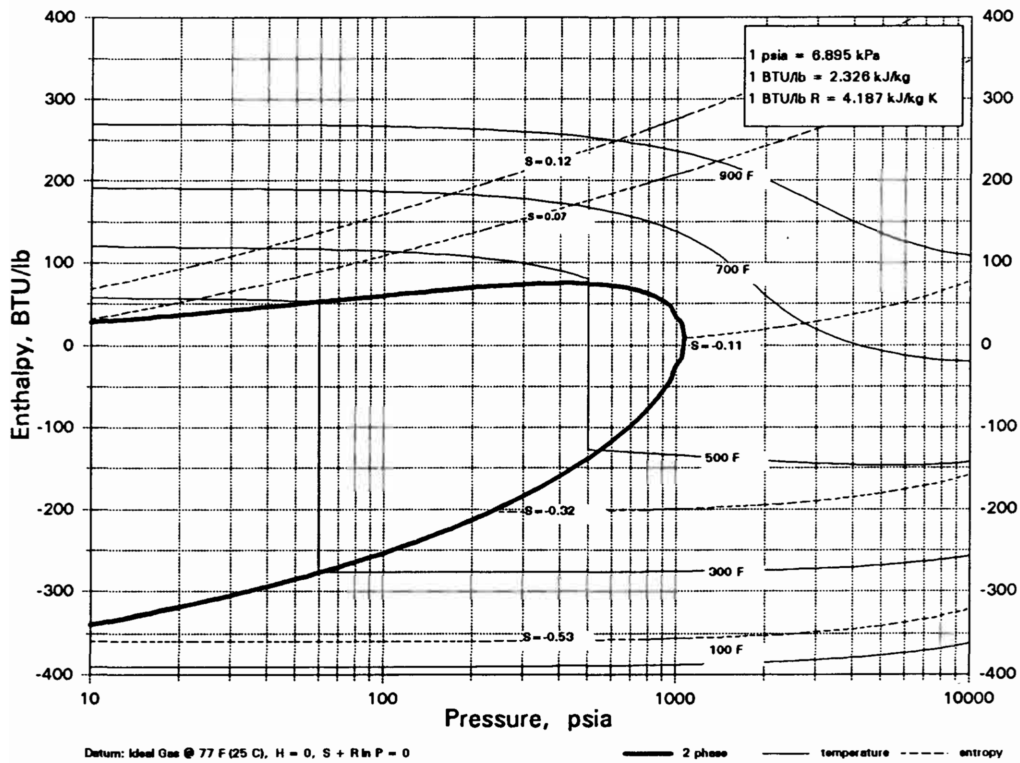

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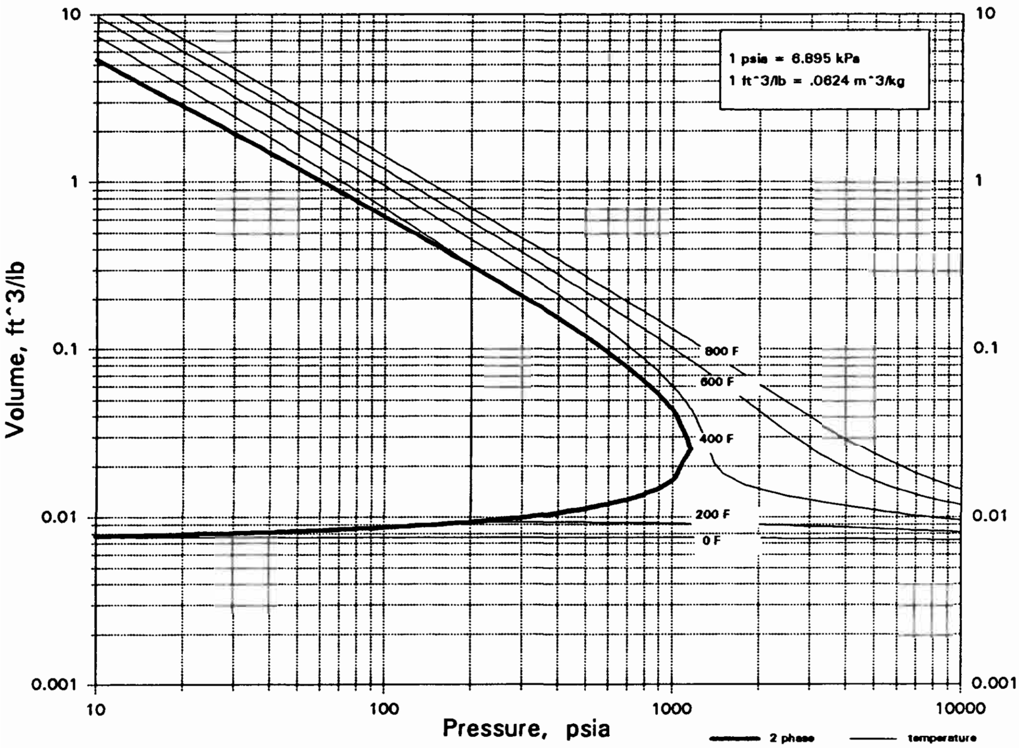
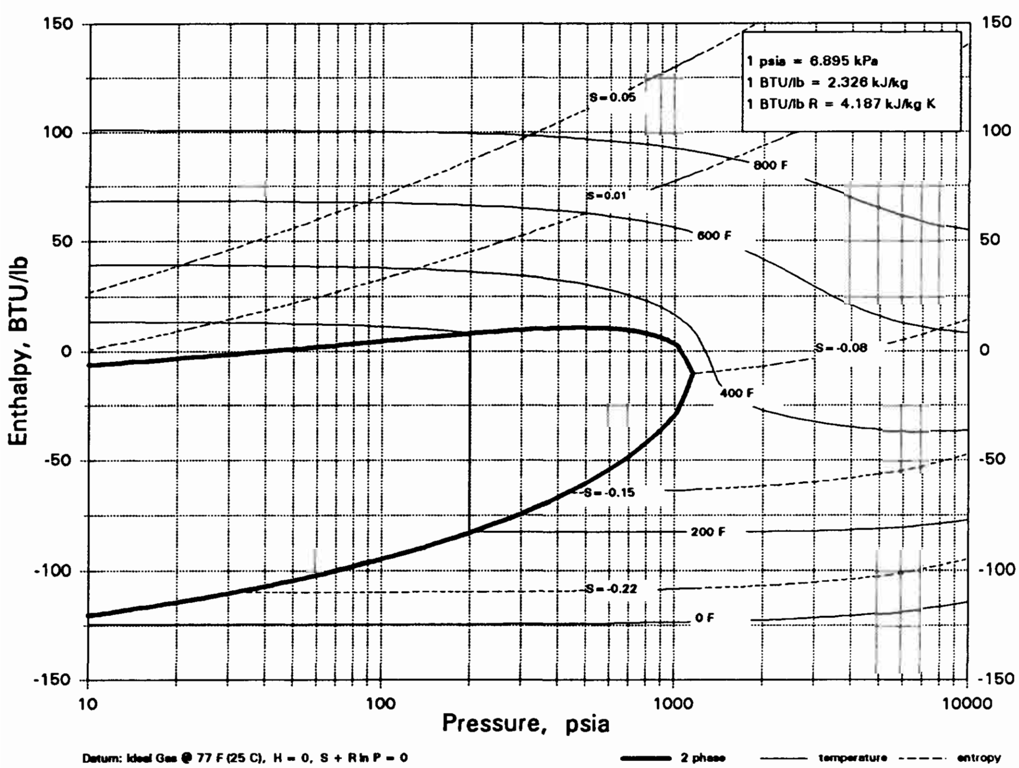
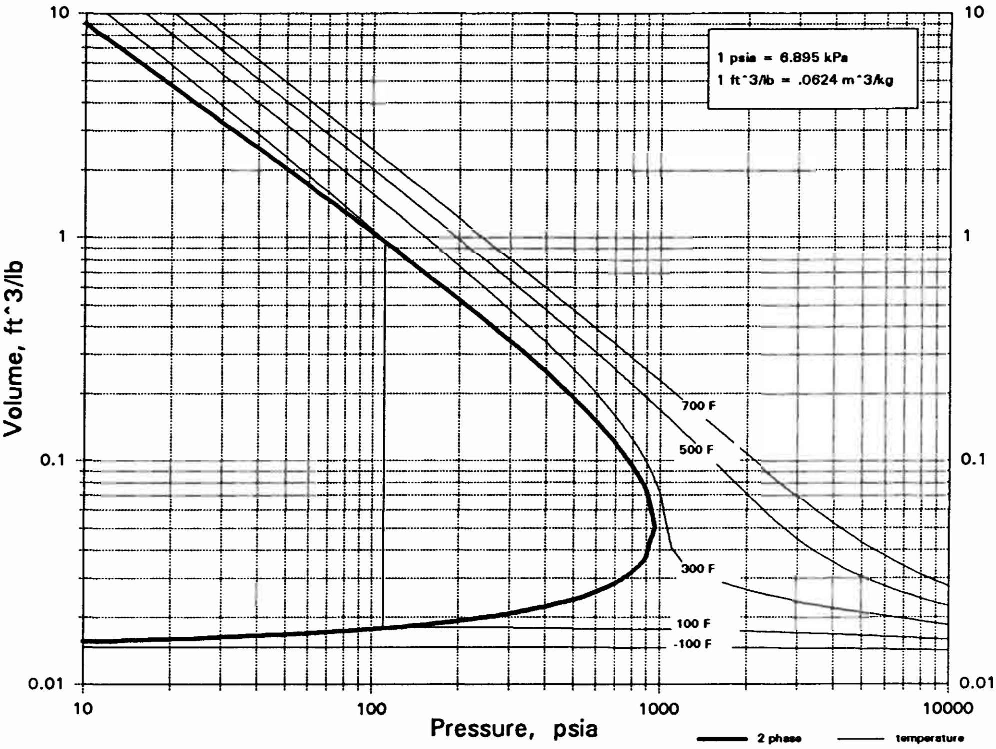
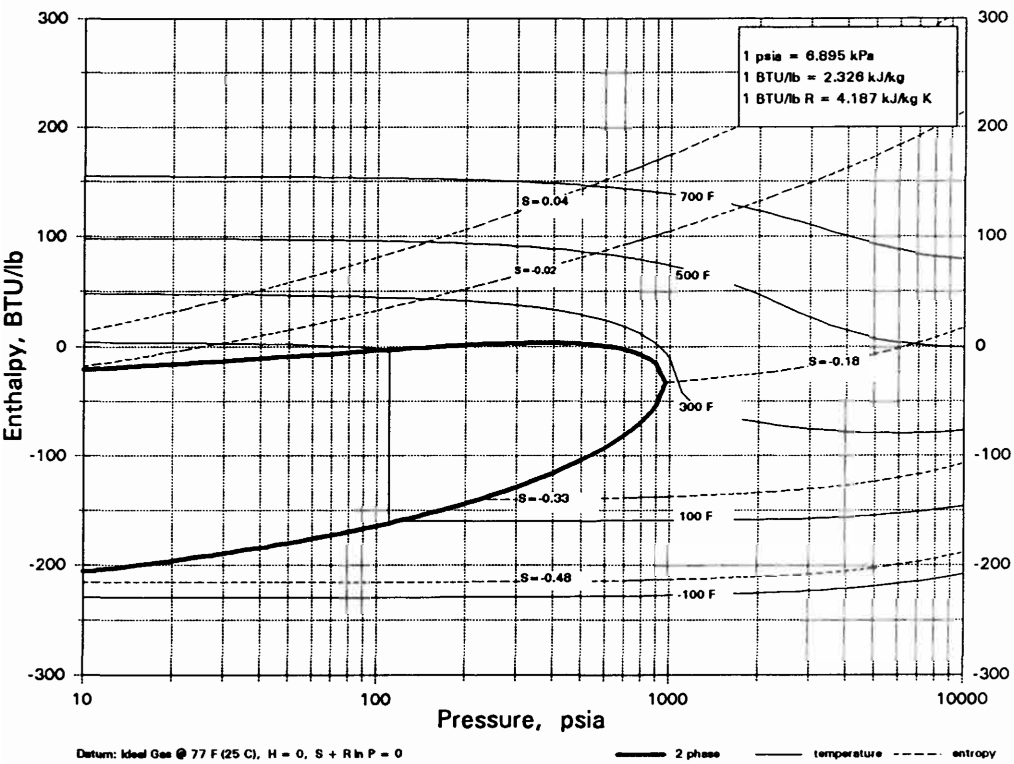


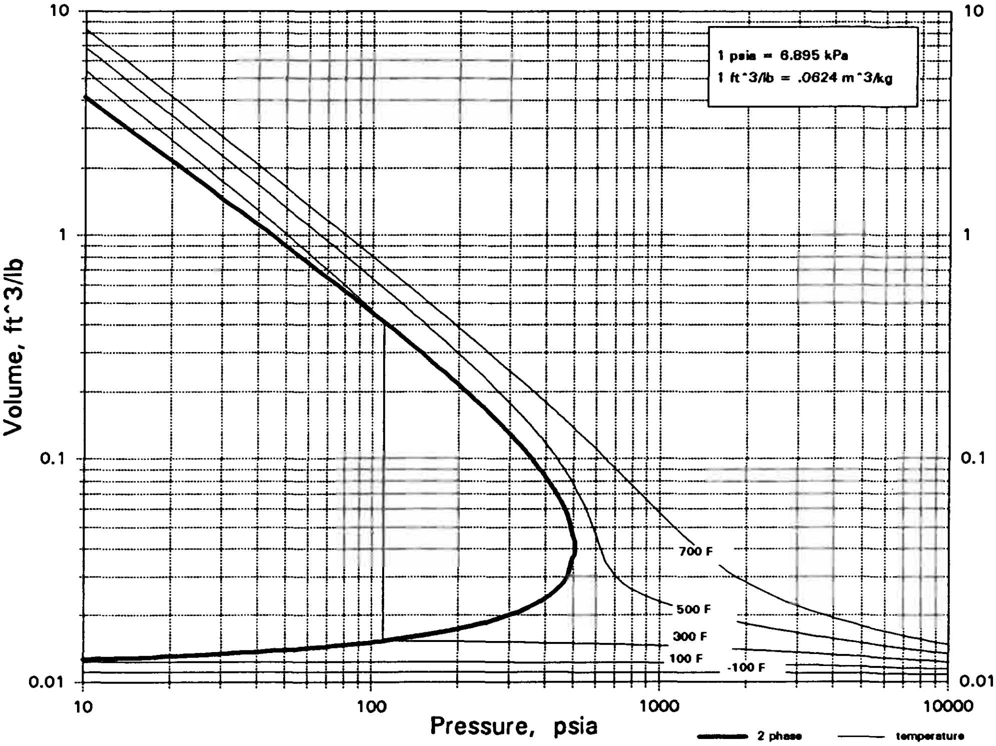


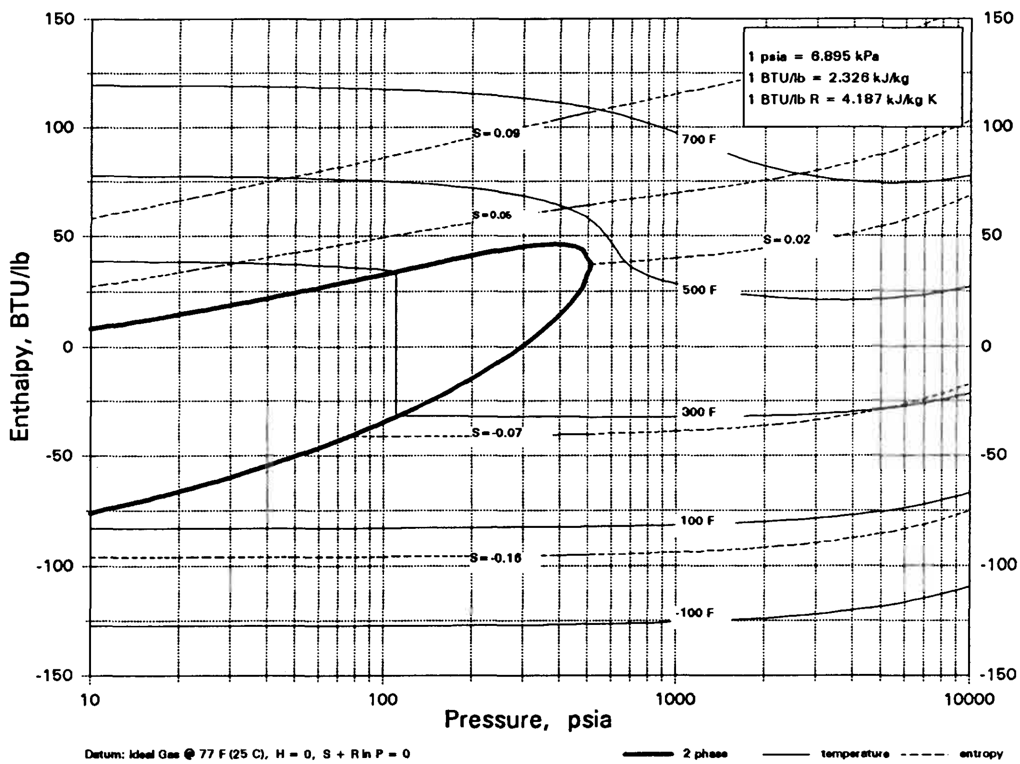
CH3Cl METHYL CHLORIDE



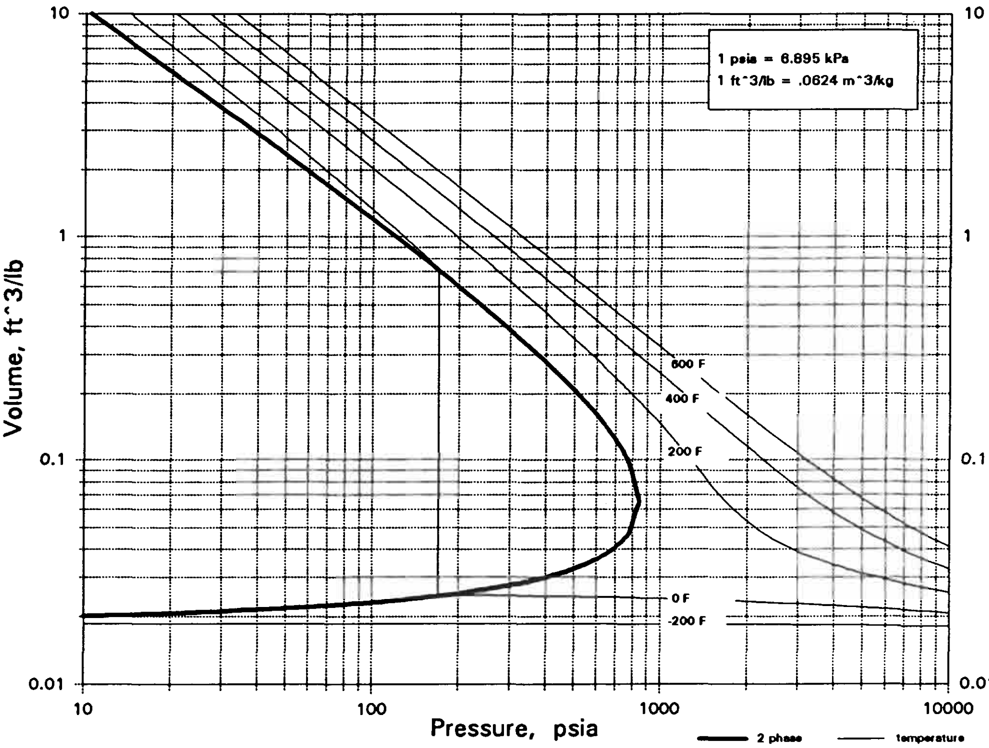


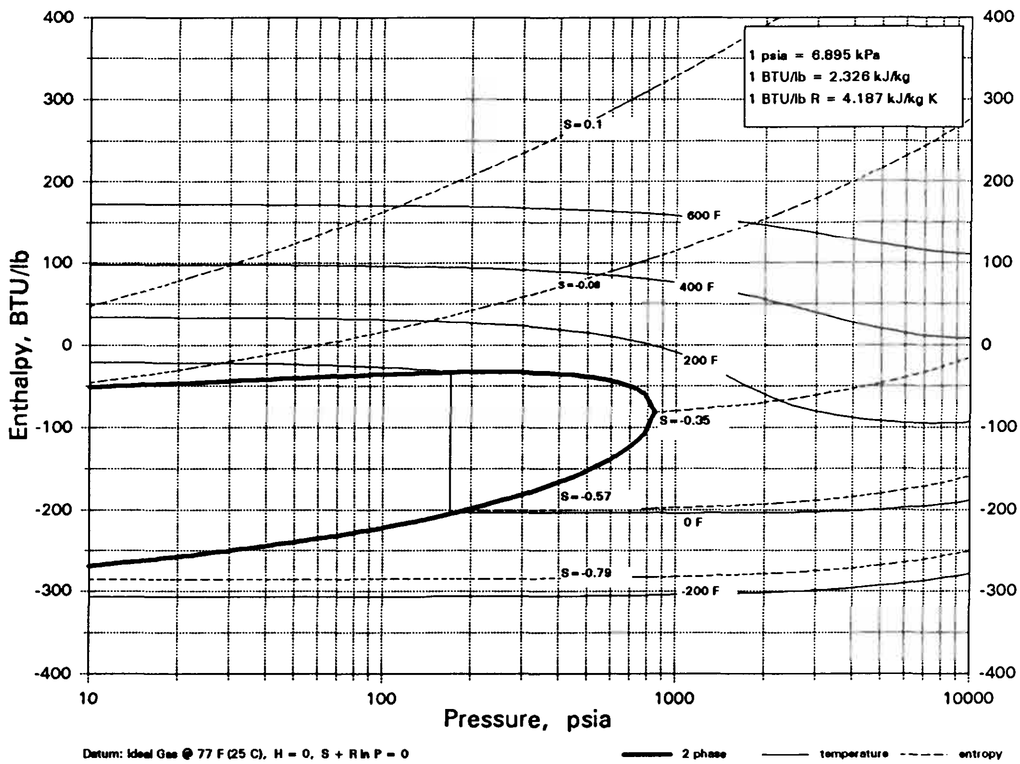
CH3Cl3Si	METHYL TRICHLOROSILANE



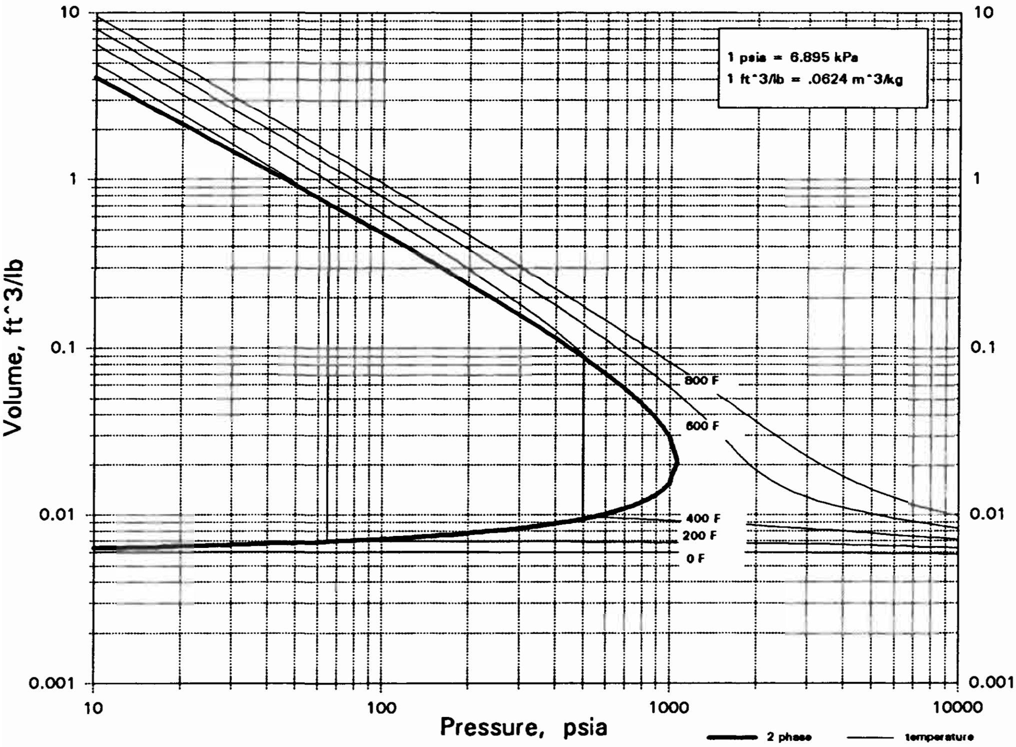


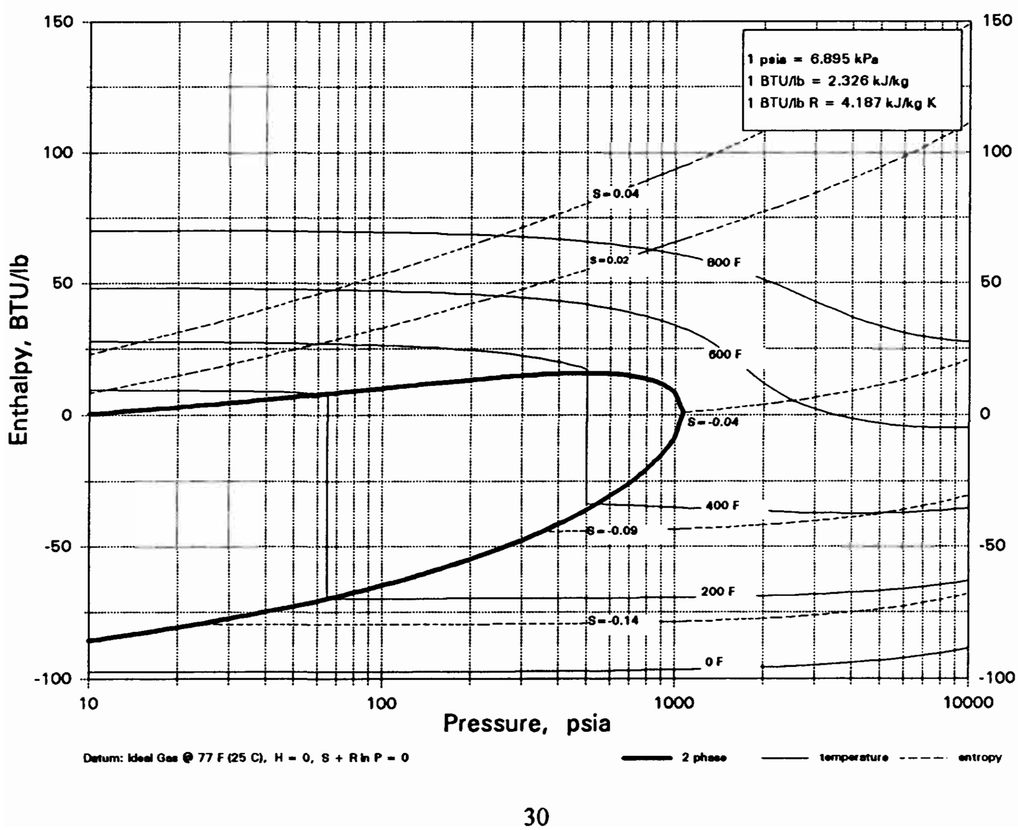
CH3F METHYL FLUORIDE



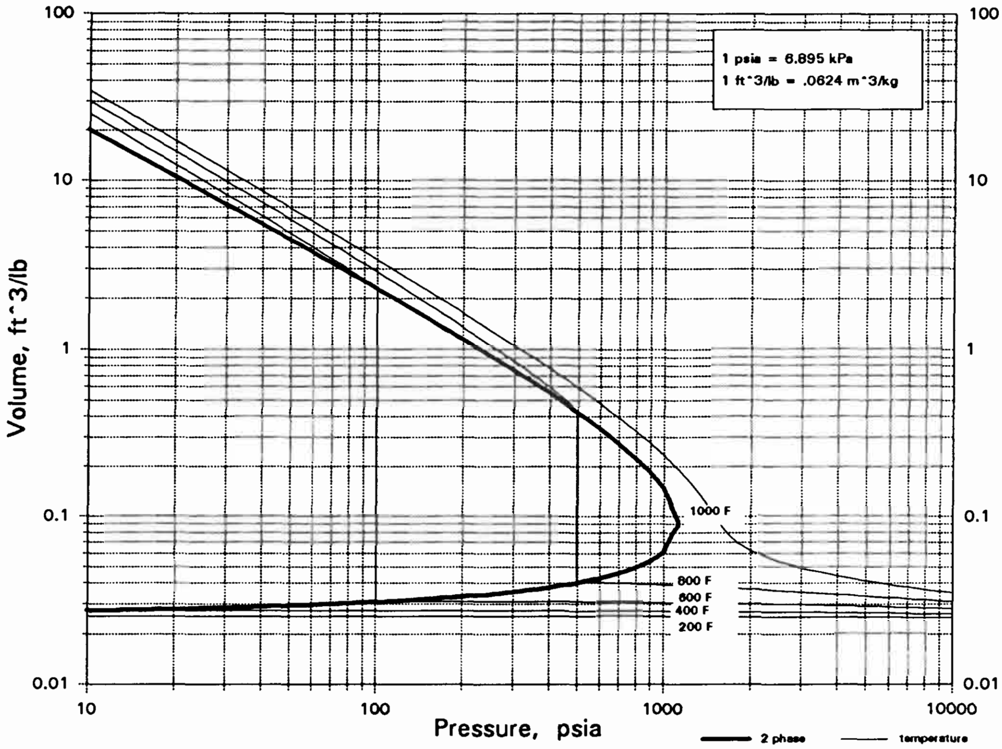


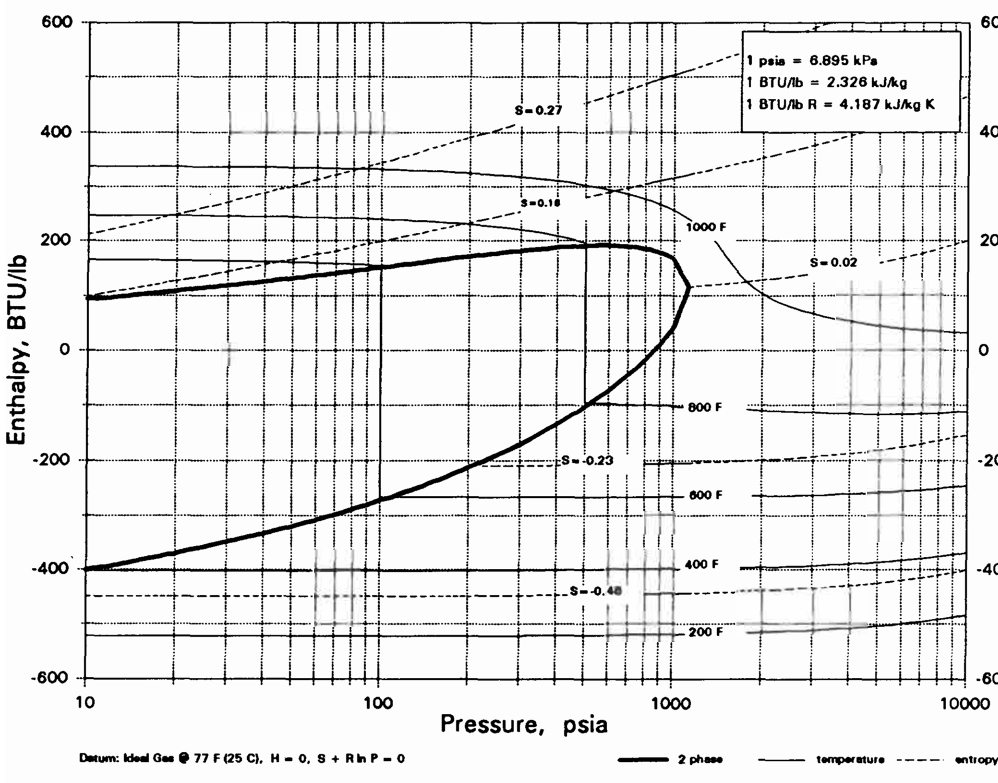
CH3I METHYL IODIDE



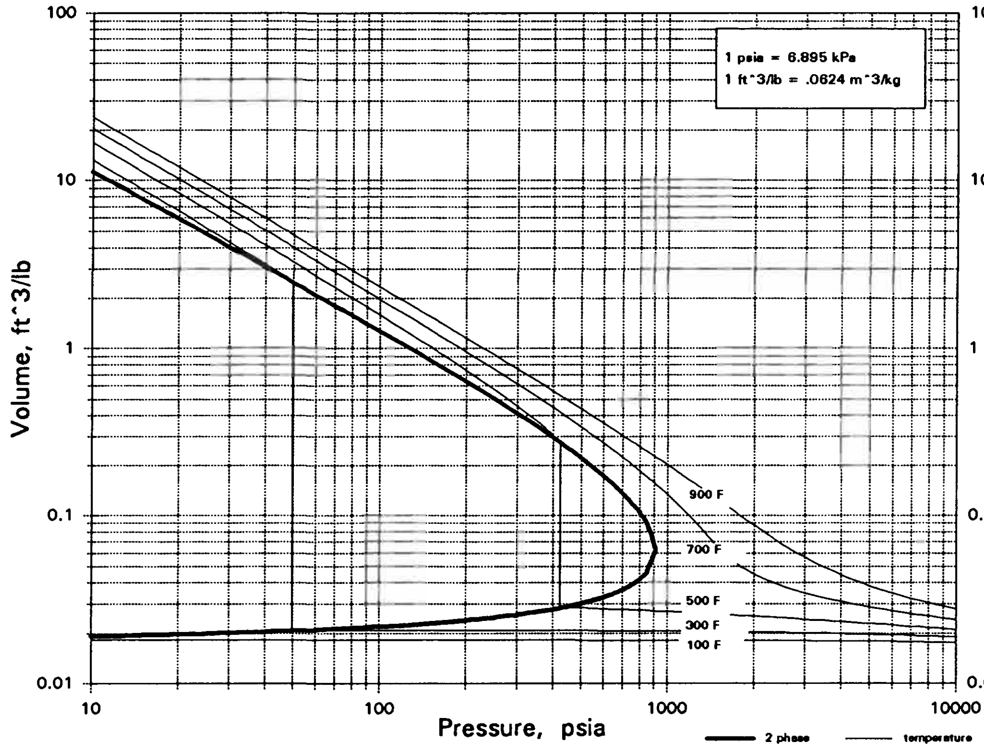


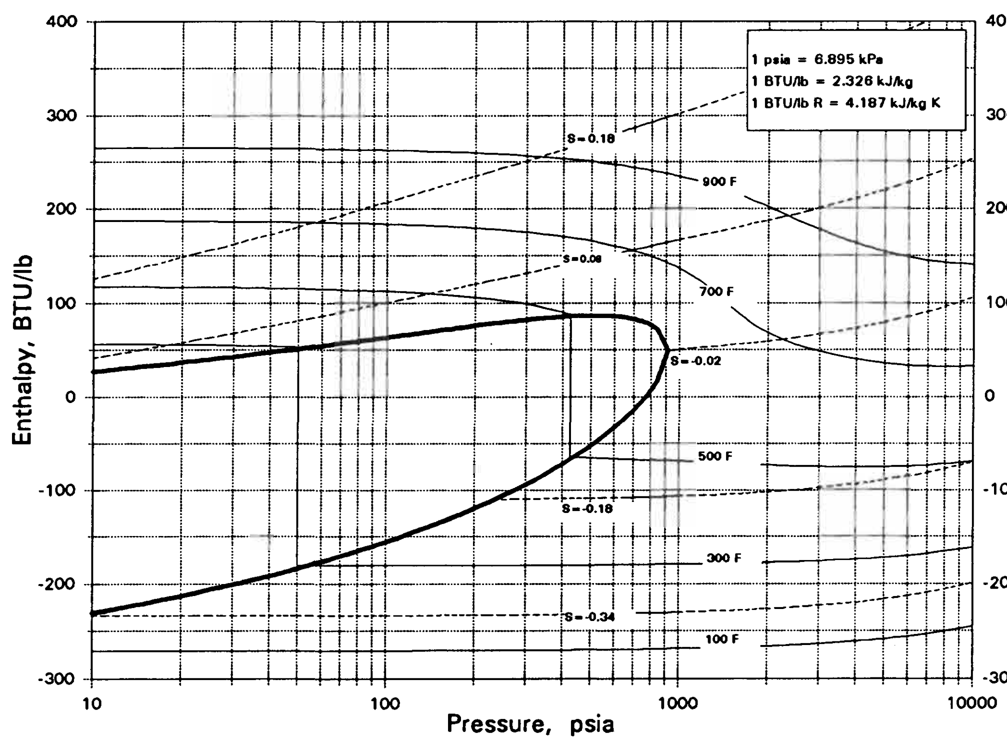
CH3NO FORMAMIDE





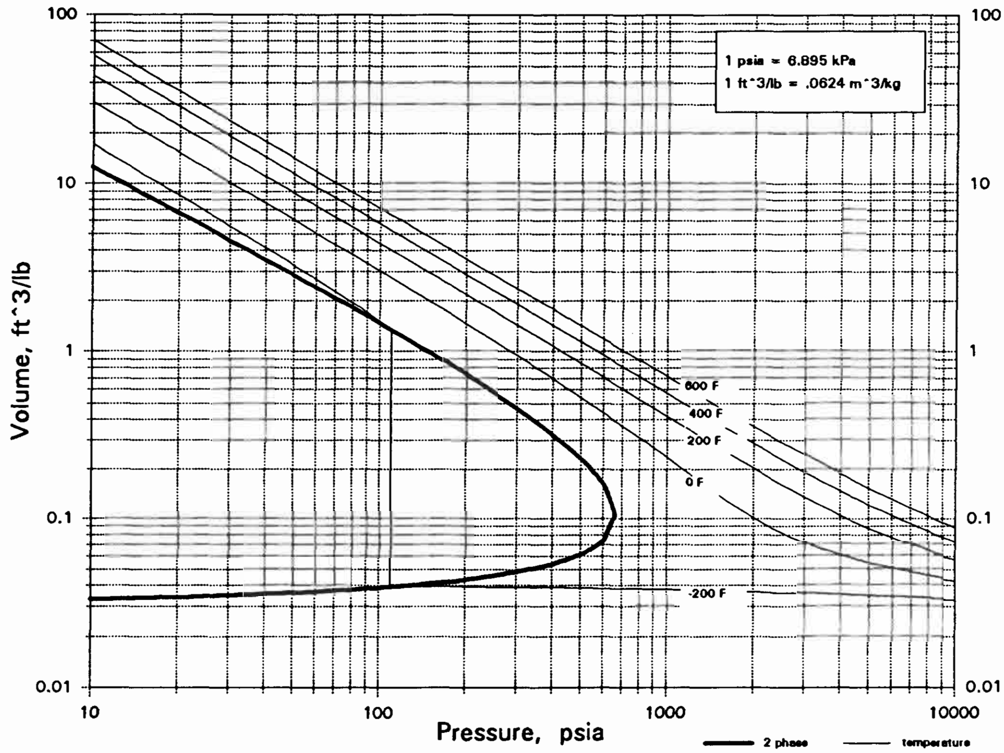
CH3NO2 NITROMETHANE

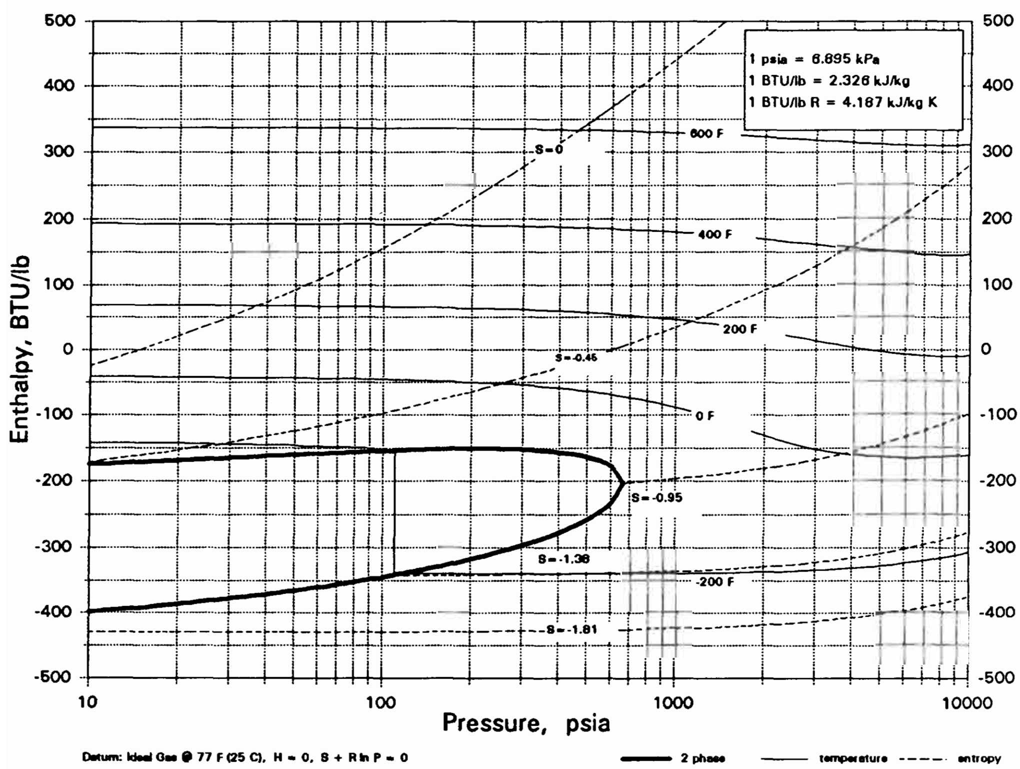




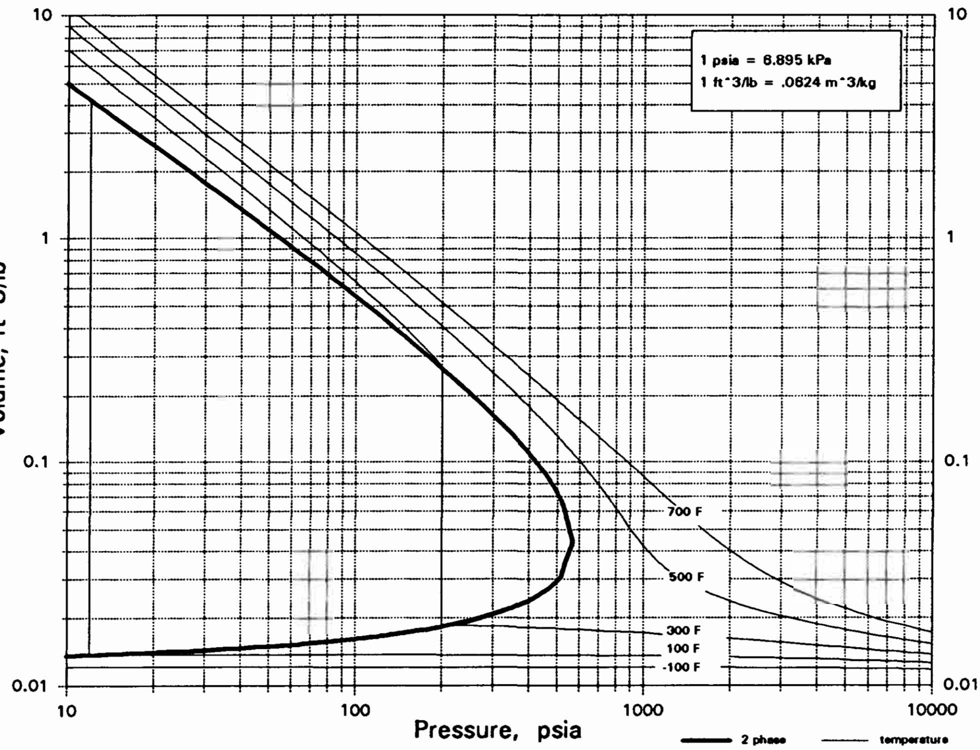
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

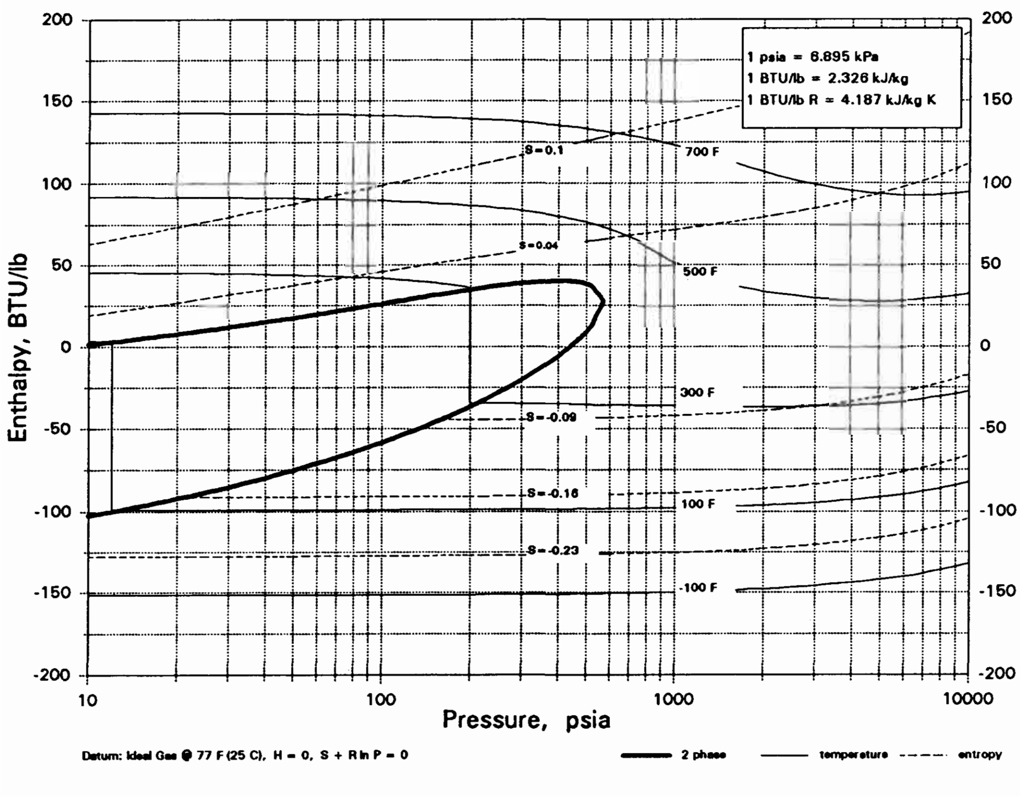
CH4 METHANE


1 psia = 6.895 kPa
1 ft^3/lb = .0624 m^3/kg
Volume, ft^3/lb
Pressure, psia
600 F
400 F
200 F
0 F
-200 F
2 phase
temperature

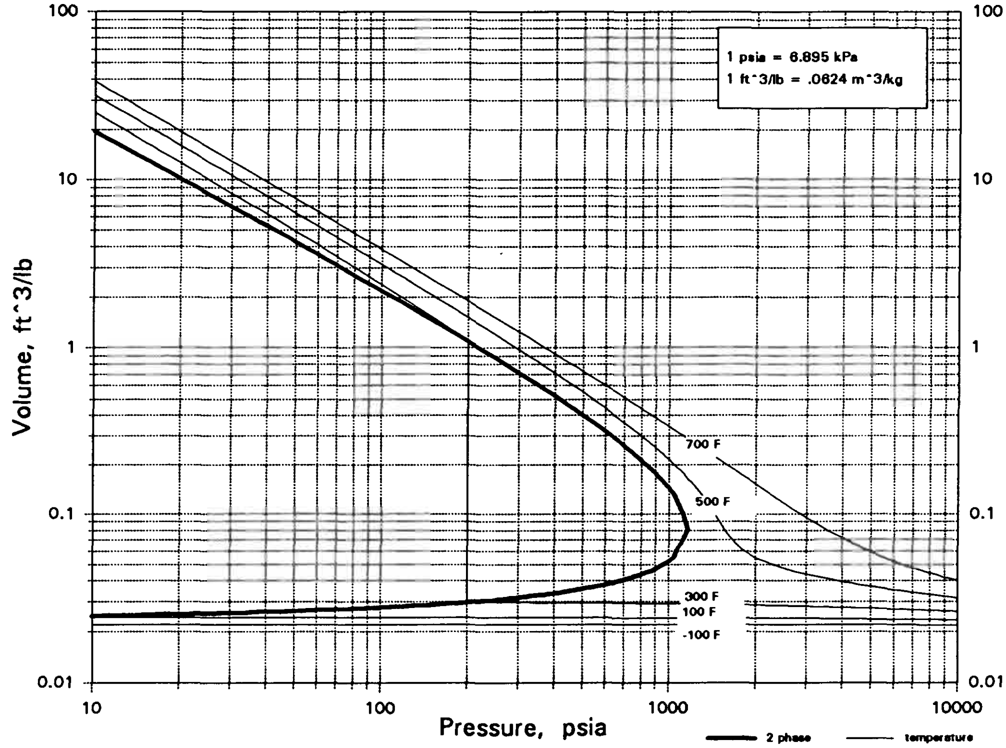

1 psia = 6.895 kPa
1 BTU/lb = 2.326 kJ/kg
1 BTU/lb R = 4.187 kJ/kg K
Enthalpy, BTU/lb
Pressure, psia
600 F
400 F
200 F
0 F
-200 F
S=0
S=-0.45
S=-0.95
S=-1.38
S=-1.81
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0
2 phase
temperature
entropy

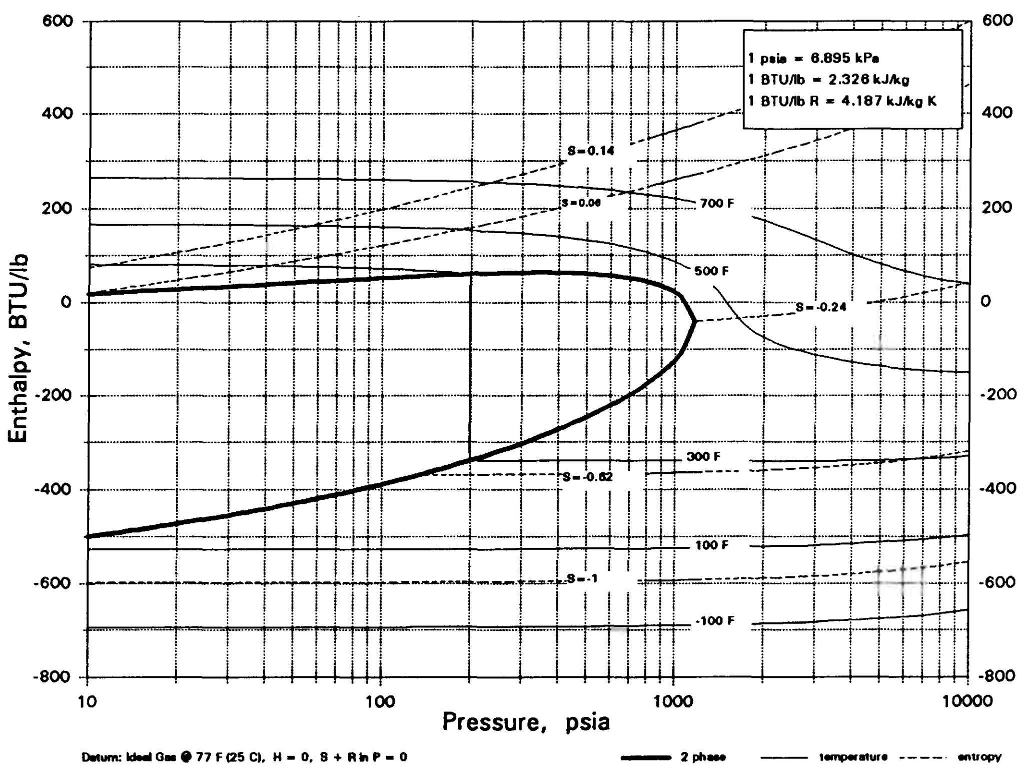
CH4Cl2Si METHYL DICHLOROSILANE





CH4O METHANOL





1. Molecular Weight, lb/mol........ 96.107

2. Boiling Point, K........................ 561.00

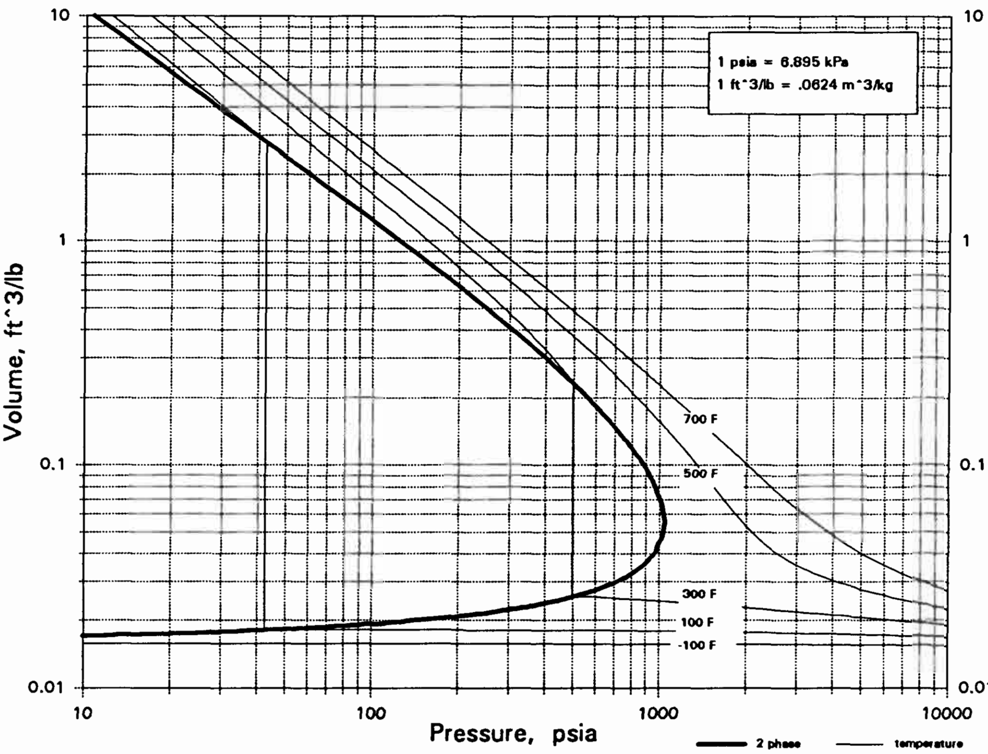
Critical data (Tc, Pc) are not available.

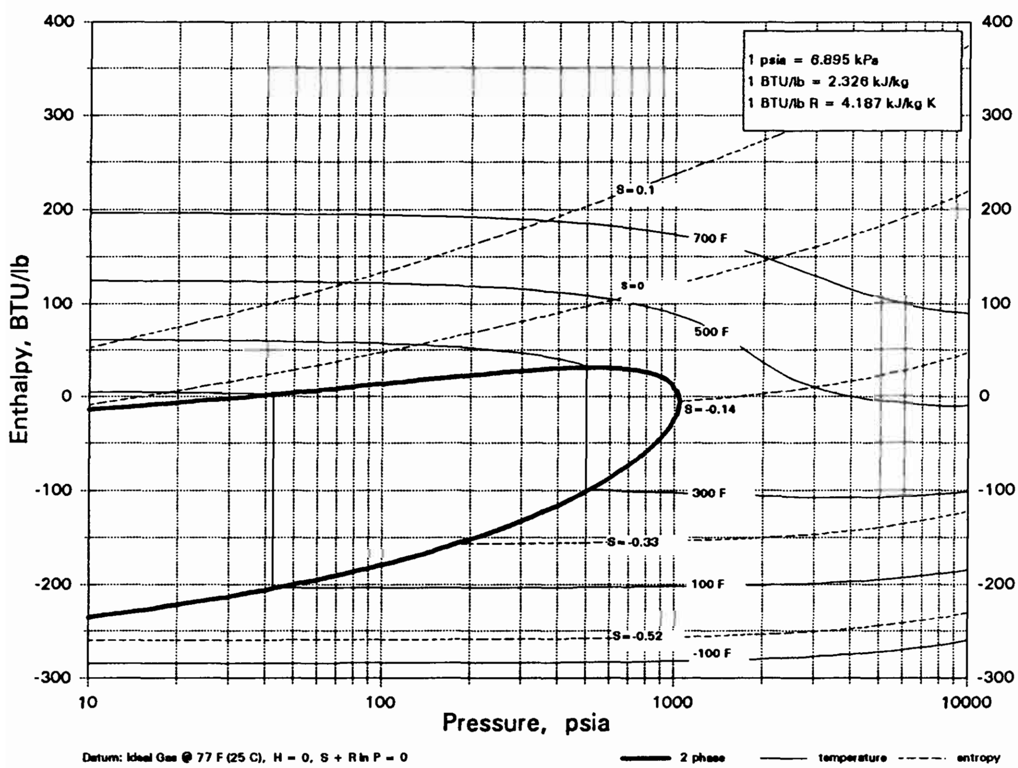
1. Molecular Weight, lb/mol........ 96.107

2. Boiling Point, K........................ 561.00

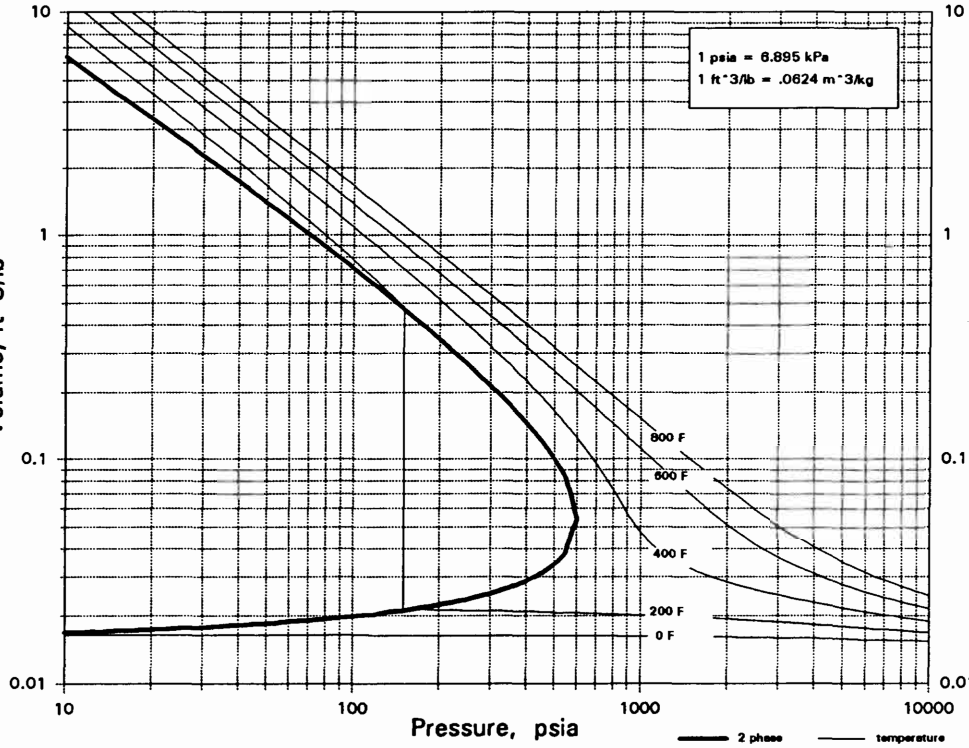
Critical data (Tc, Pc) are not available.

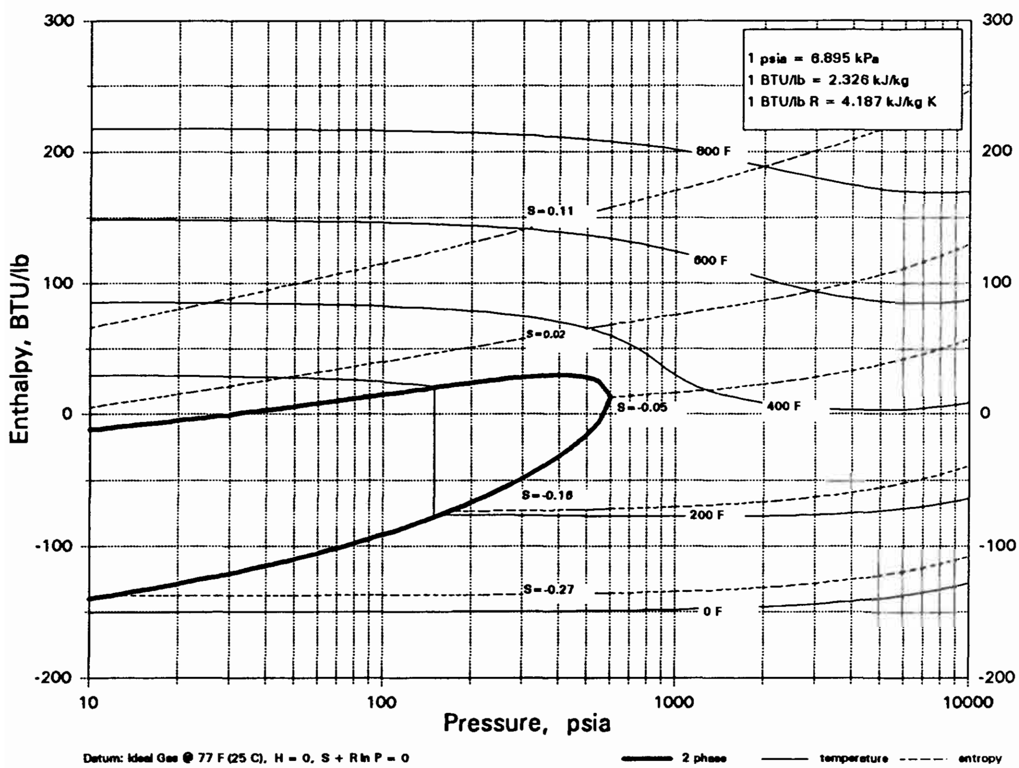
CH4S METHYL MERCAPTAN



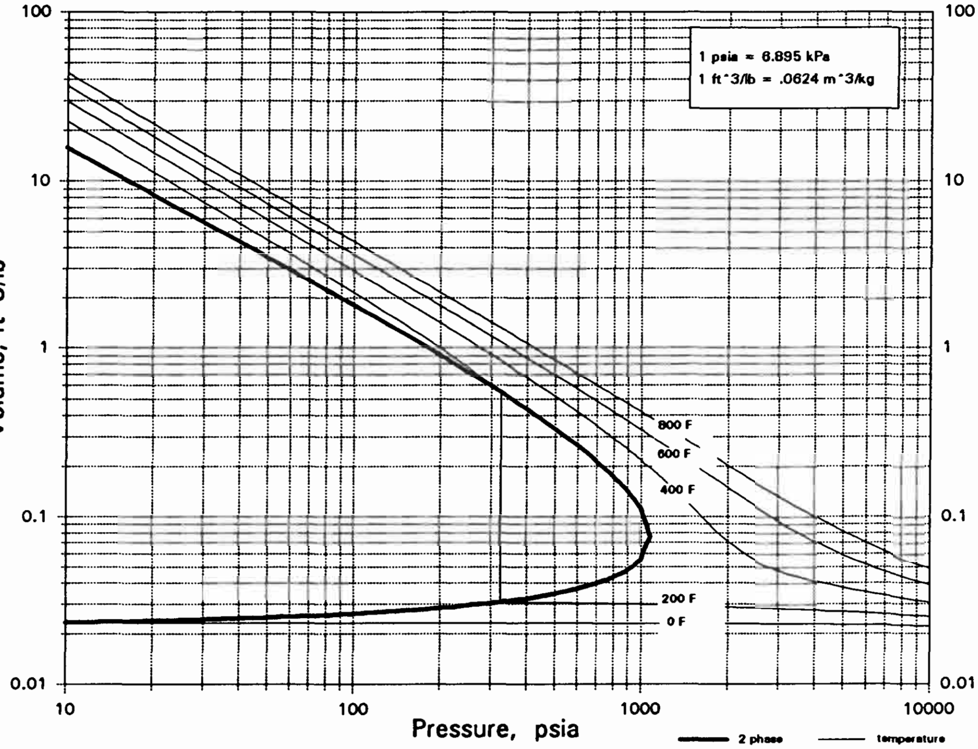


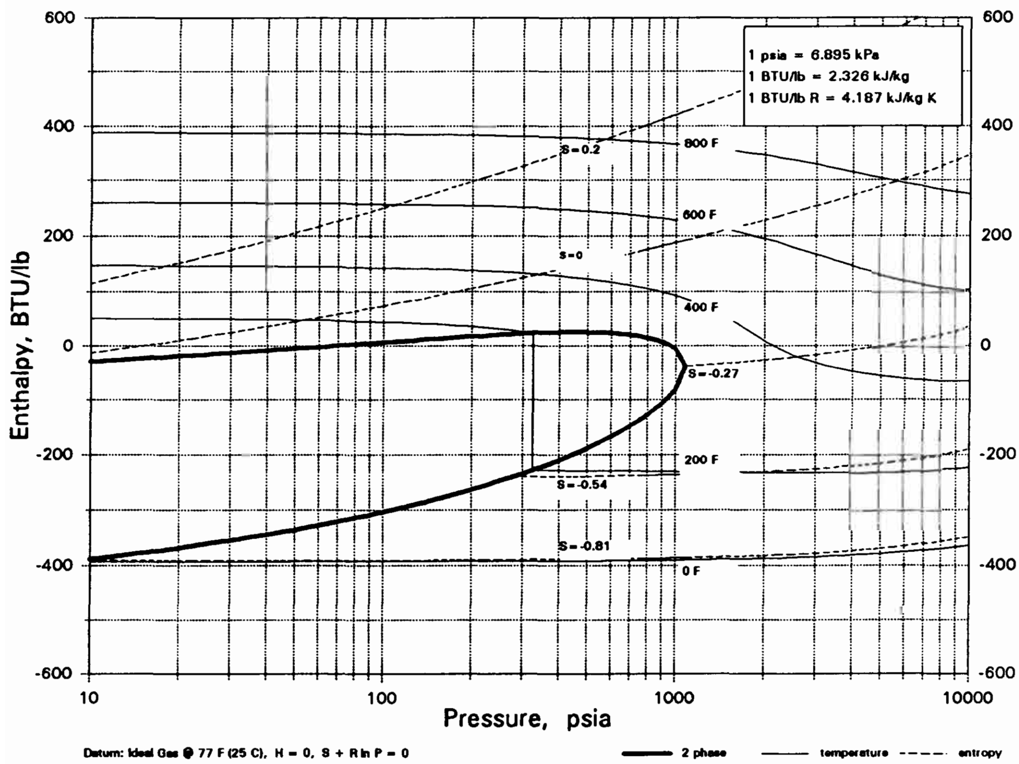
CH5ClSi	METHYL CHLOROSILANE



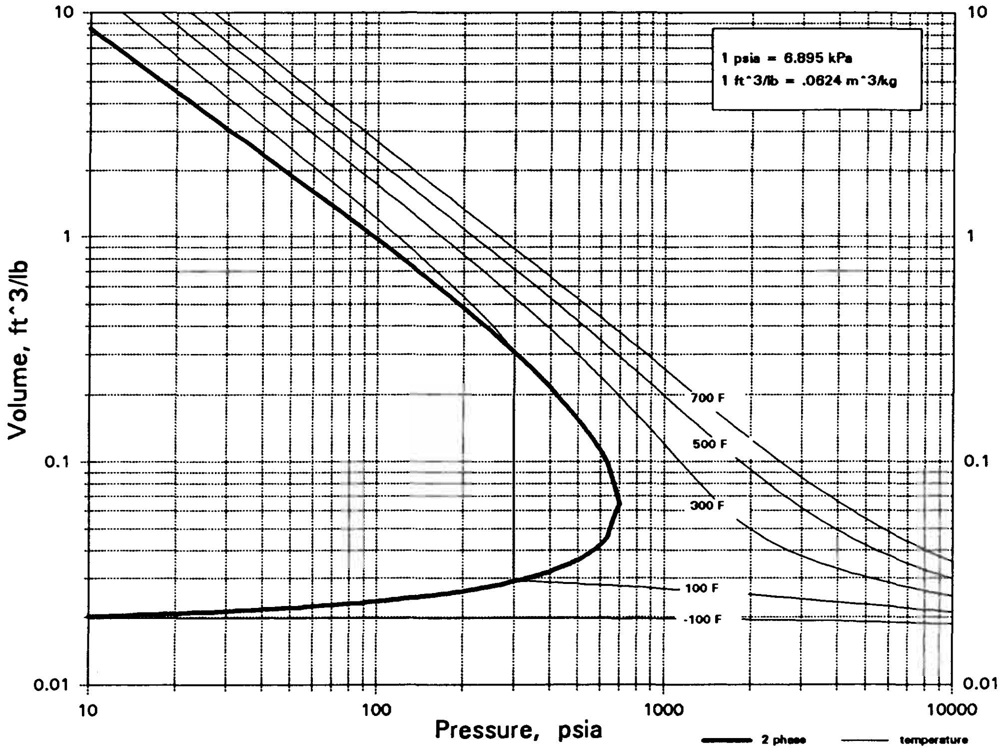


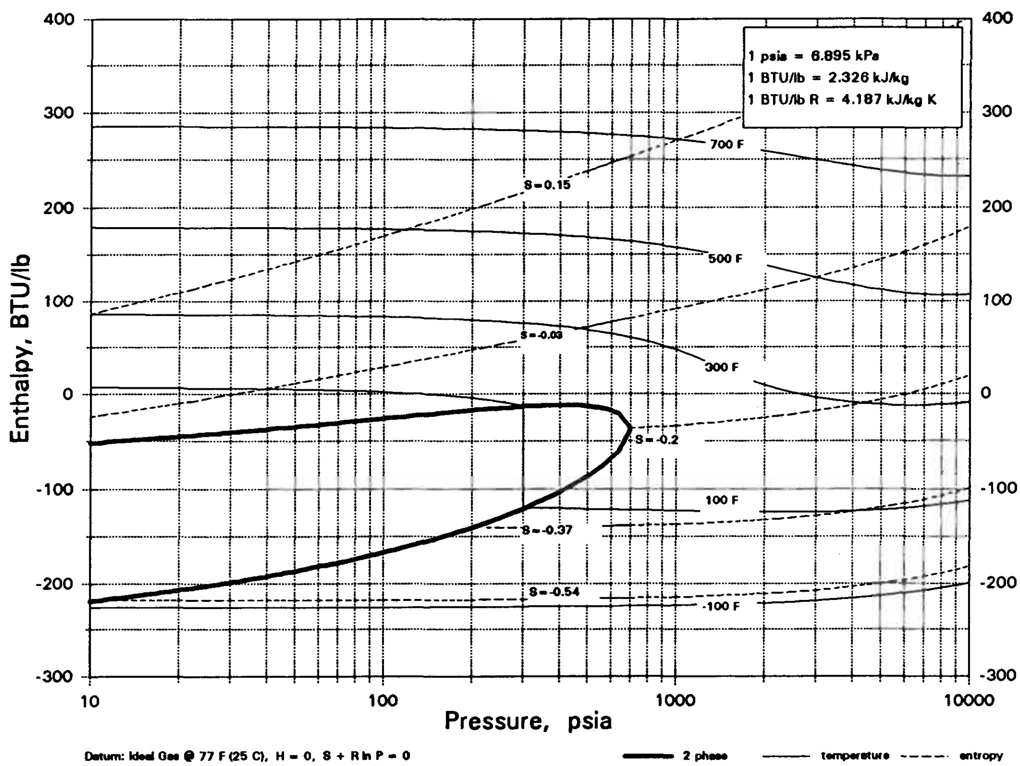
CH5N METHYLAMINE



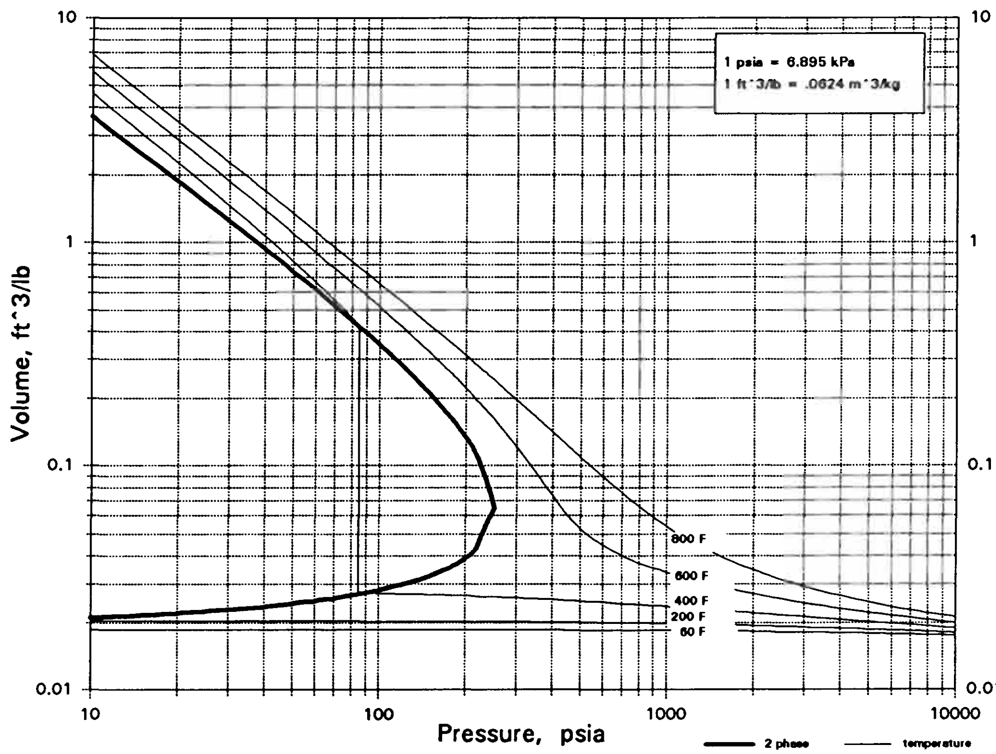


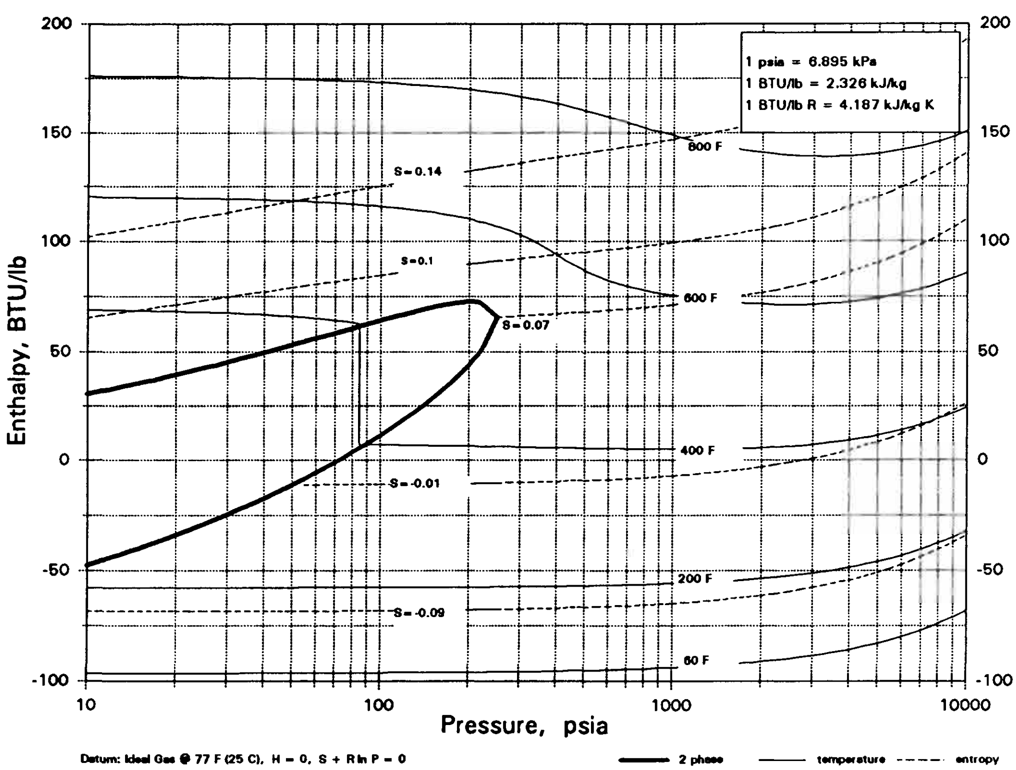
CH6Si METHYL SILANE



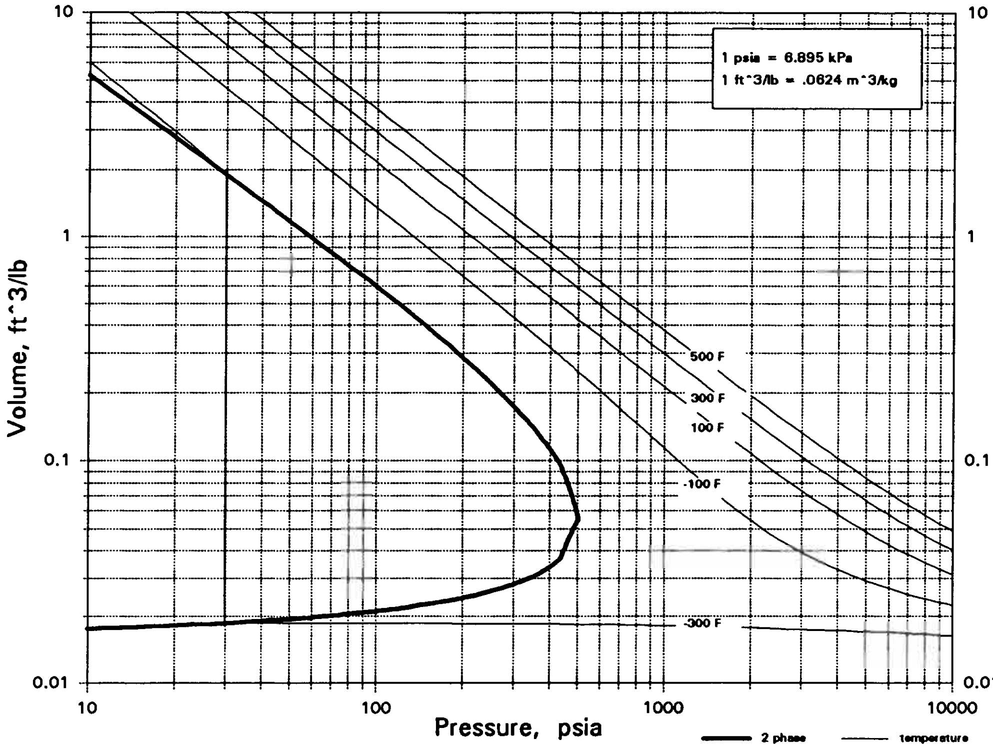


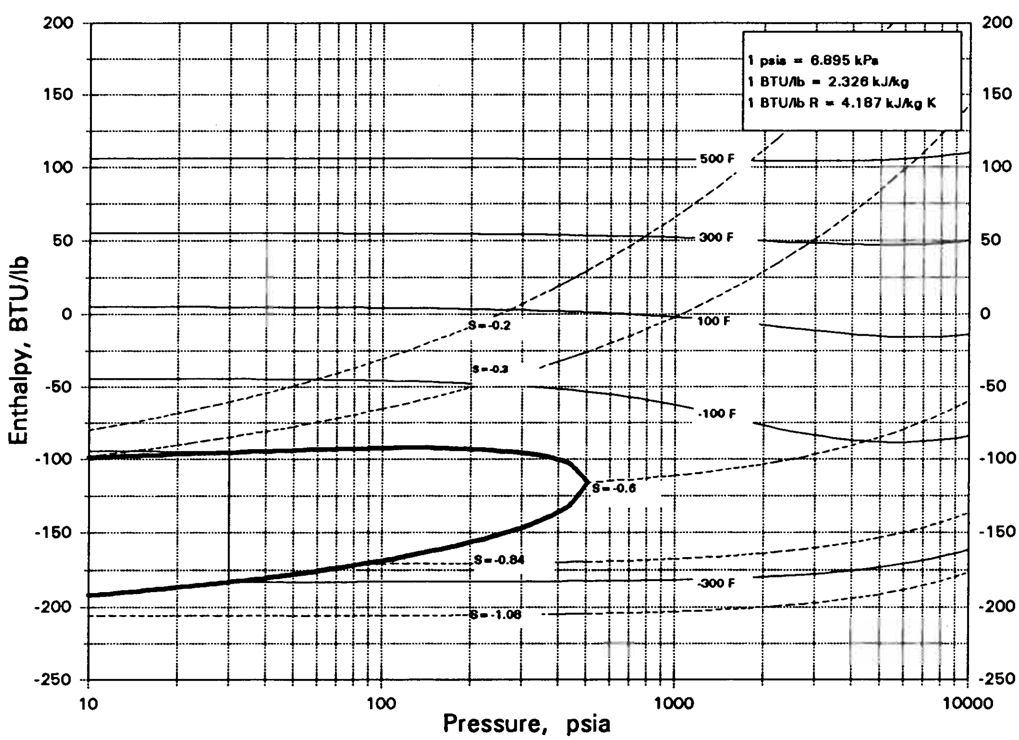
CN4O8	TETRANITROMETHANE





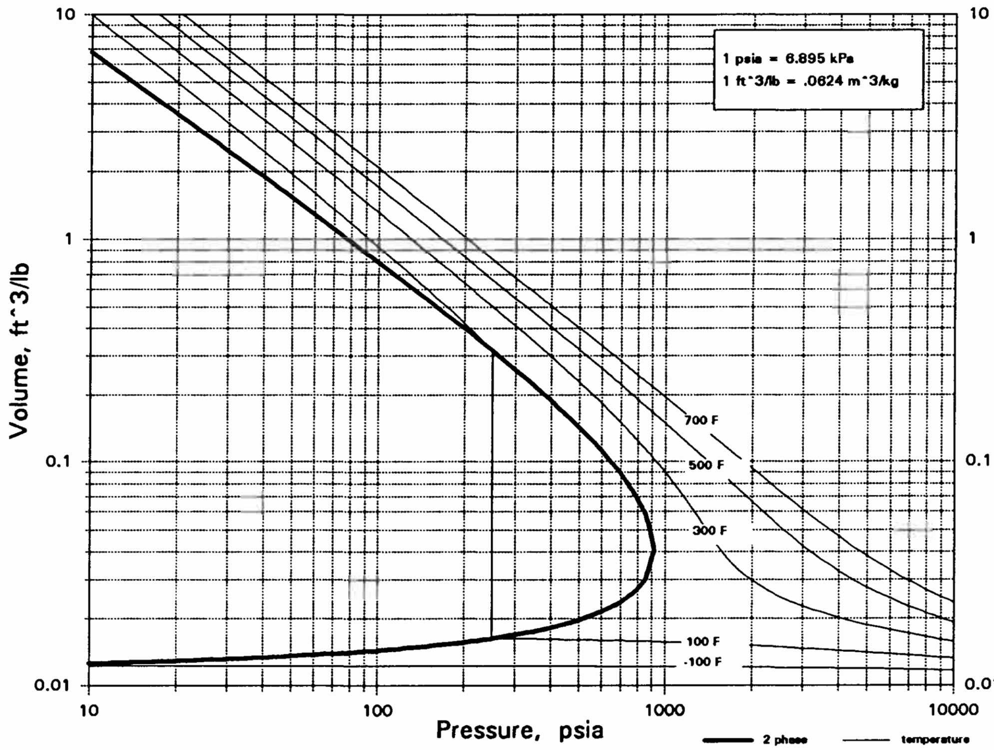
CO	CARBON MONOXIDE

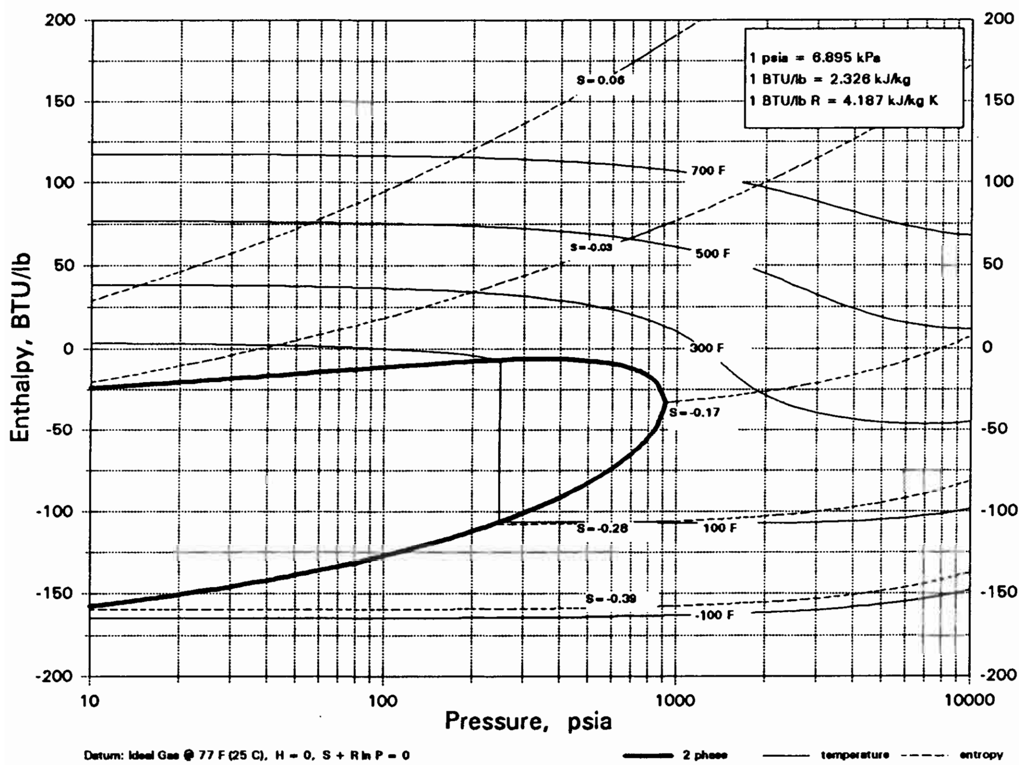




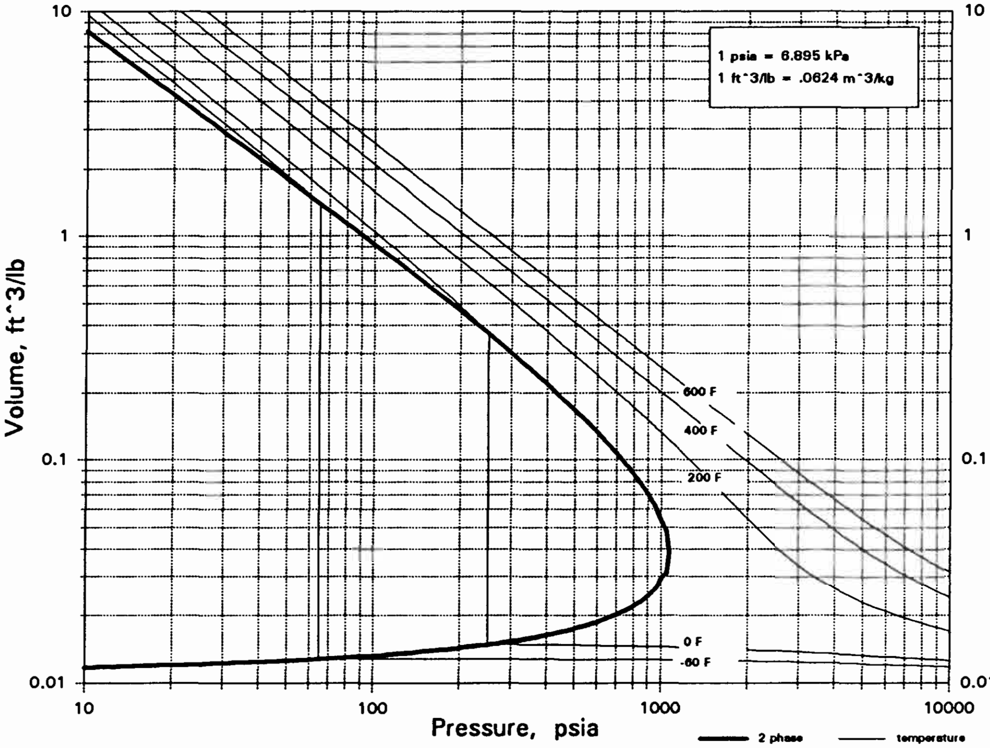
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

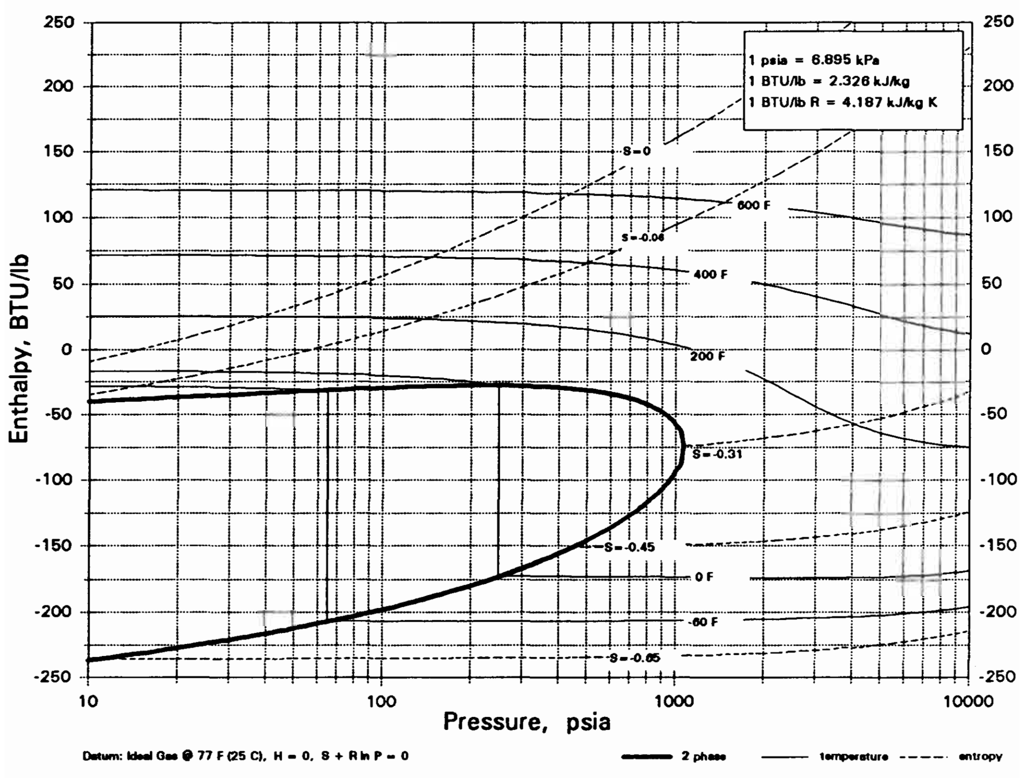
COS CARBONYL SULFIDE



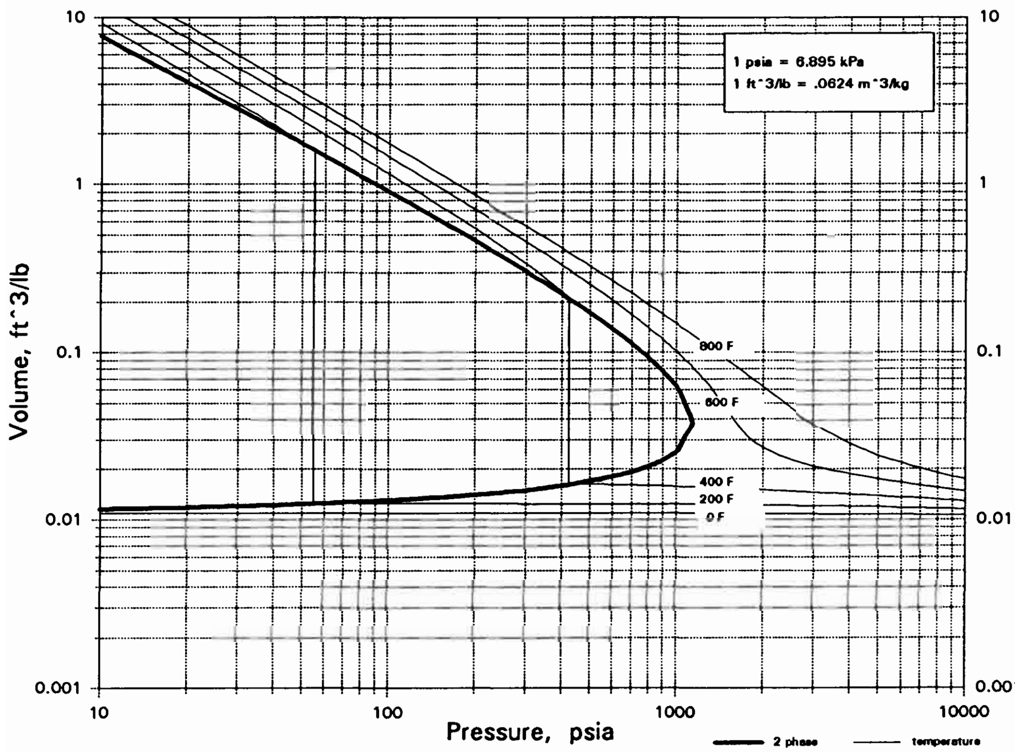


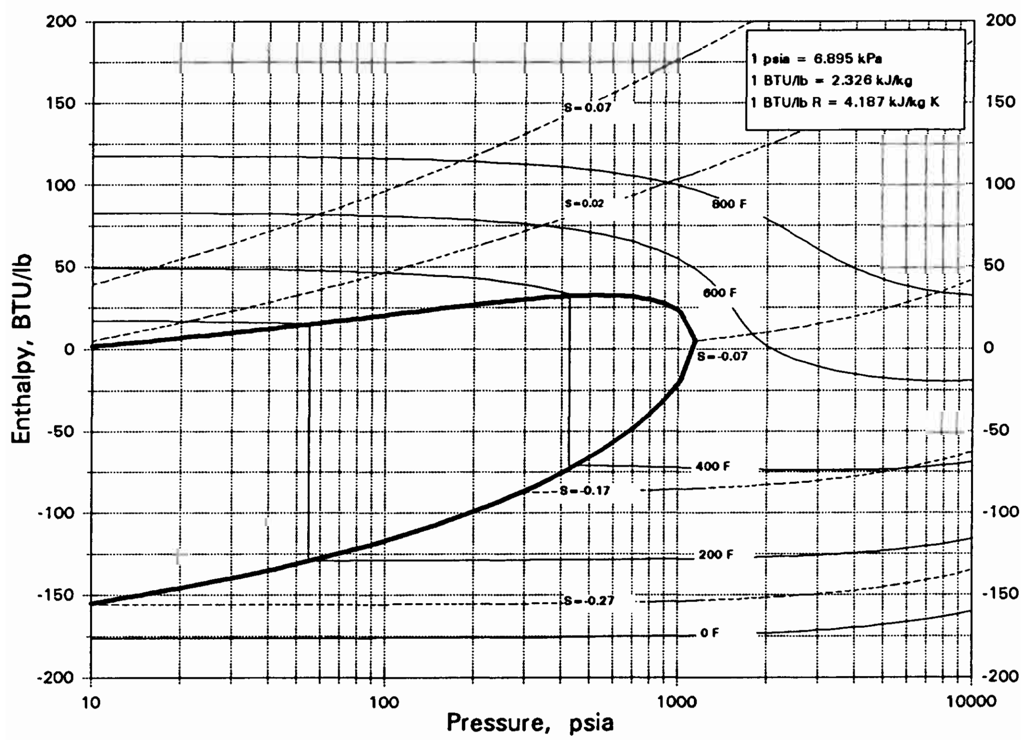
CO2	CARBON DIOXIDE



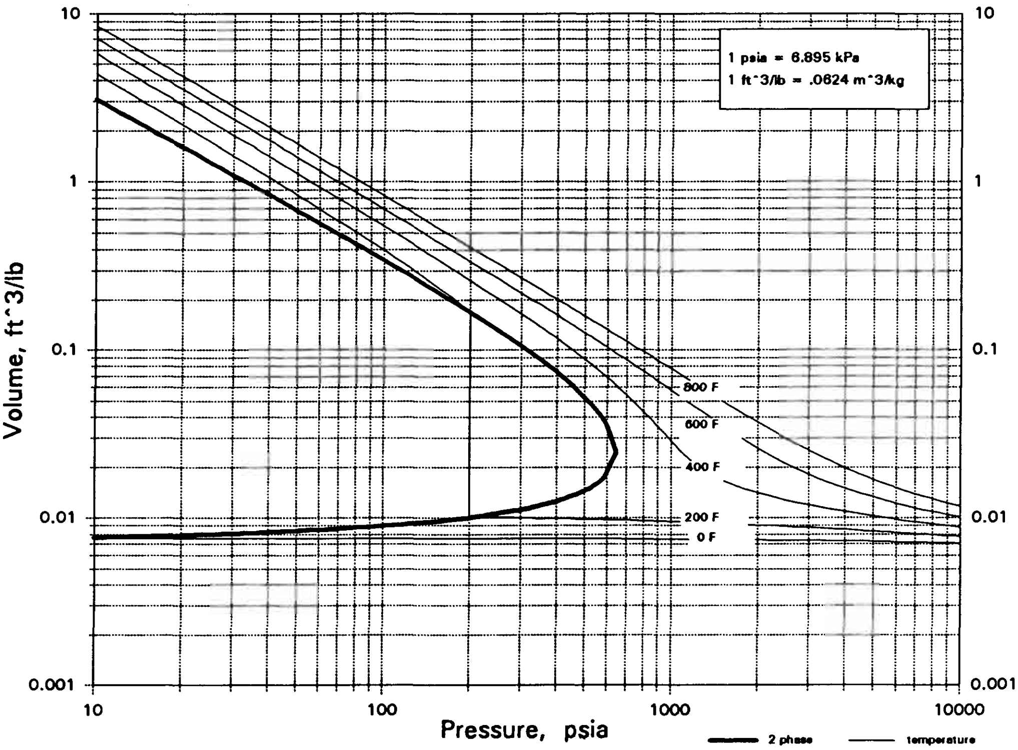


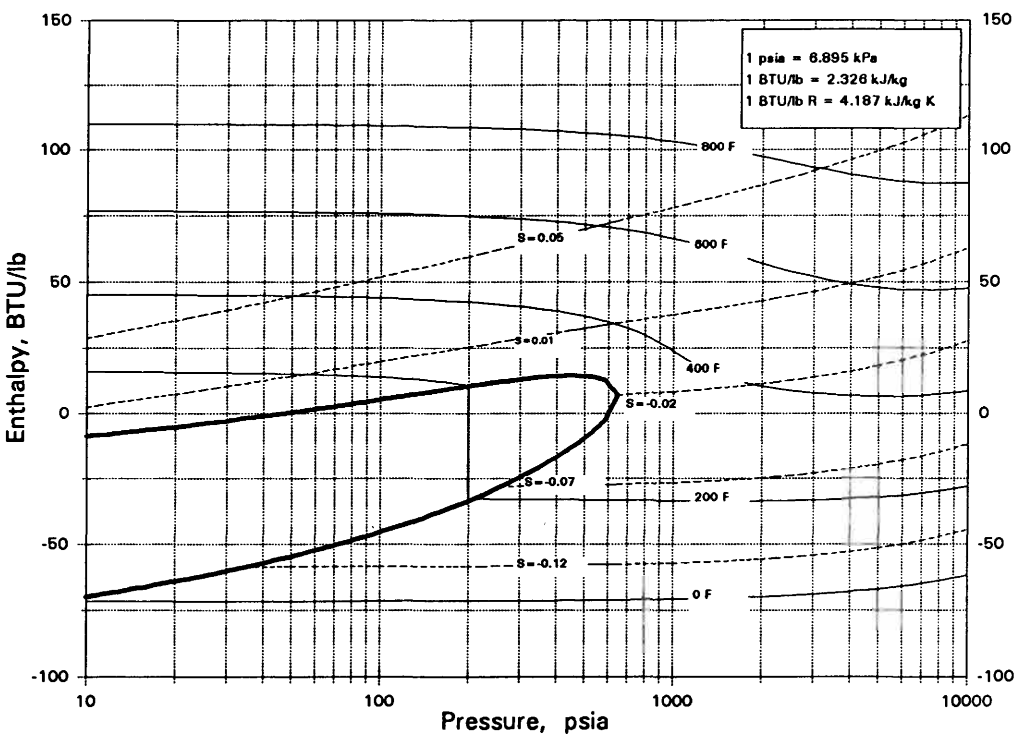
CS2 CARBON DISULFIDE





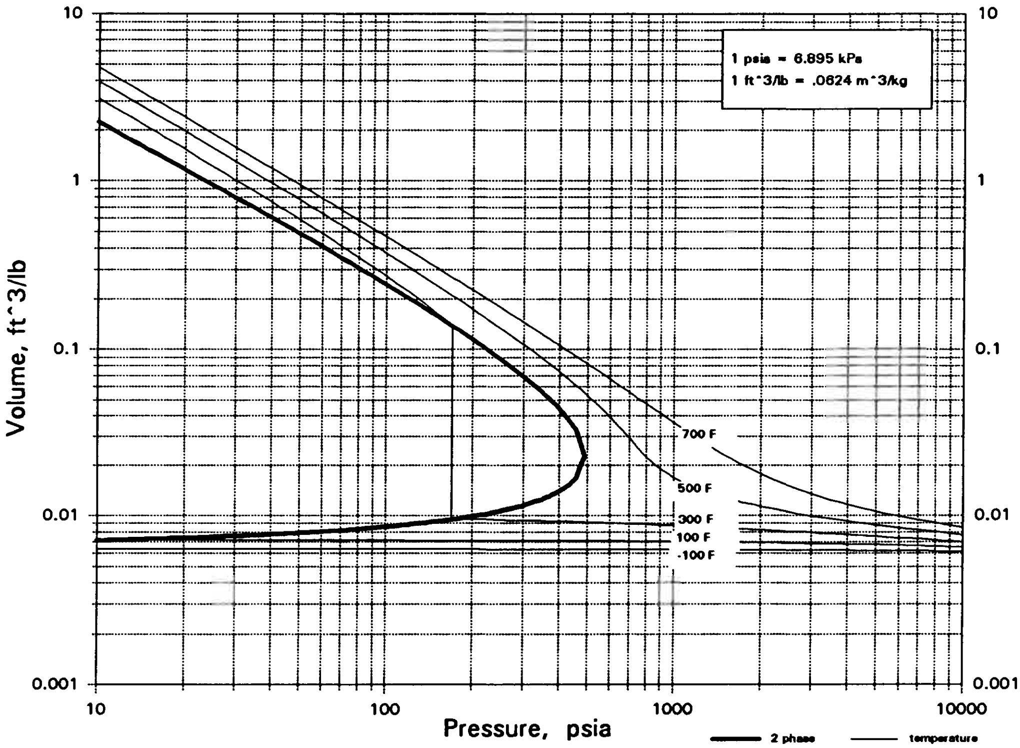
C2BrF3	BROMOTRIFLUOROETHYLENE

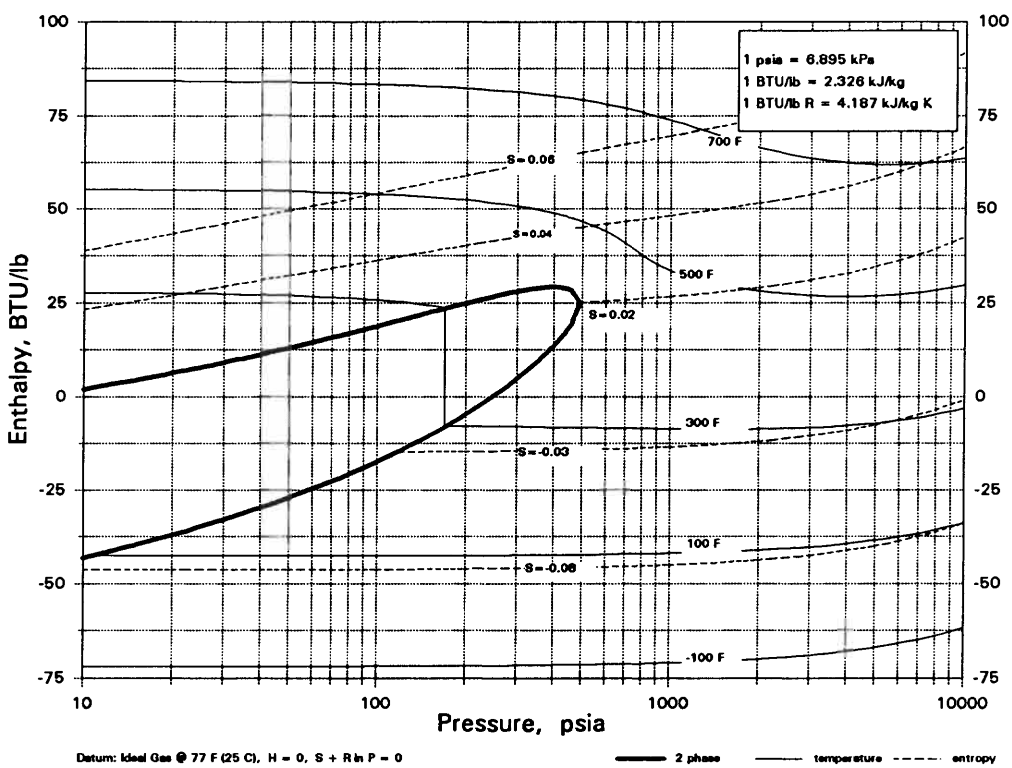




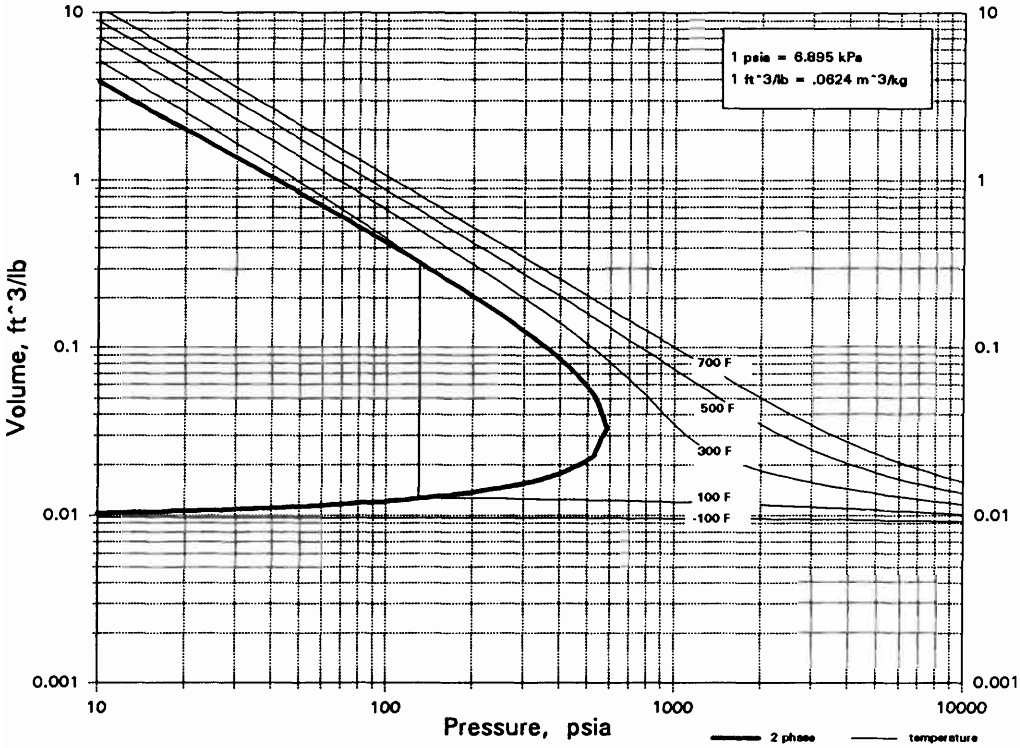
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

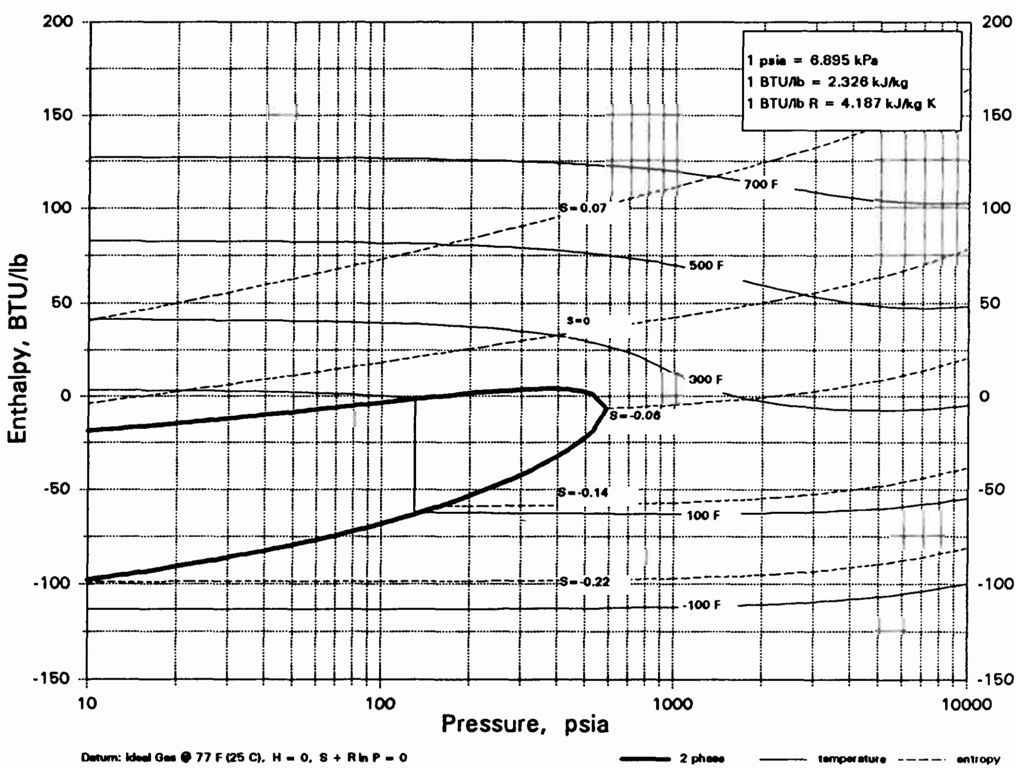
C2Br2F4 1-2-DIBROMOTETRAFLUOROETHANE



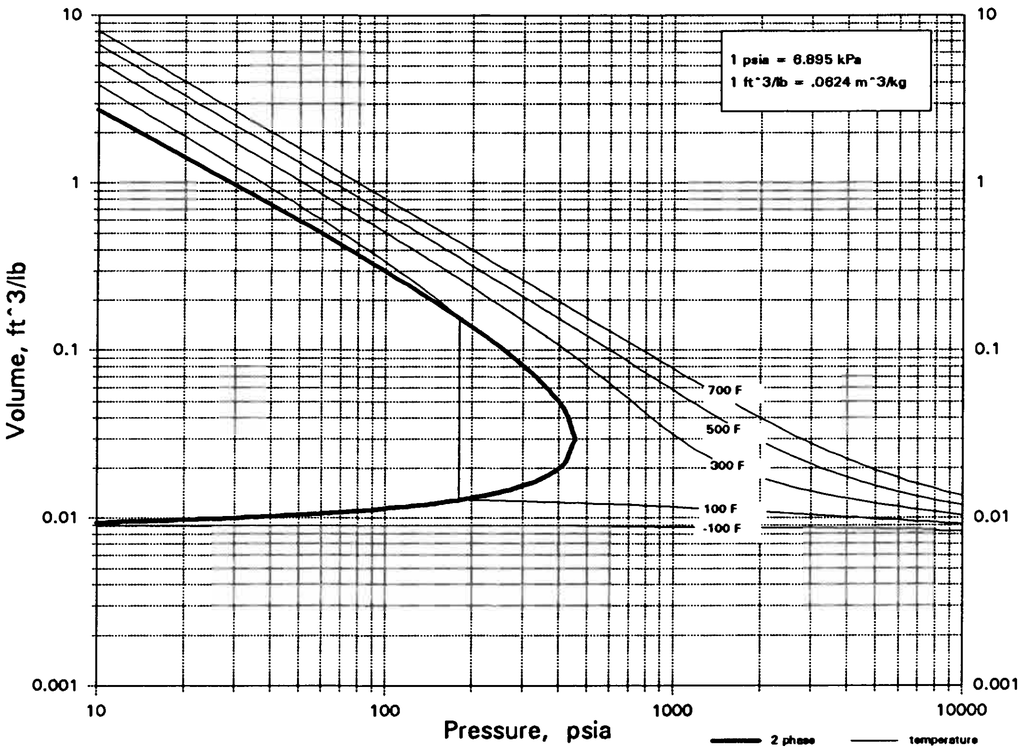


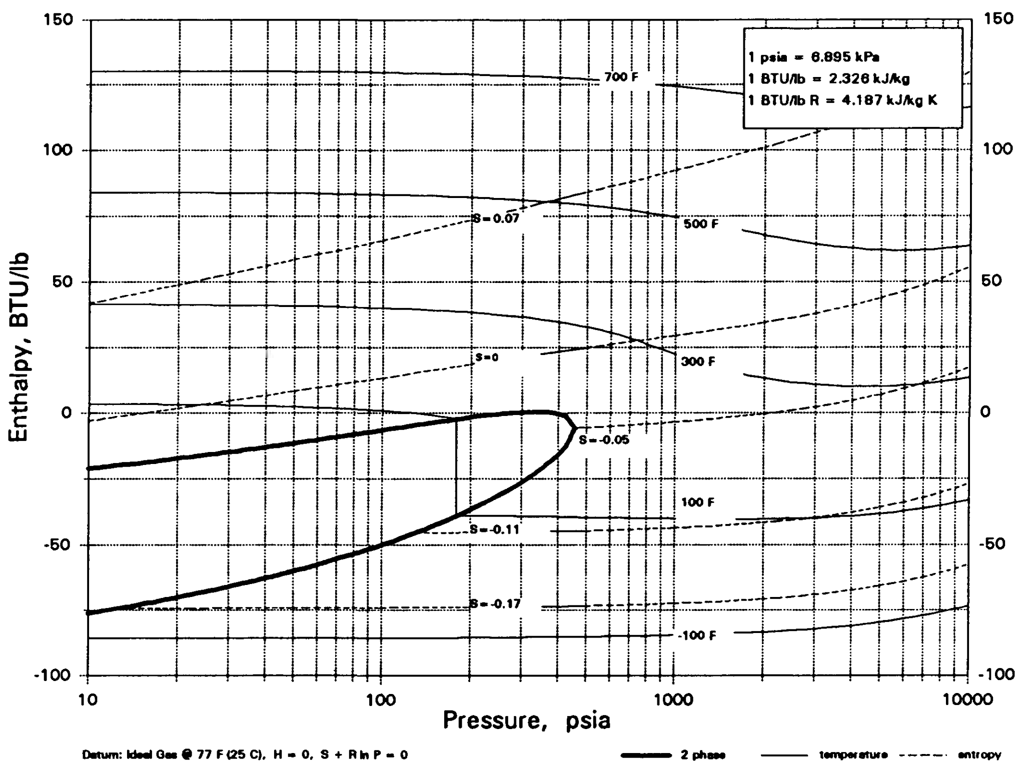
C2ClF3 CHLOROTRIFLUOROETHYLENE



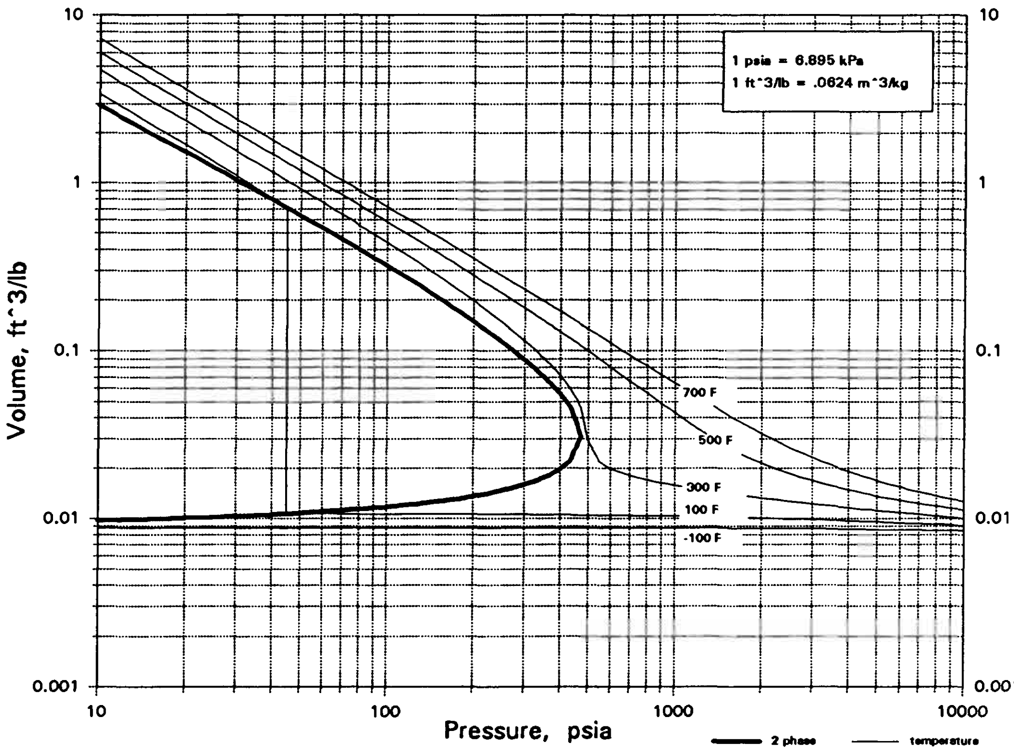


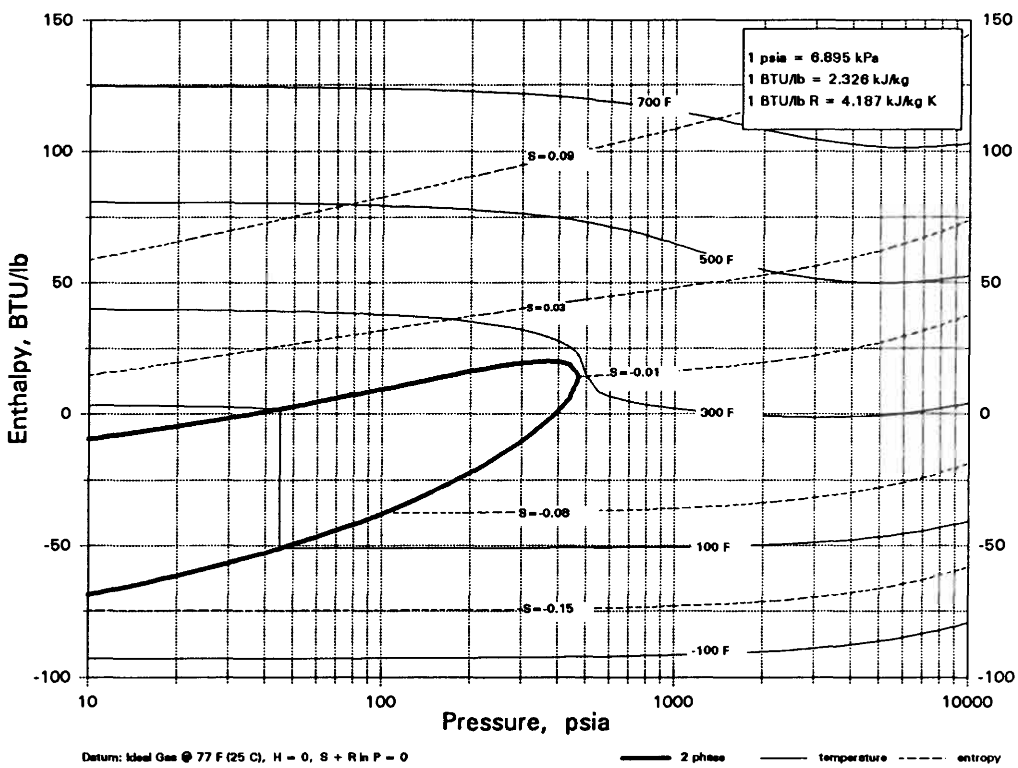
C2ClF5 CHLOROPENTAFLUOROETHANE



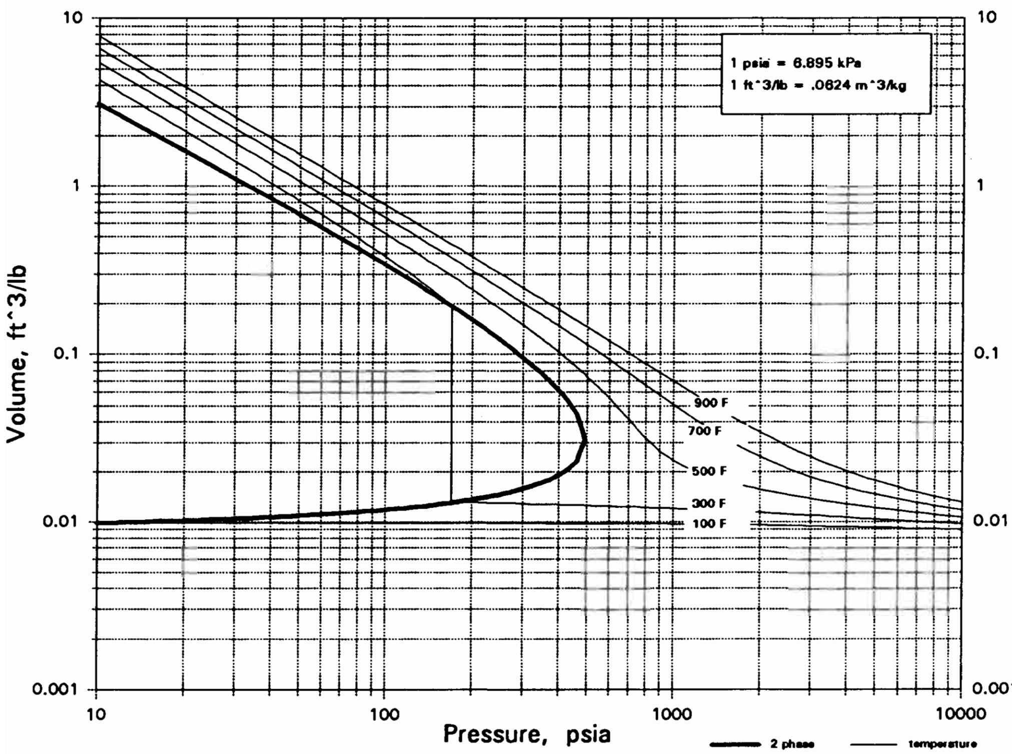


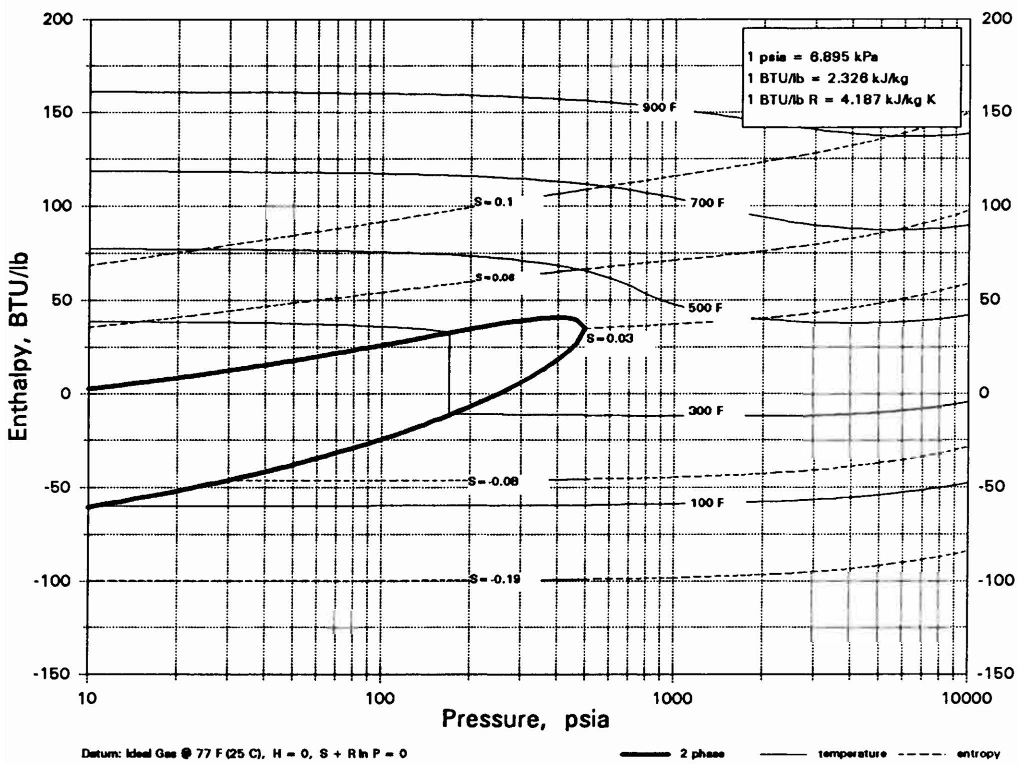
C2Cl2F4 1-2-DICHLOROTETRAFLUOROETHANE



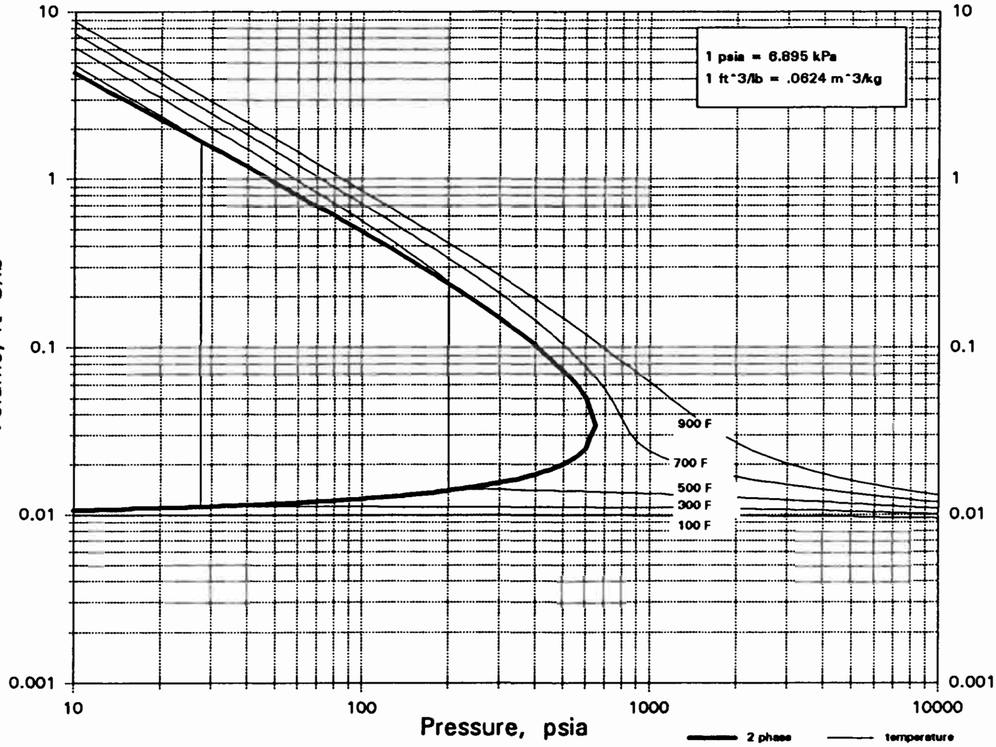


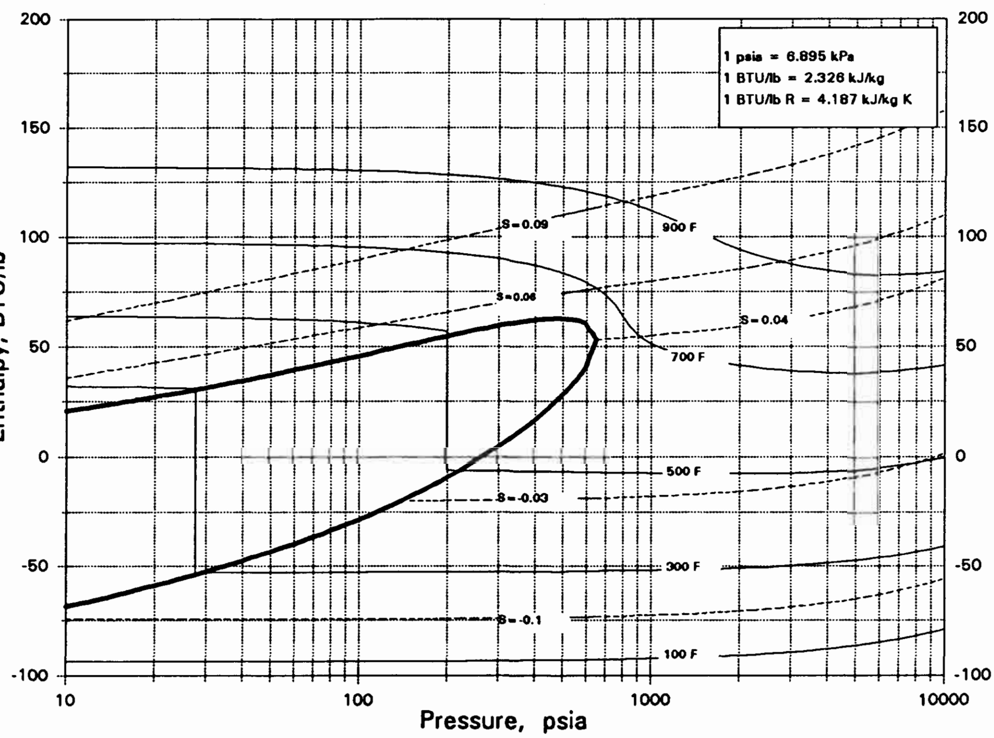
$C_2Cl_3F_3$ 1-1-2-TRICHLOROTRIFLUOROETHANE





C2Cl4 TETRACHLOROETHYLENE

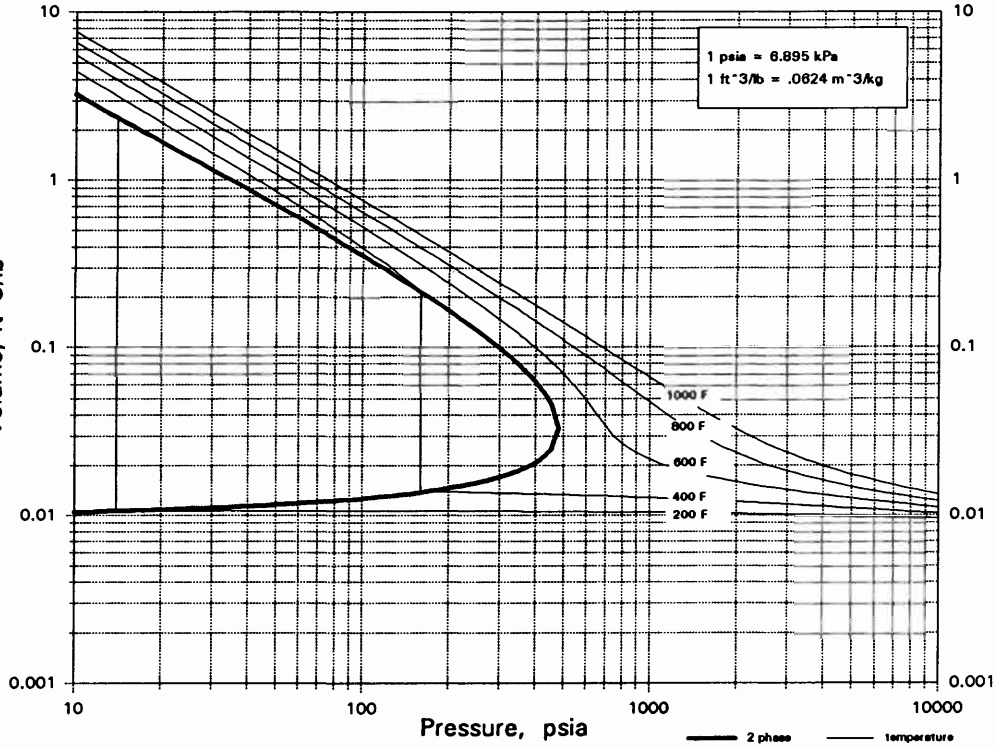


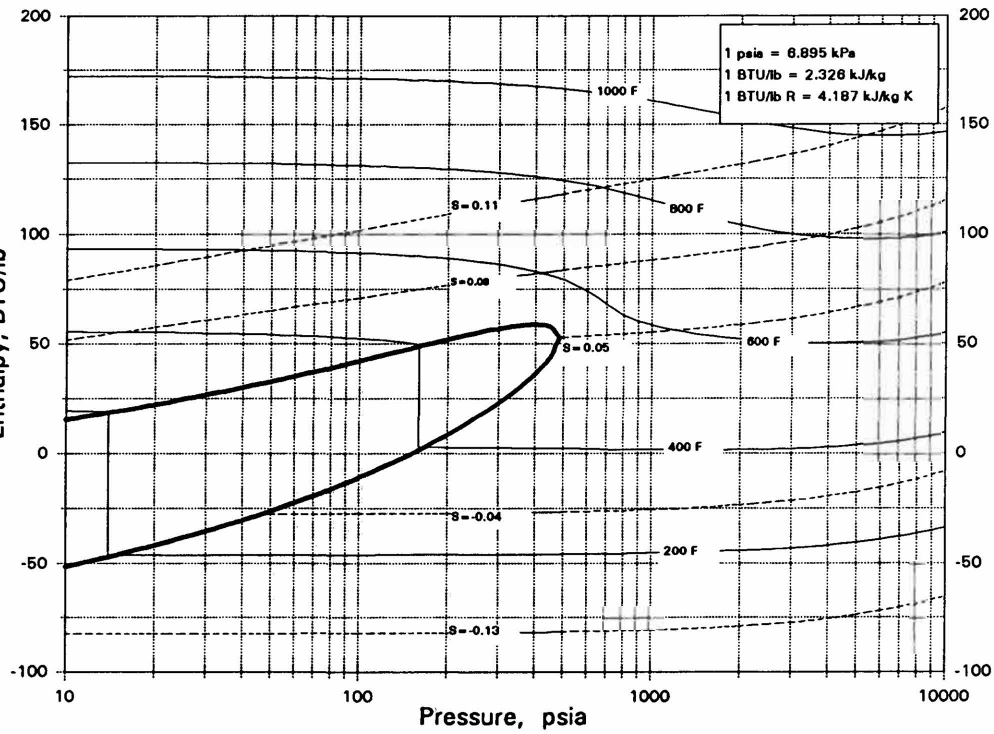


Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

2 phase —— temperature - - - - entropy

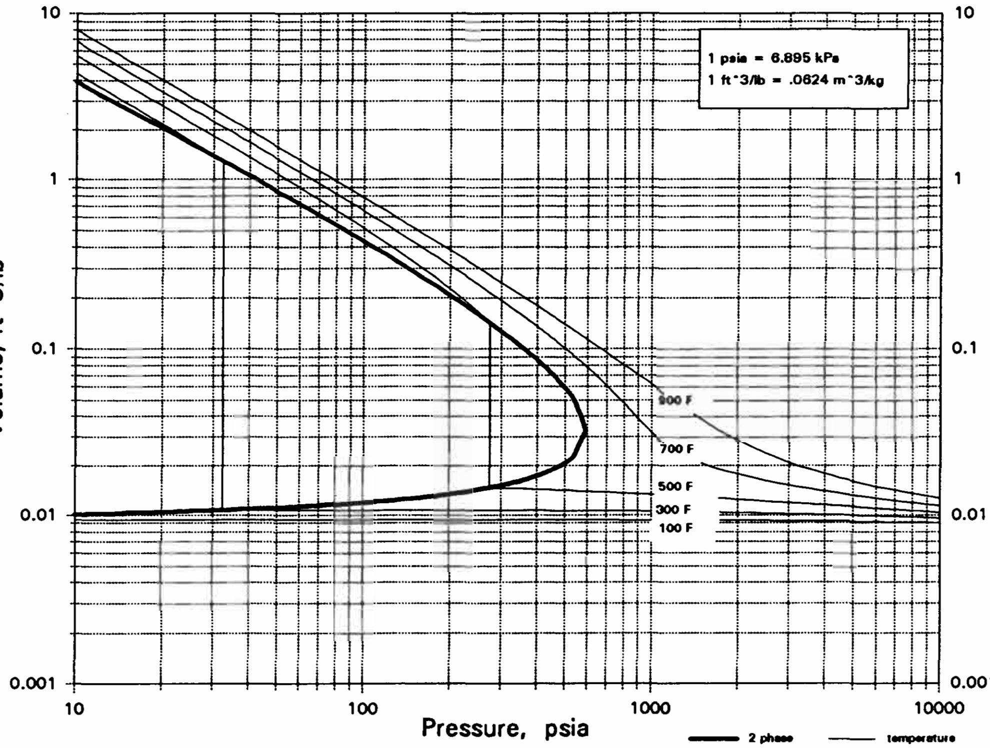
C2Cl4F2 1-1-2-2-TETRACHLORODIFLUOROETHANE

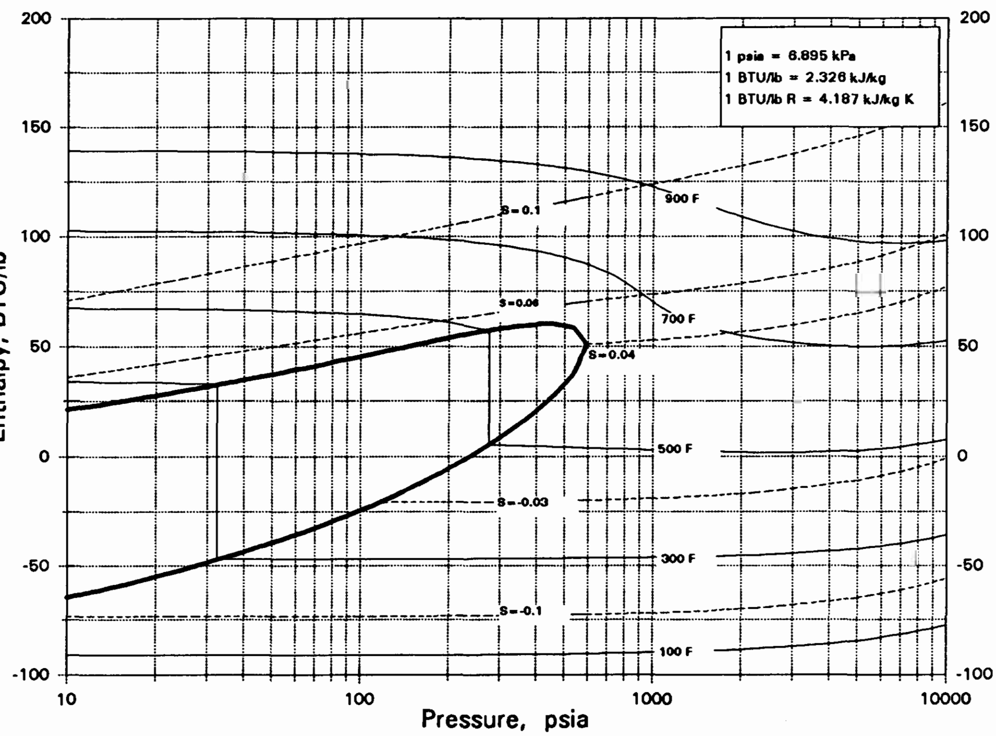




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

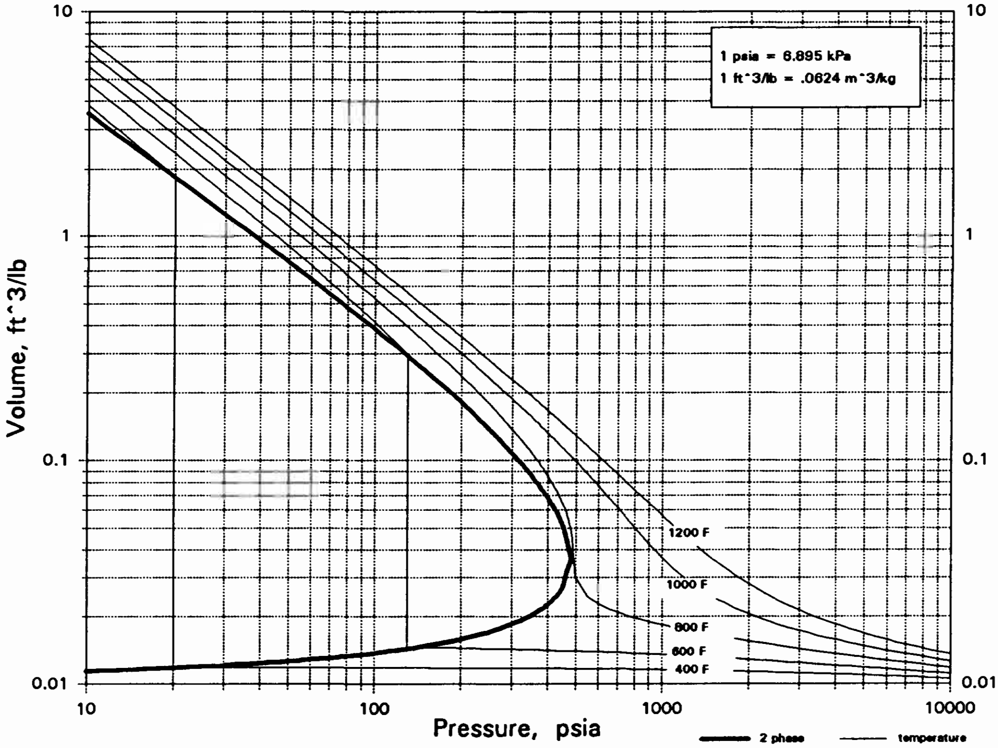
C2Cl4O TRICHLOROACETYL CHLORIDE

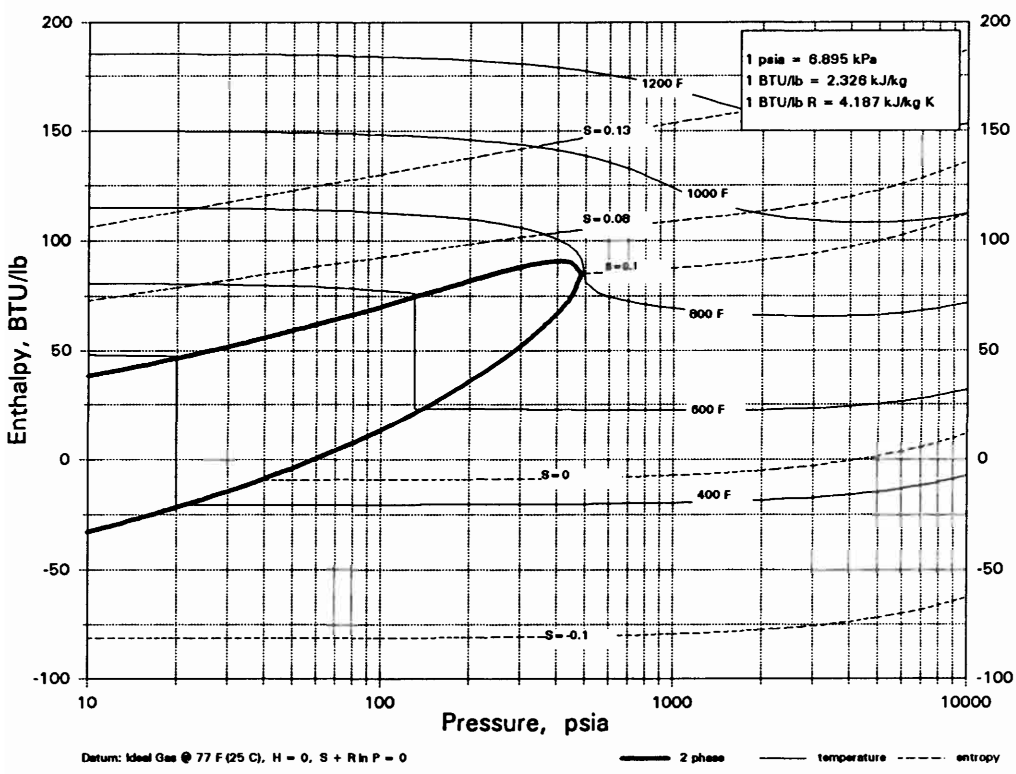




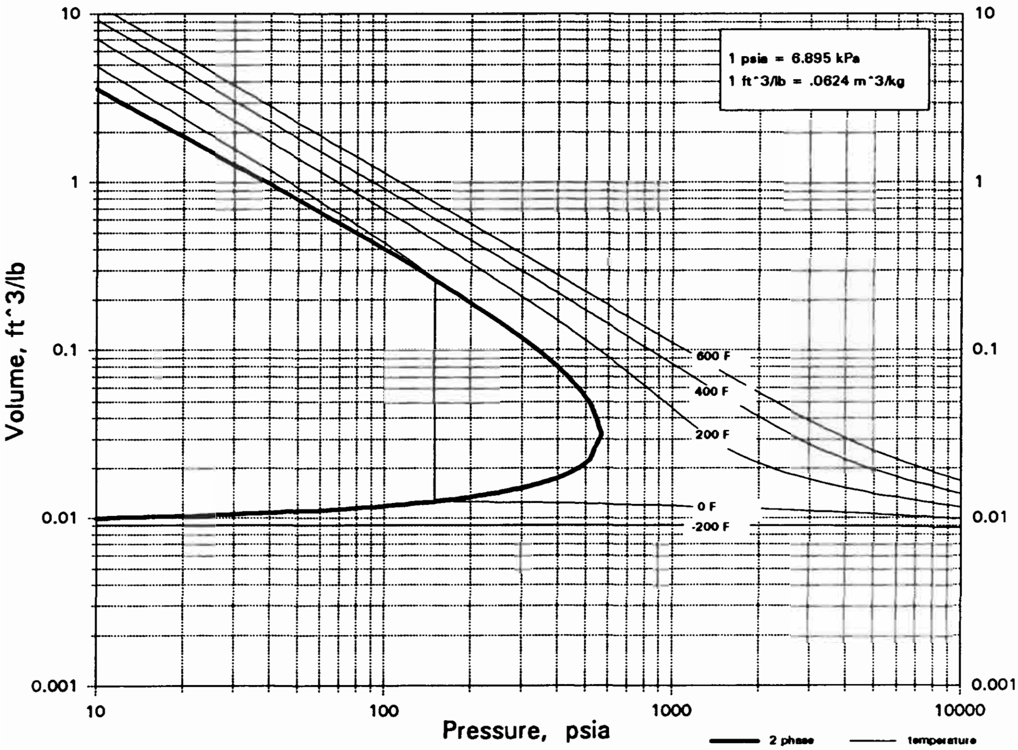
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

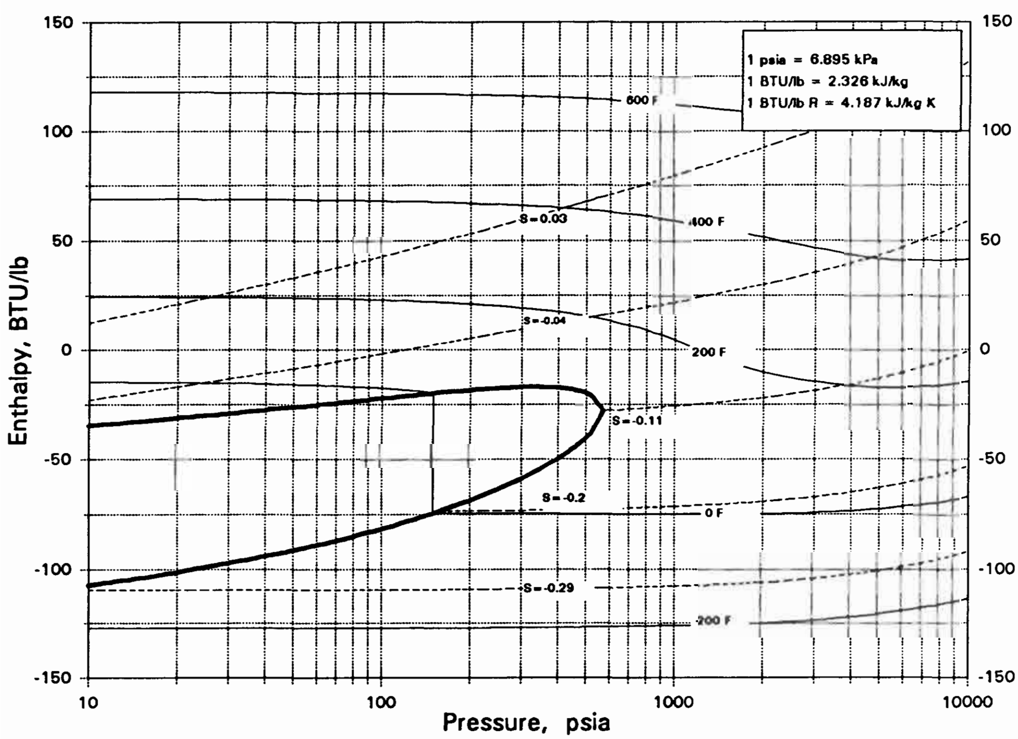
C2Cl6 HEXACHLOROETHANE





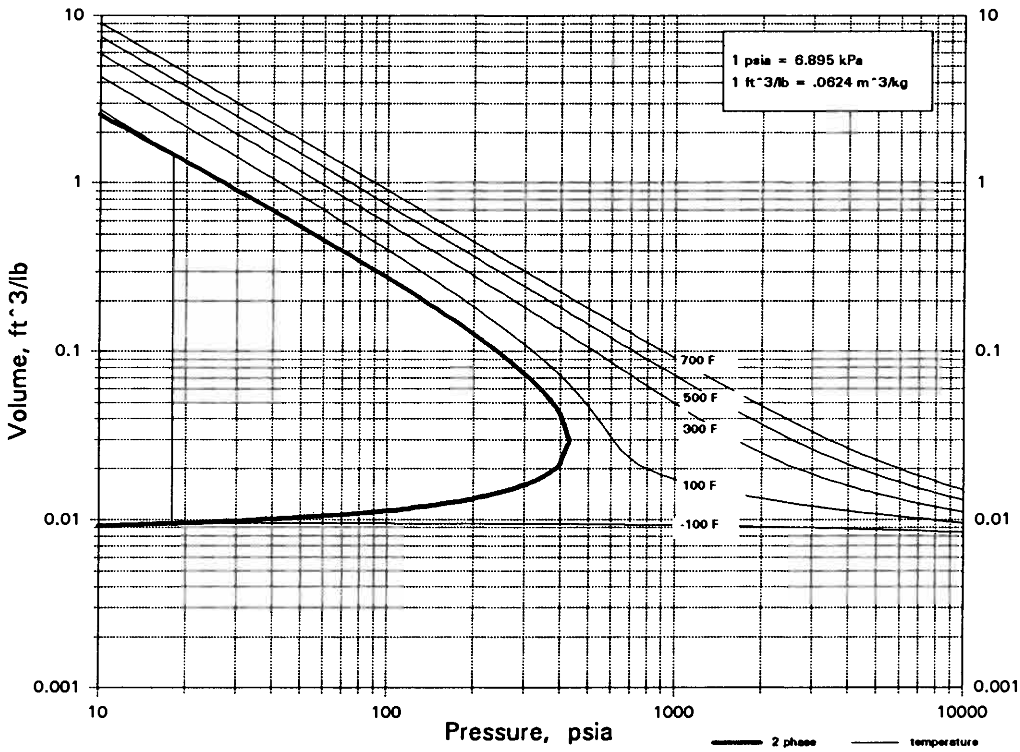
C2F4 TETRAFLUOROETHYLENE

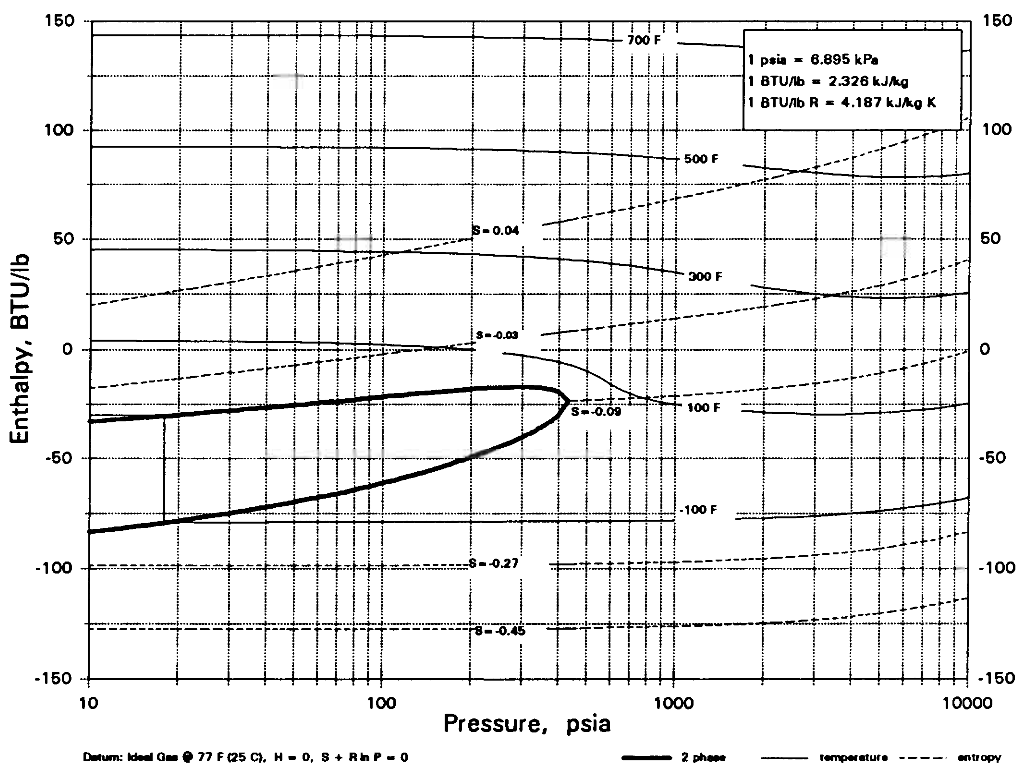




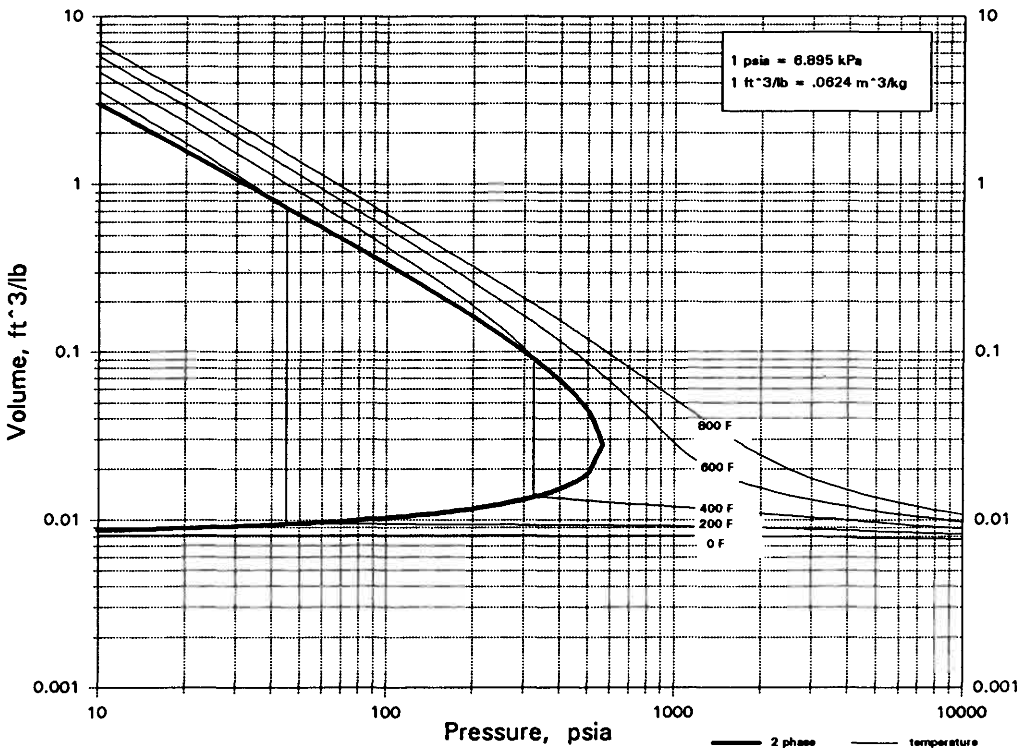
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

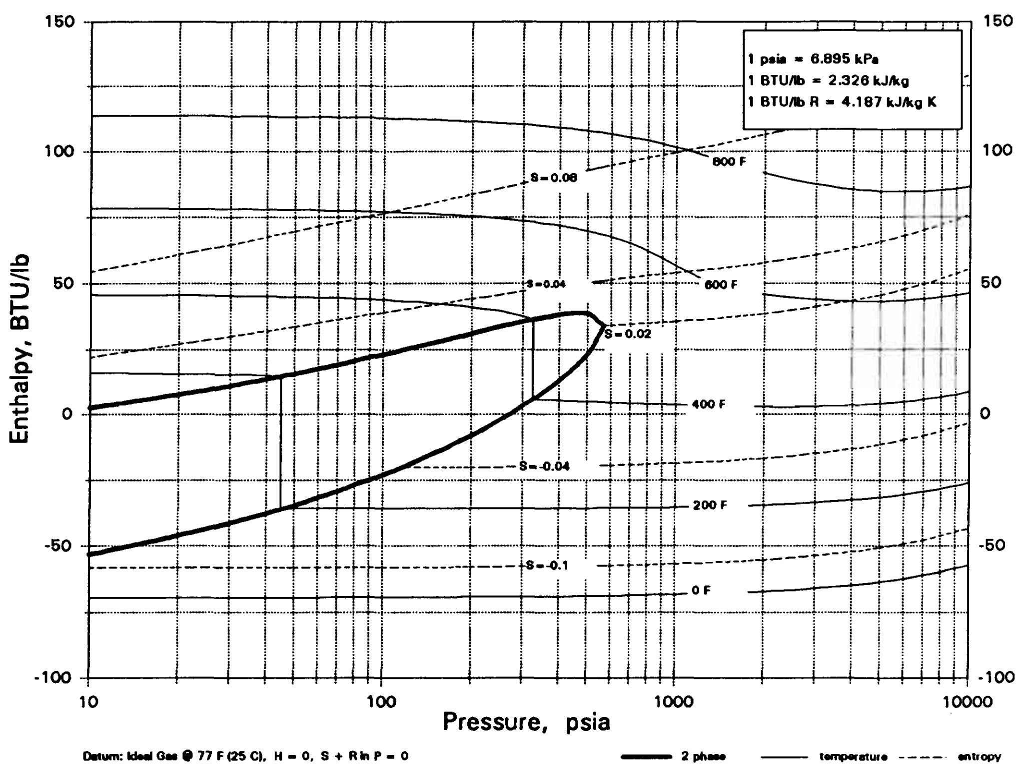
C2F6 HEXAFLUOROETHANE



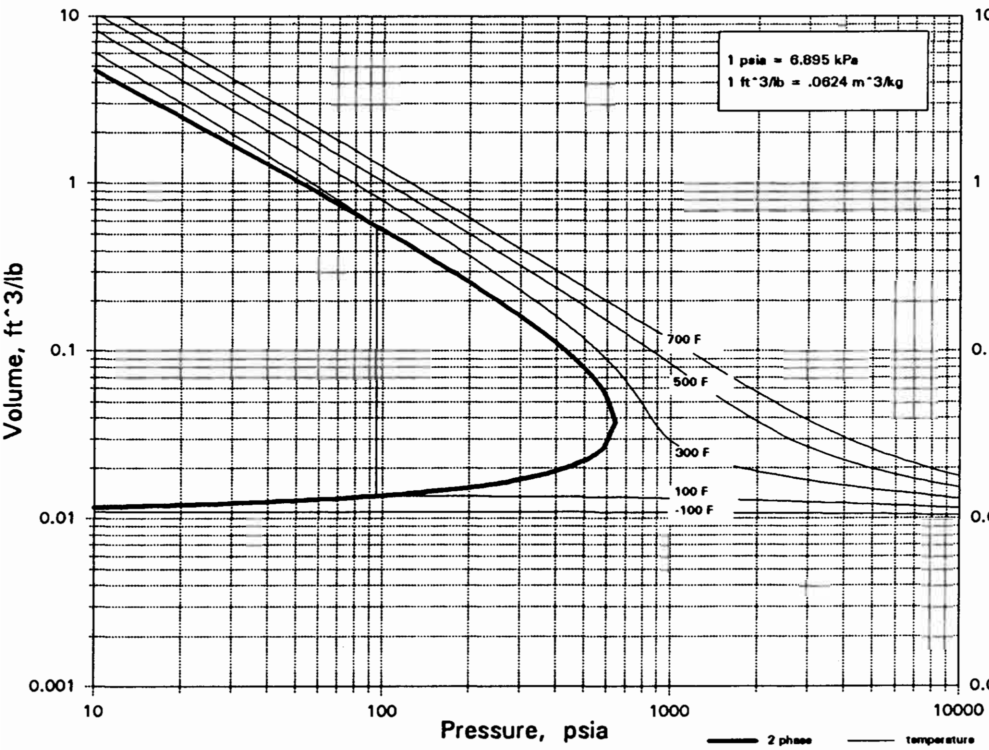


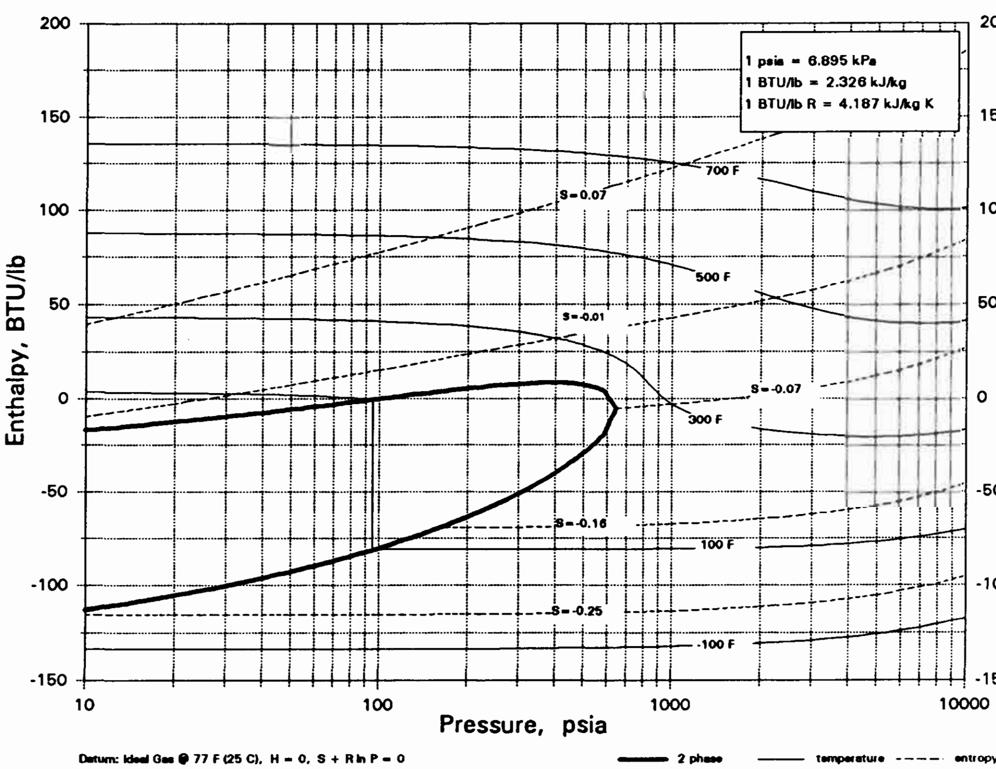
C2HBrClF3 HALOTHANE



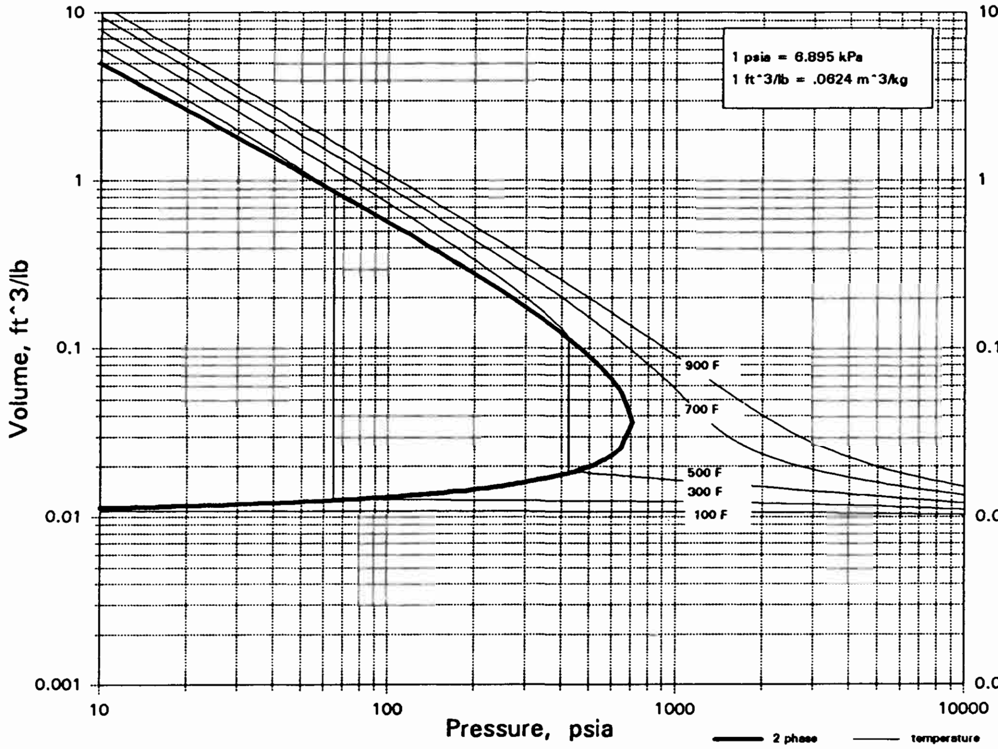


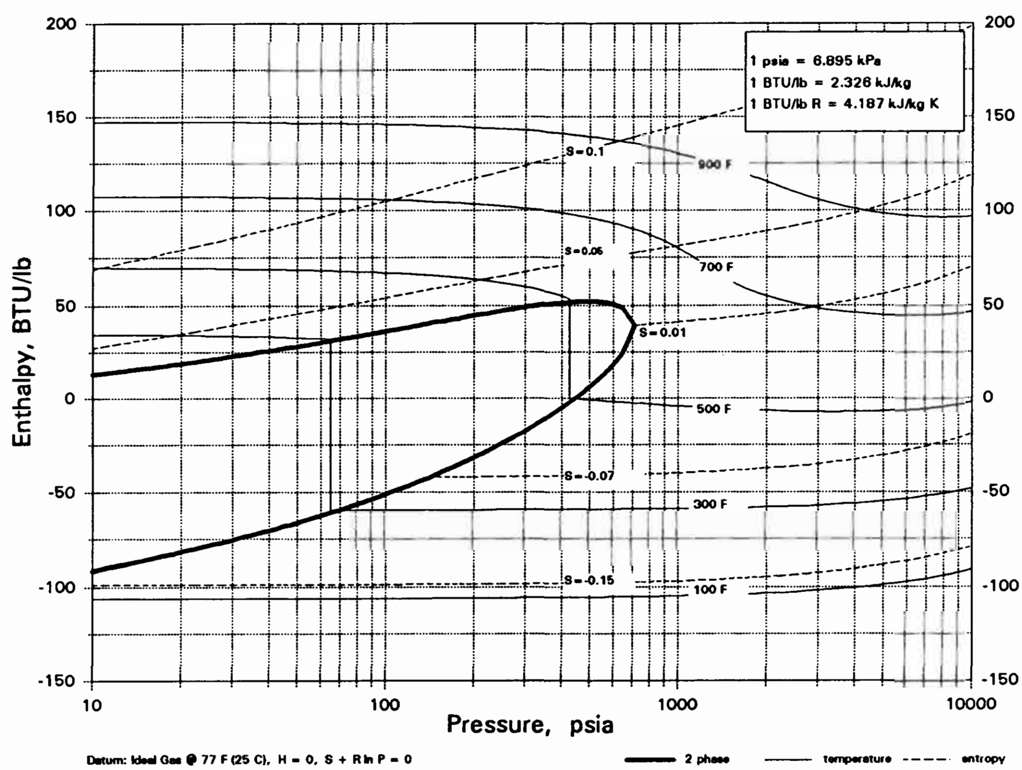
C2HClF2 2-CHLORO-1-1-DIFLUOROETHYLENE



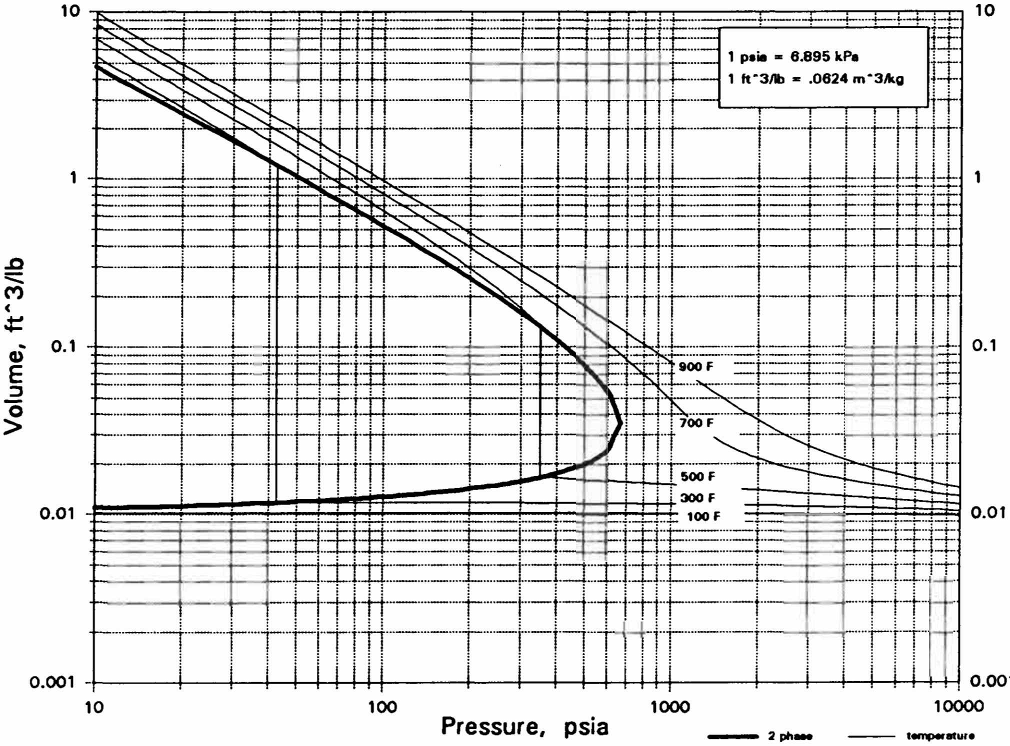


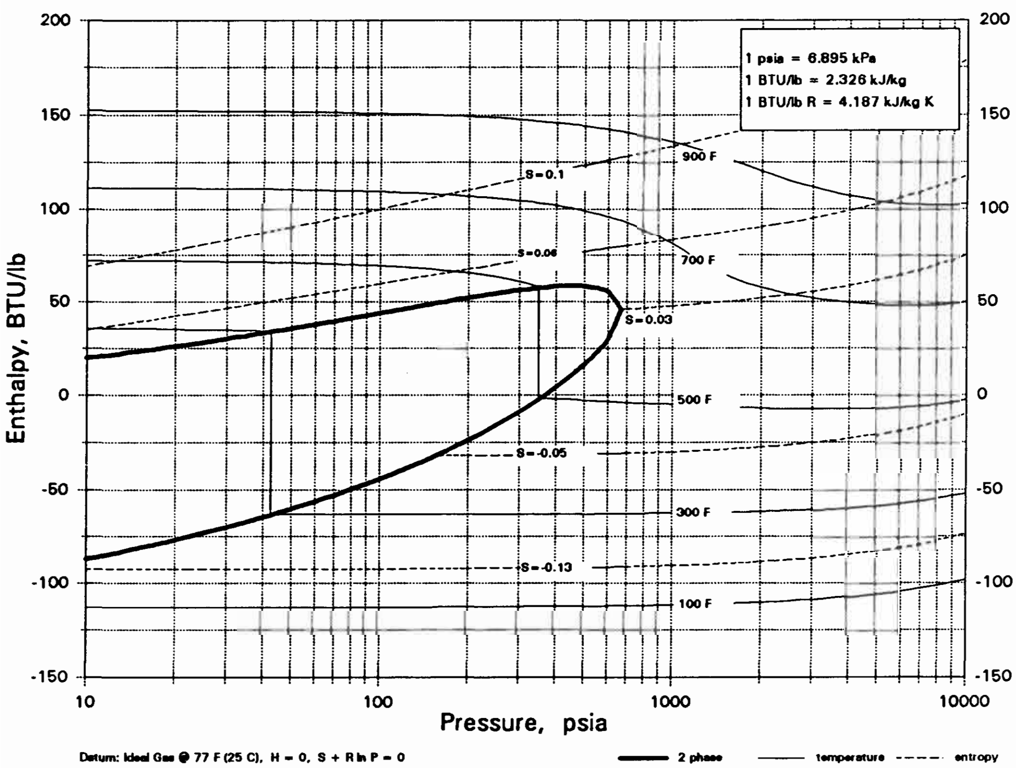
C2HCl3 TRICHLOROETHYLENE



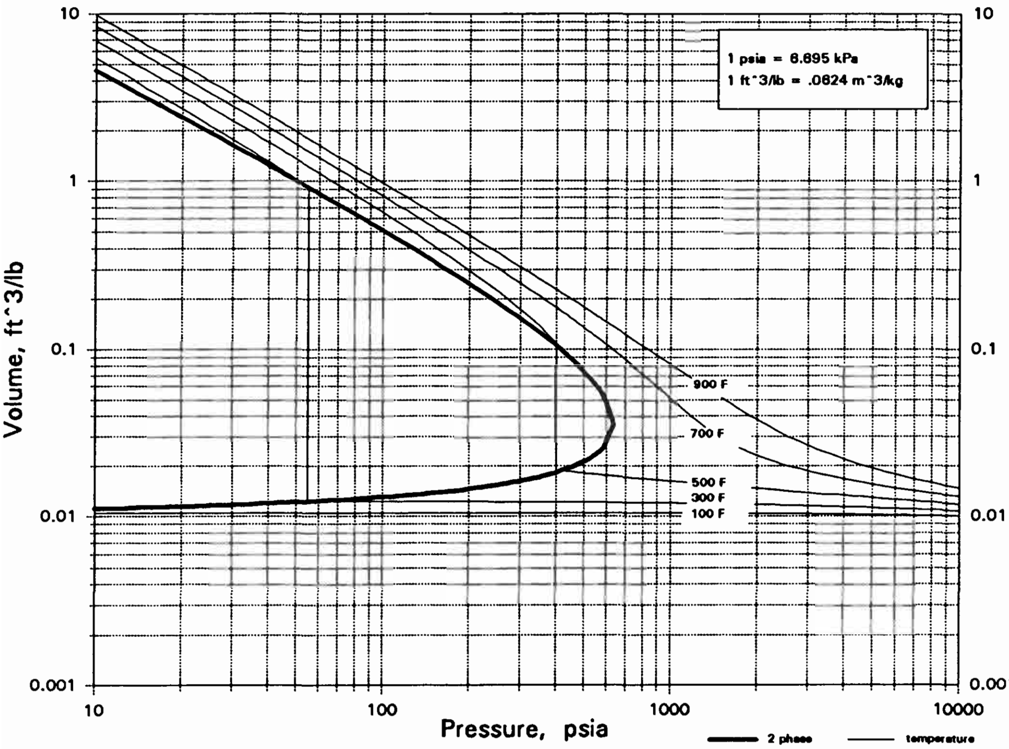


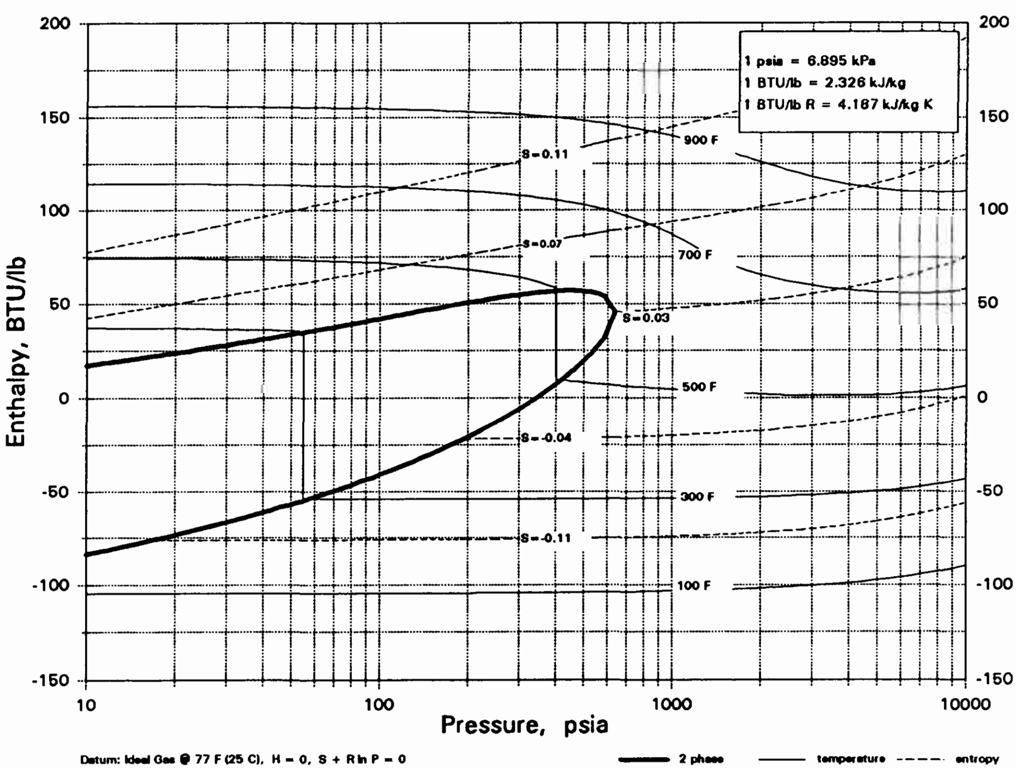
C2HCl3O DICHLOROACETYL CHLORIDE



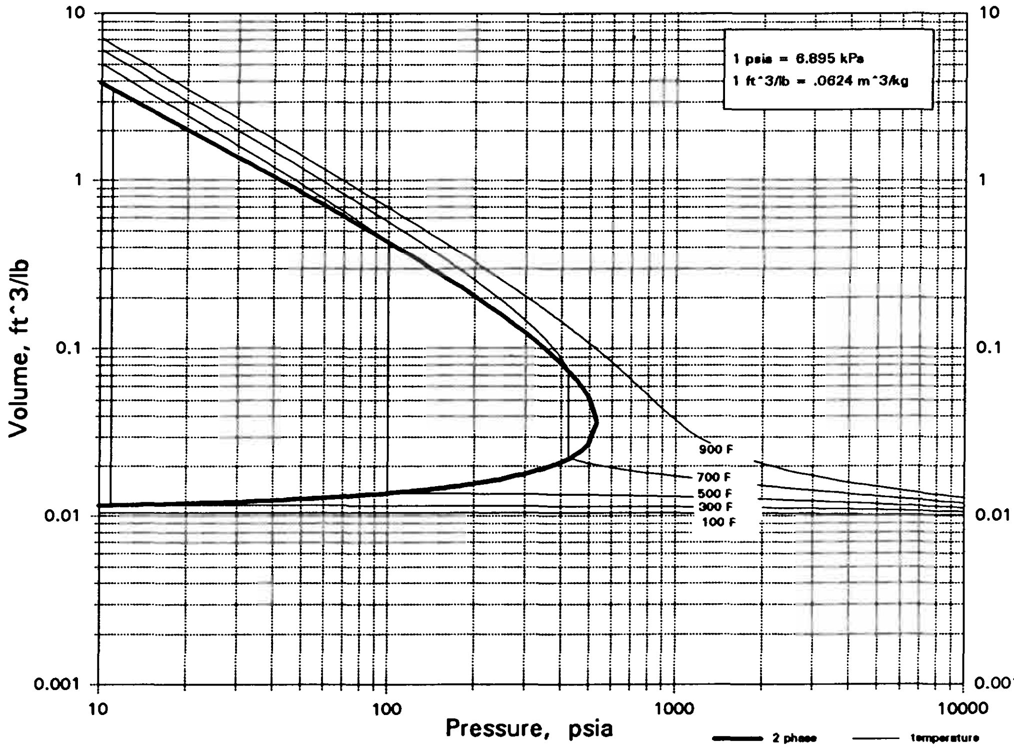


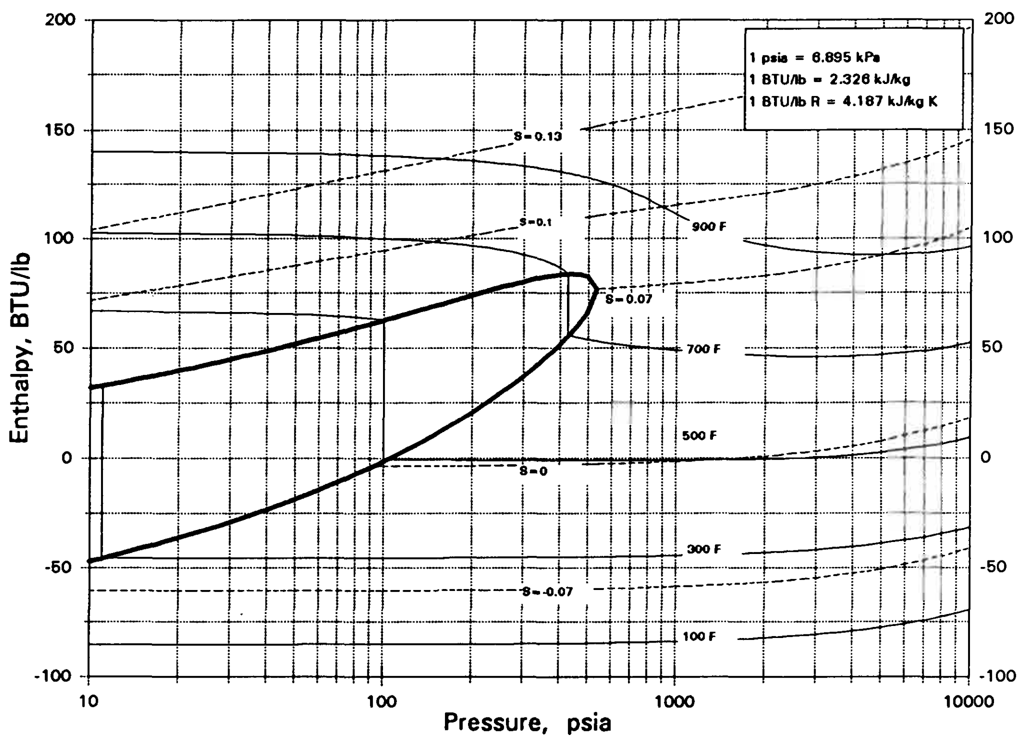
C2HCl3O TRICHLOROACETALDEHYDE





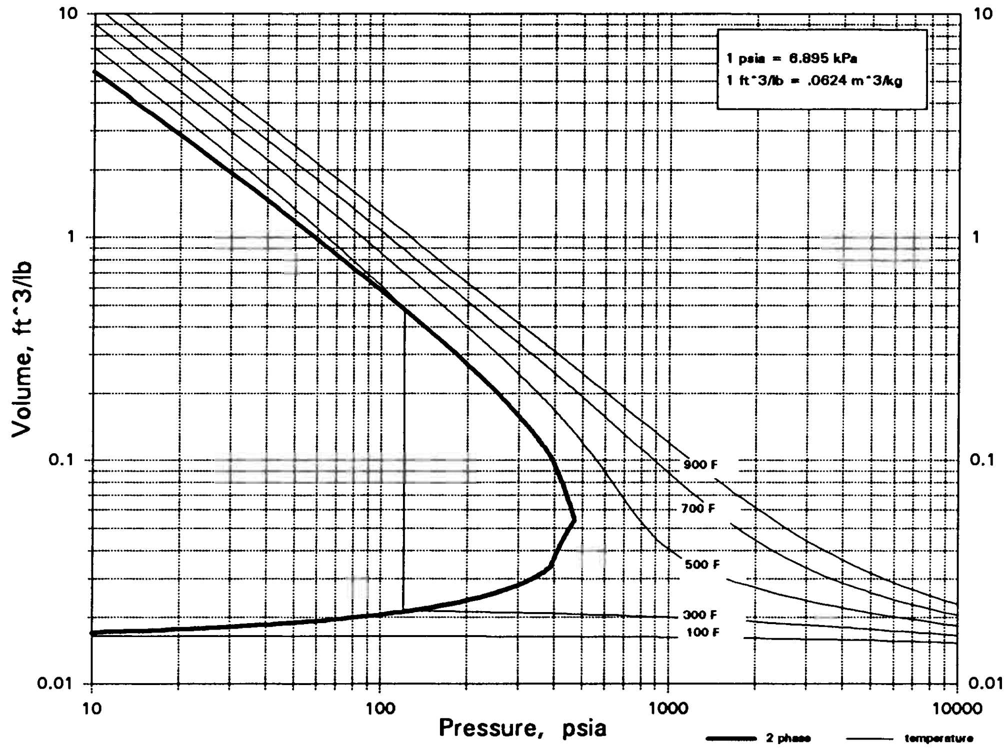
C2HCl5	PENTACHLOROETHANE

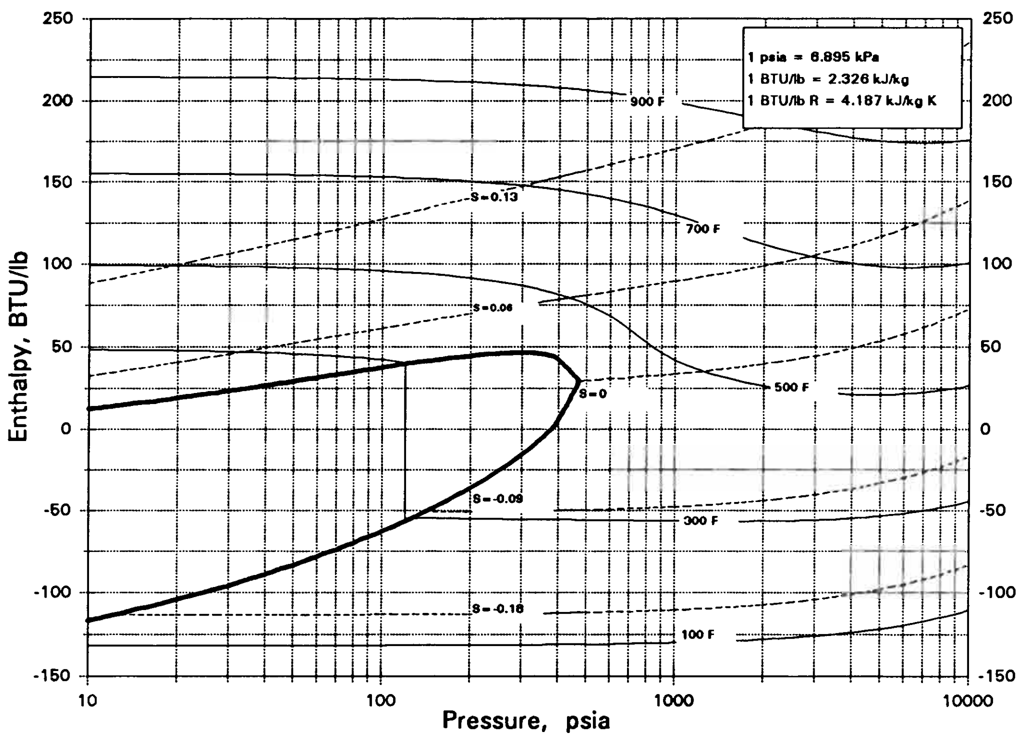




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

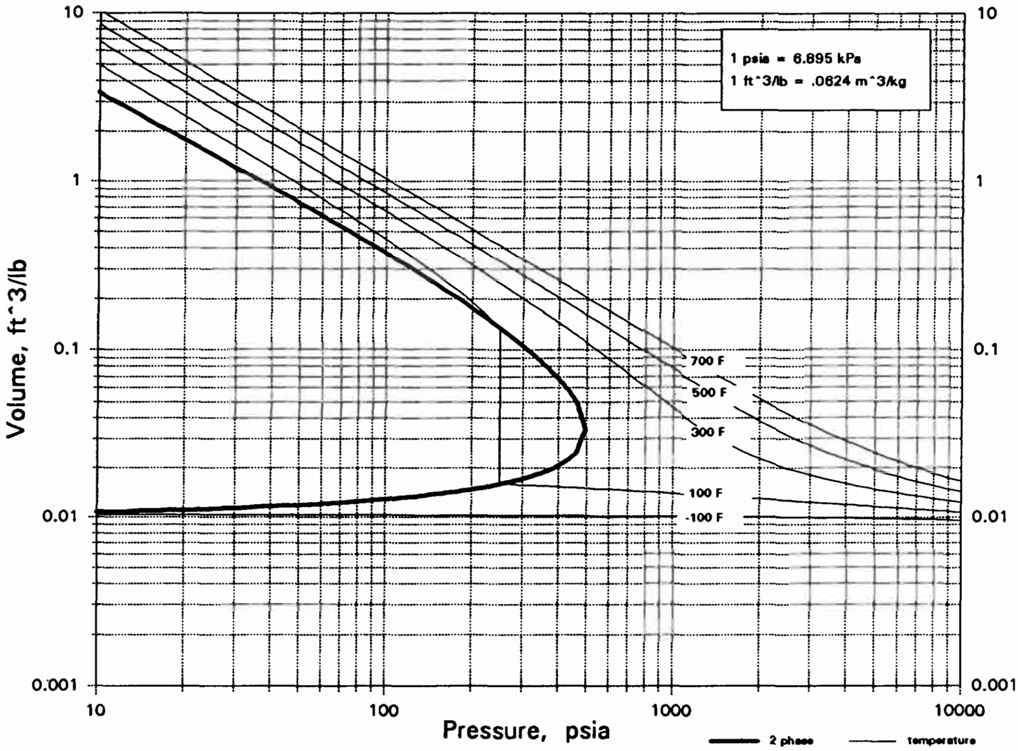
C2HF3O2 TRIFLUOROACETIC ACID

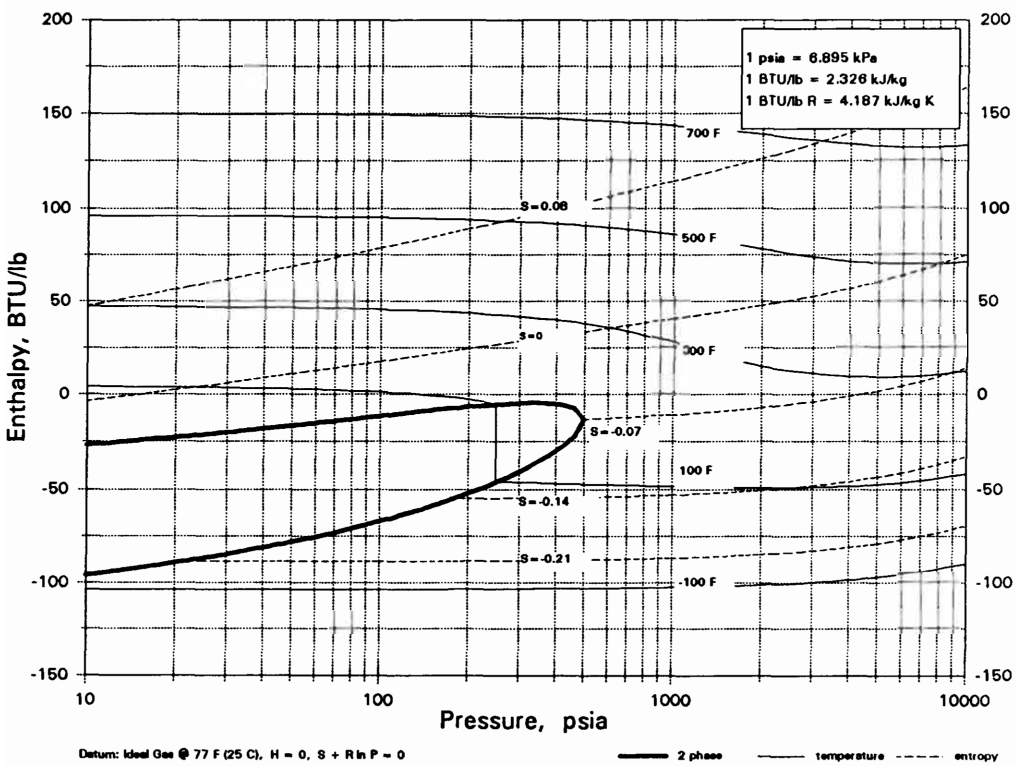




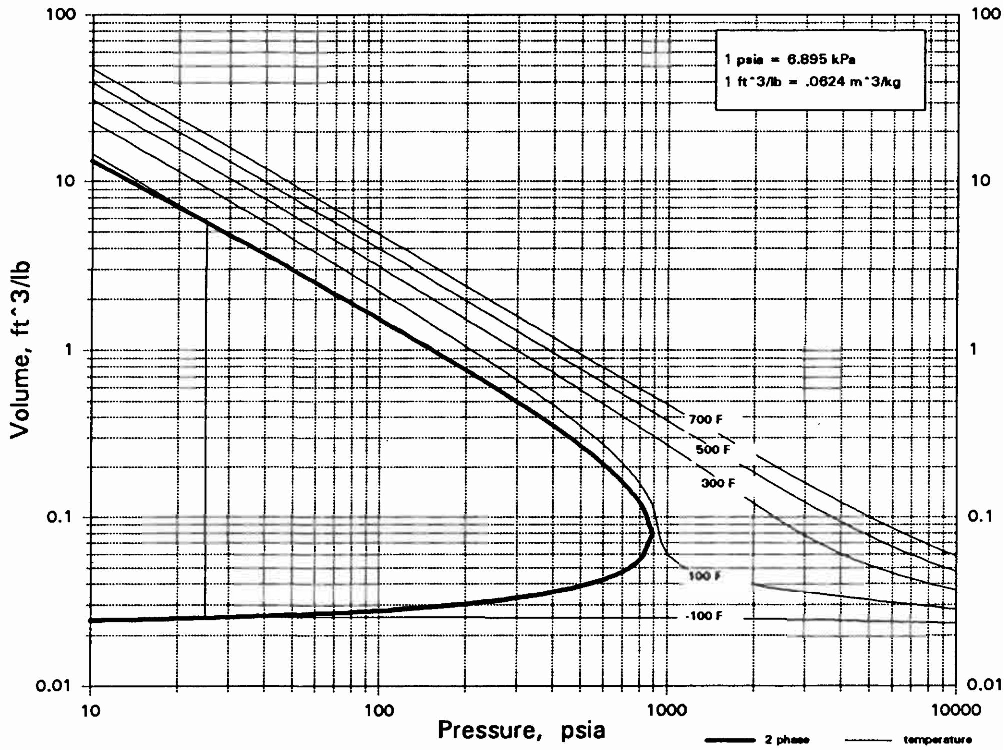
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

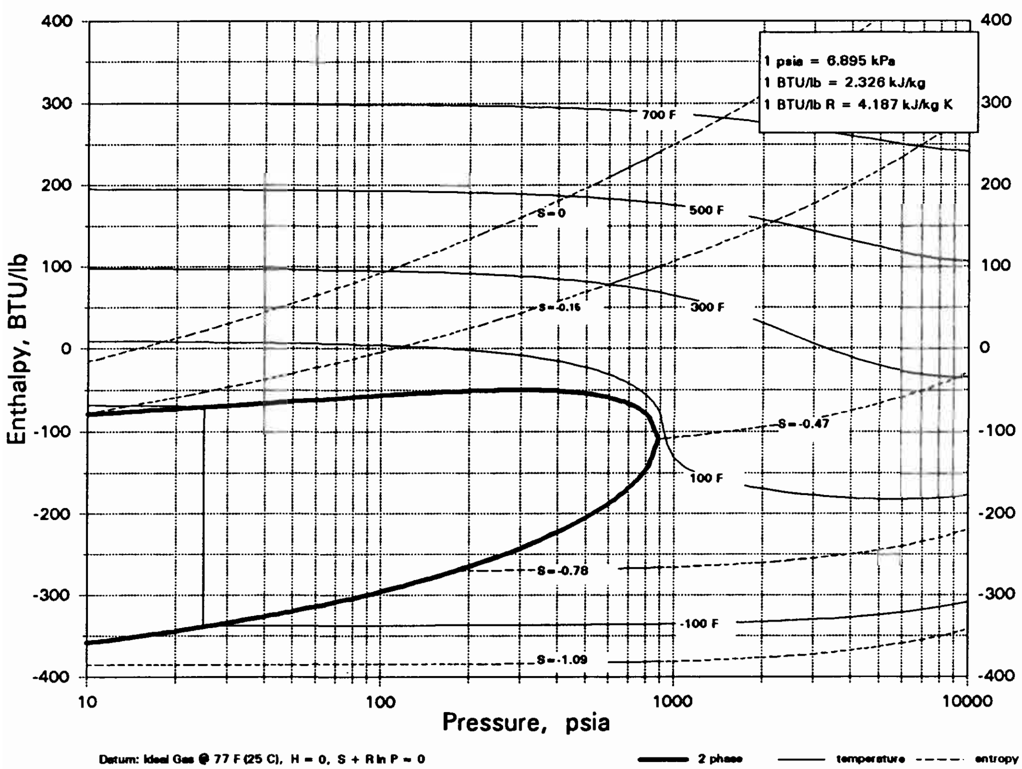
C2HF5 PENTAFLUOROETHANE



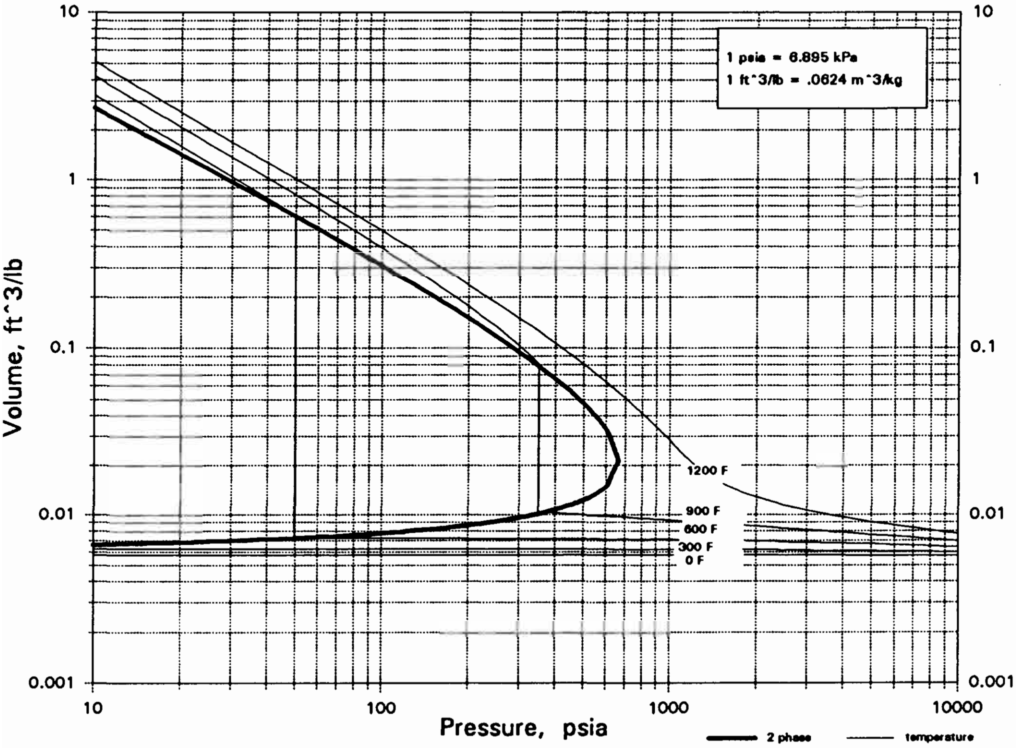


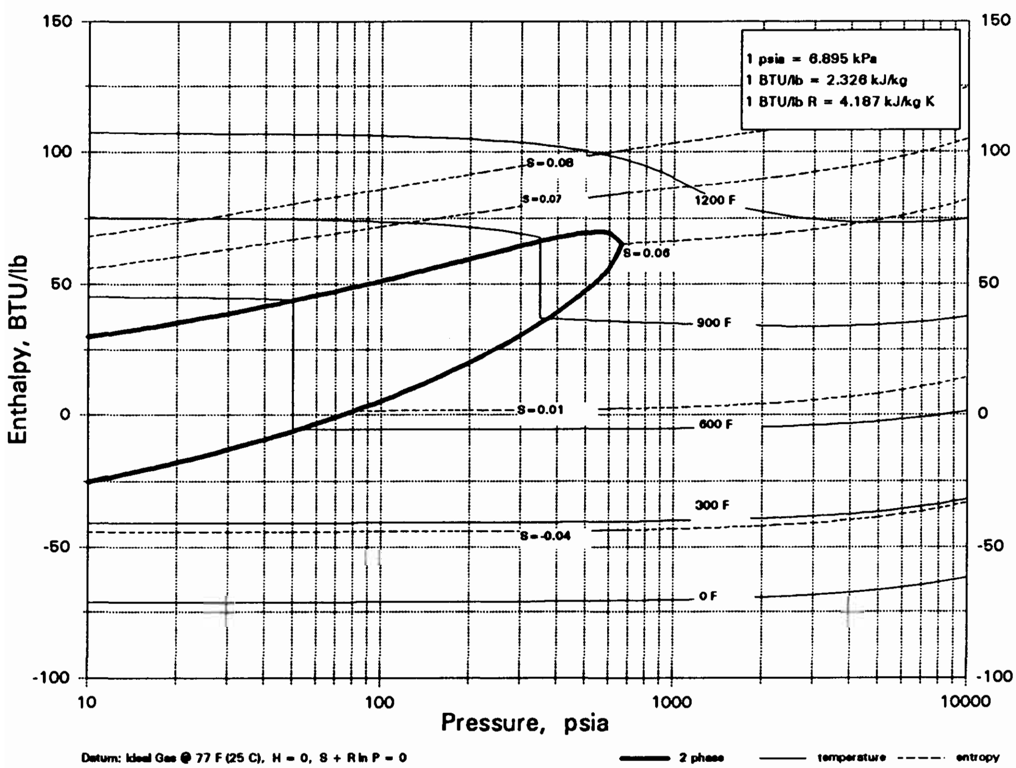
C2H2 ACETYLENE



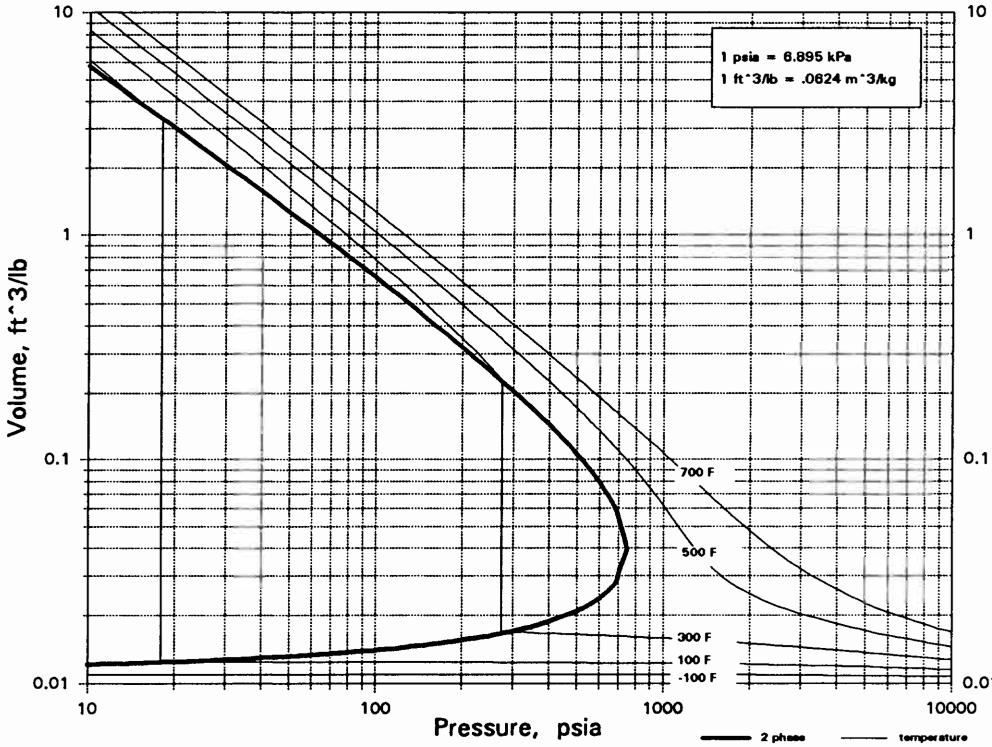


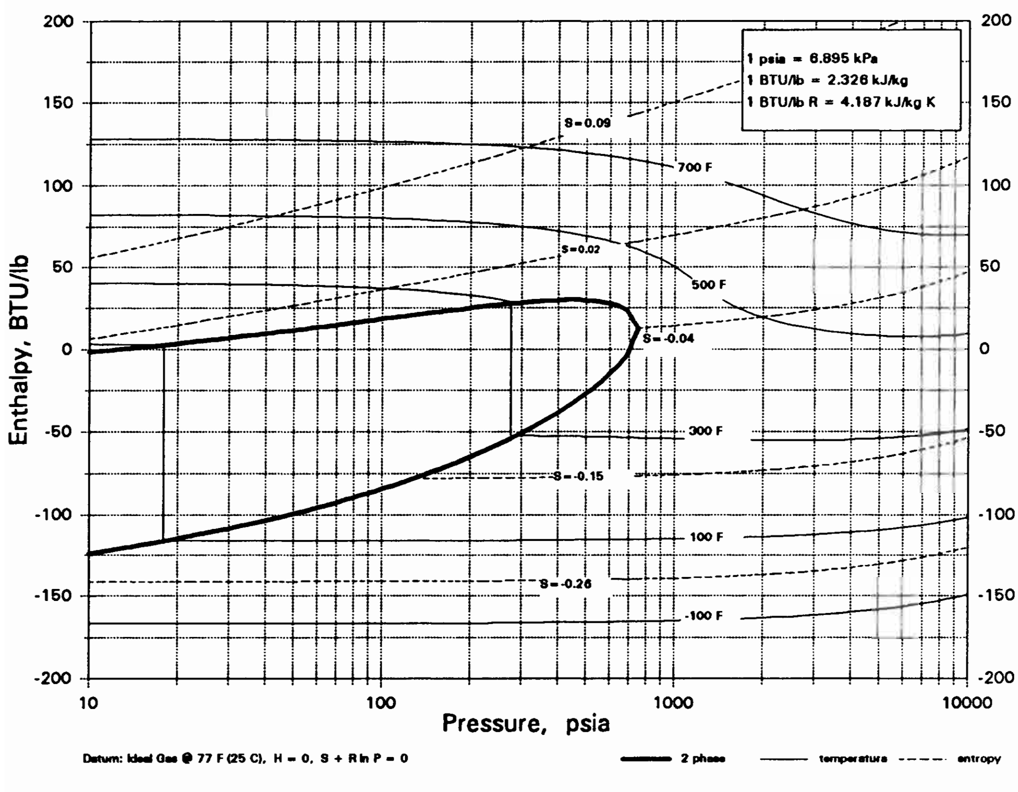
C2H2Br4 1-1-2-2-TETRABROMOETHANE



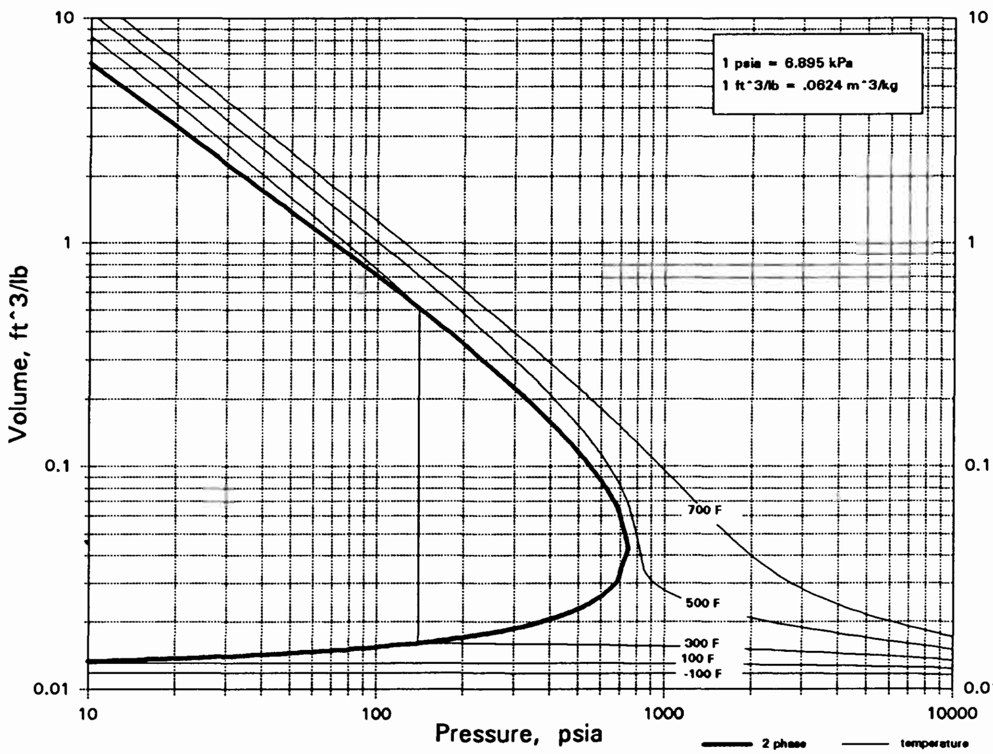


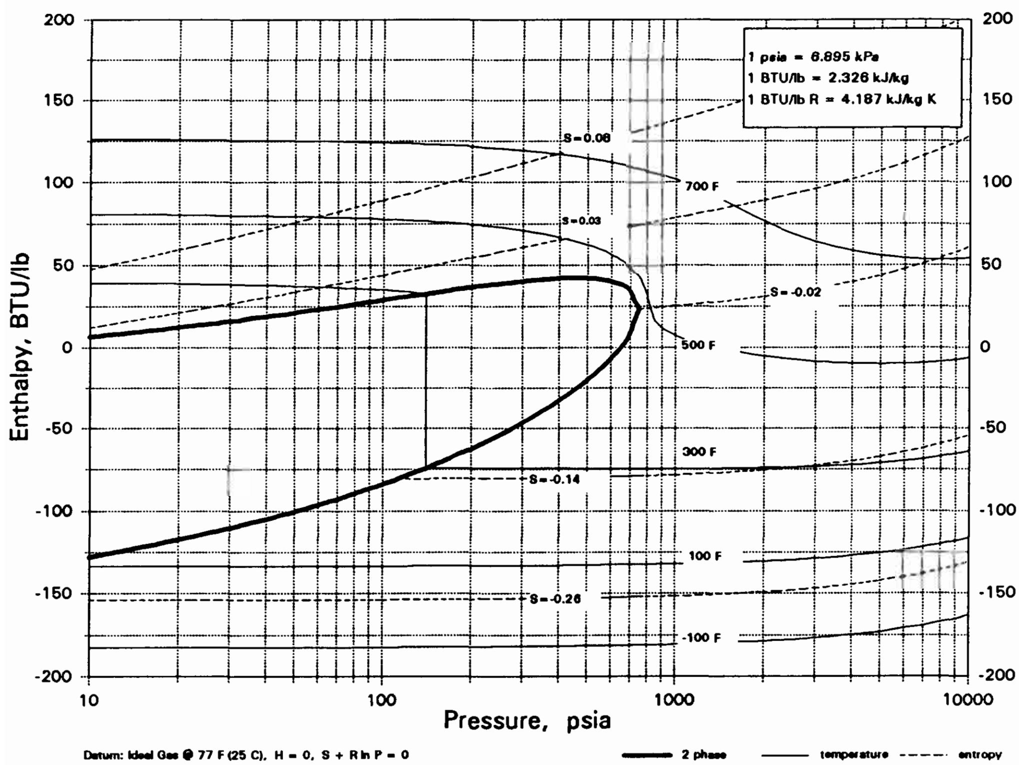
C2H2Cl2 1-1-DICHLOROETHYLENE



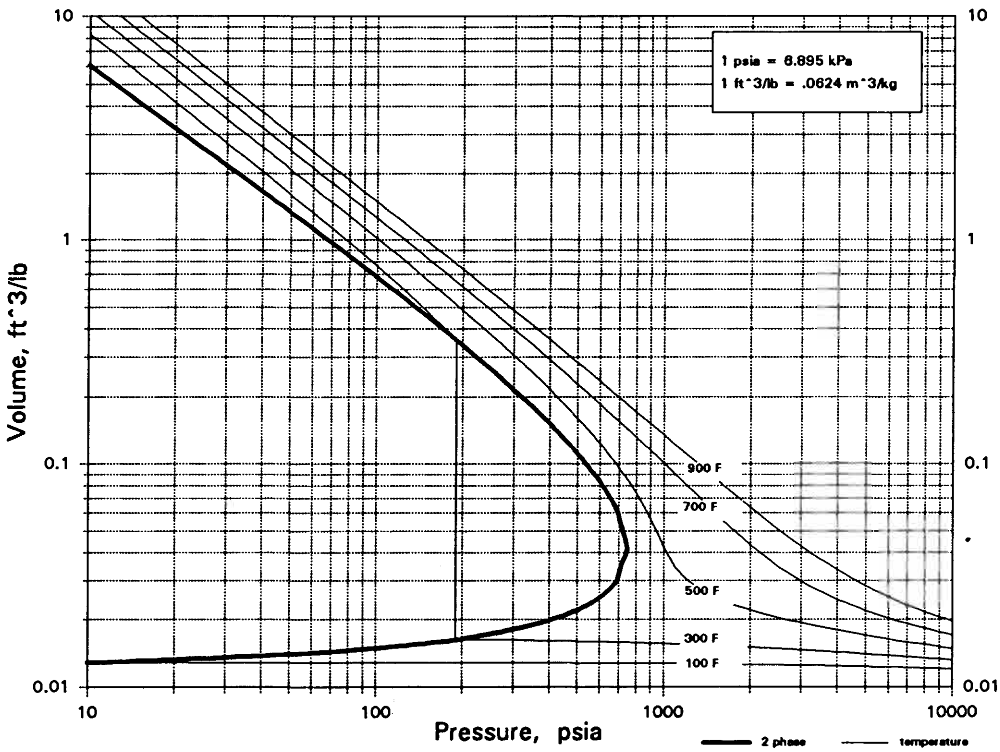


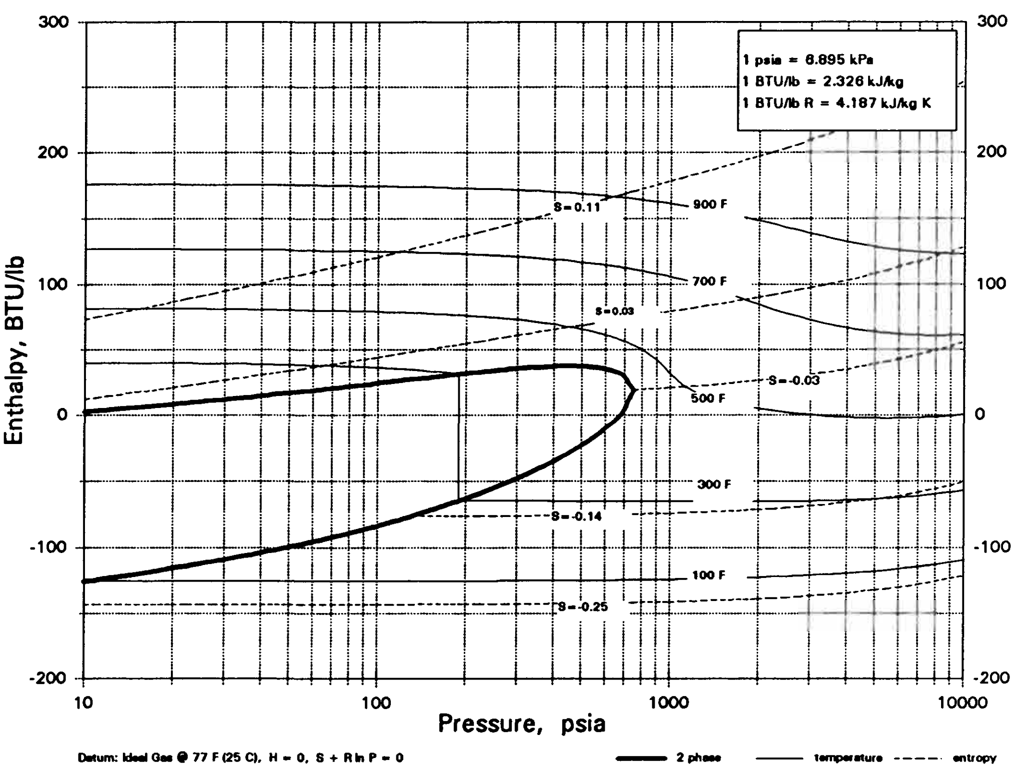
C2H2Cl2 cis-1-2-DICHLOROETHYLENE



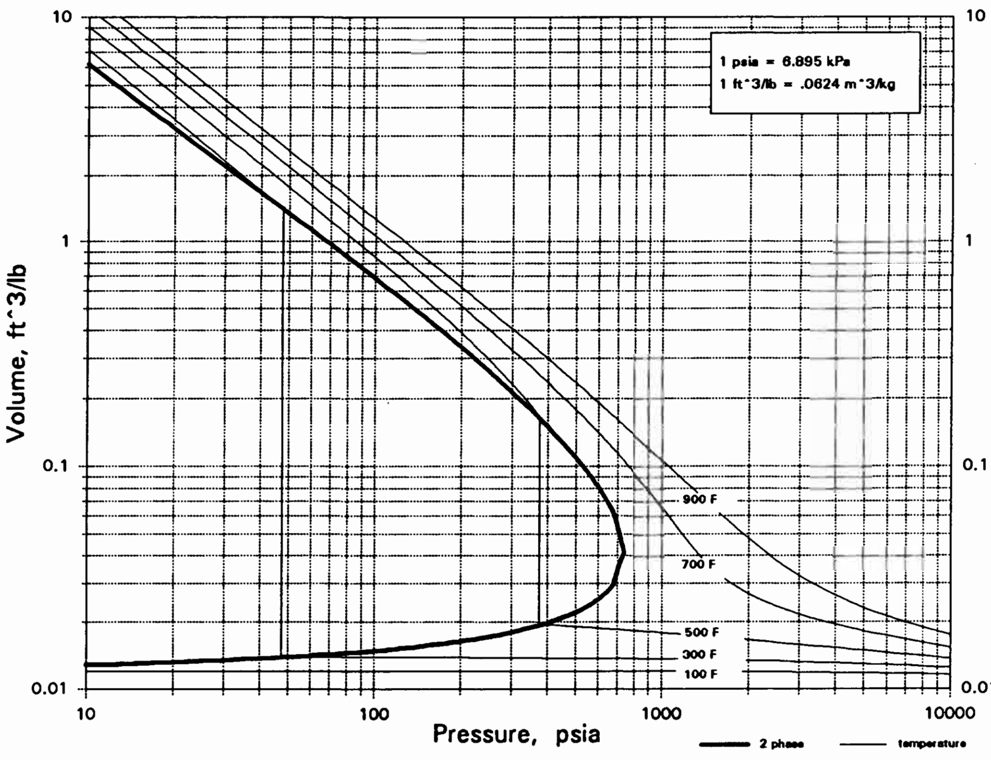


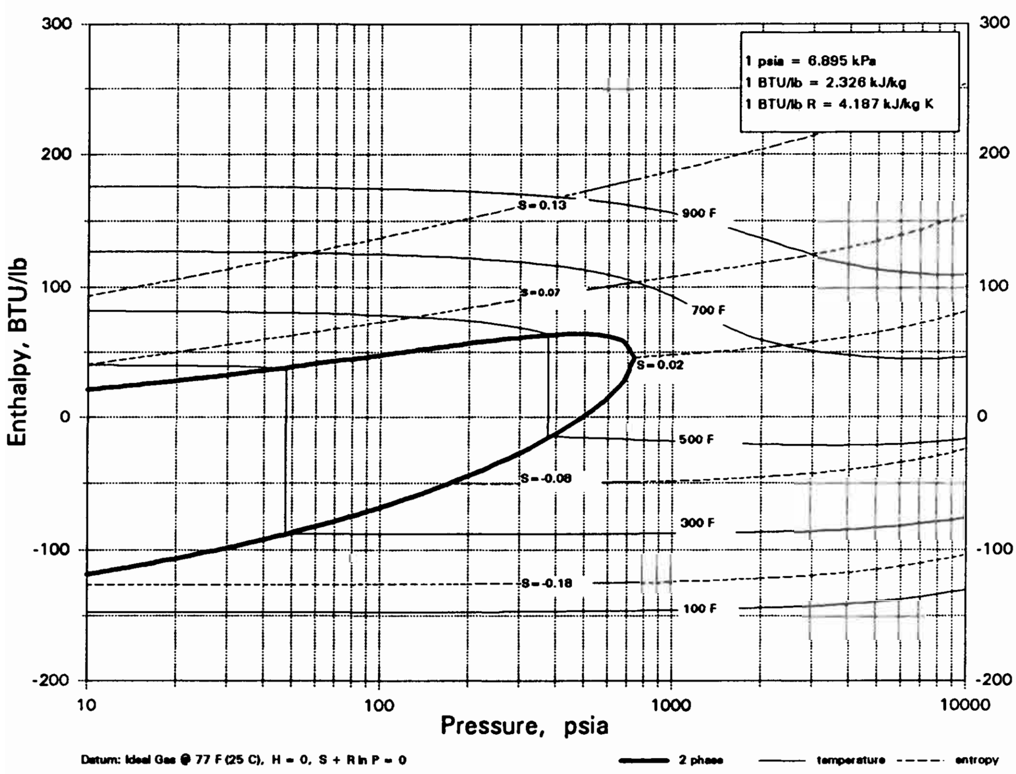
C2H2Cl2 trans-1-2-DICHLOROETHYLENE



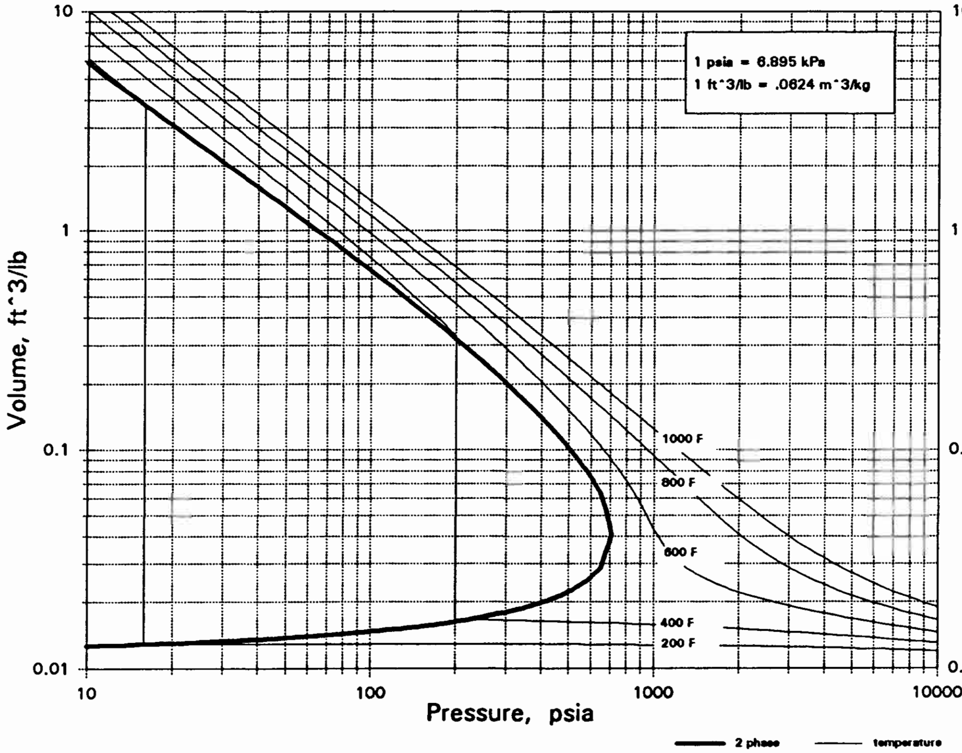


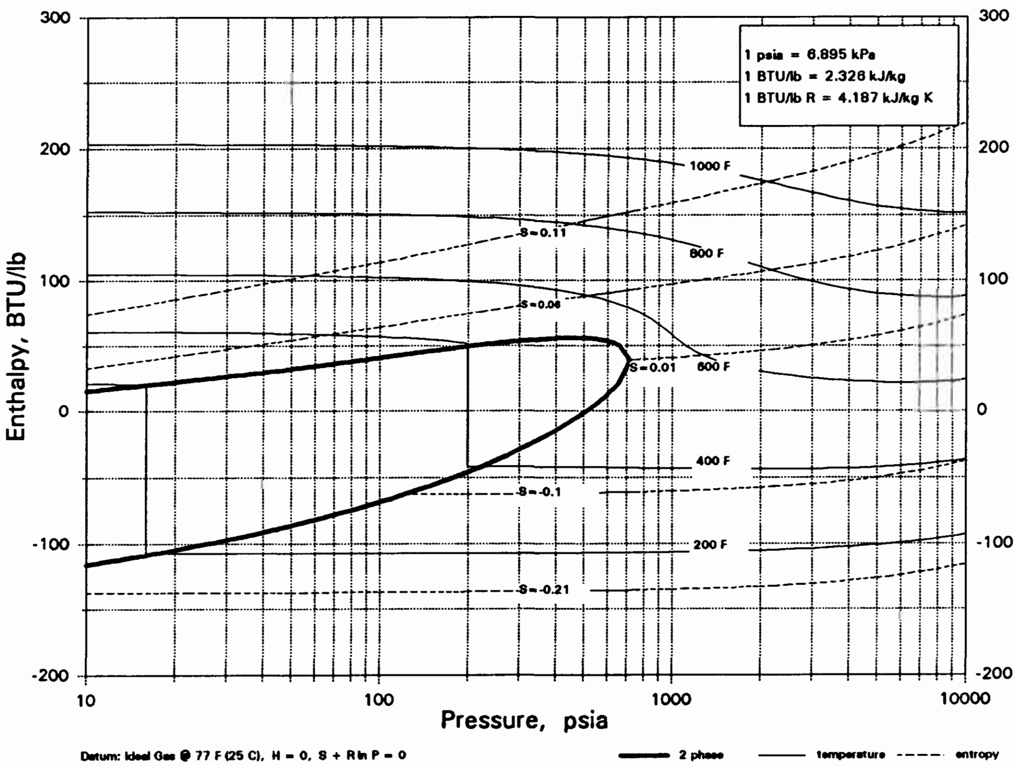
C2H2Cl2O CHLOROACETYL CHLORIDE



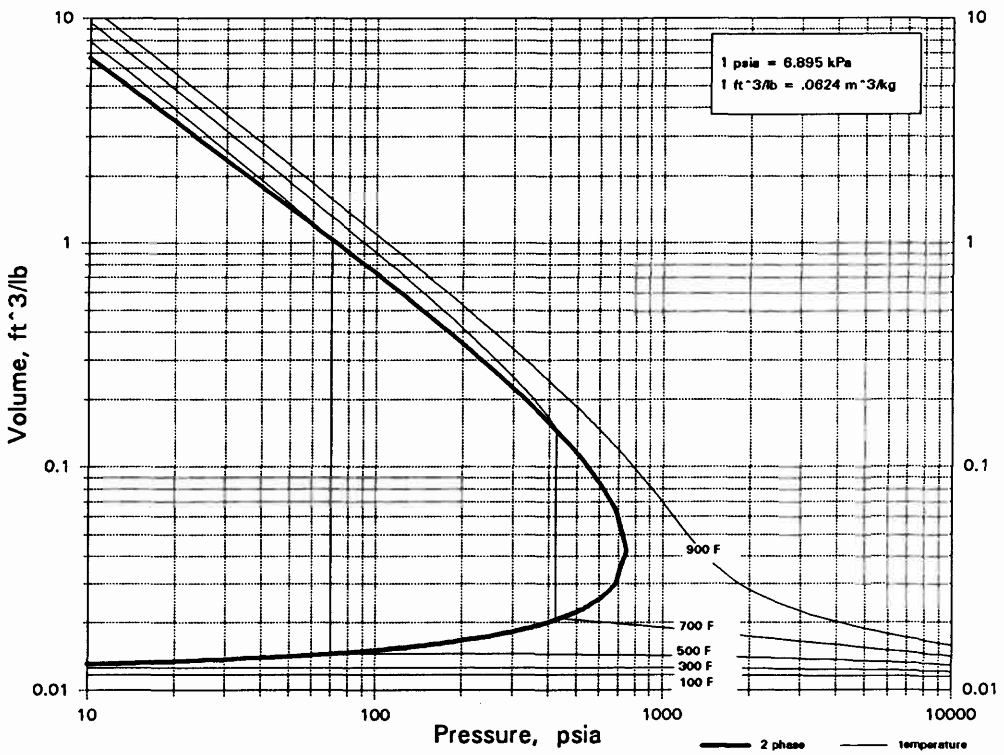


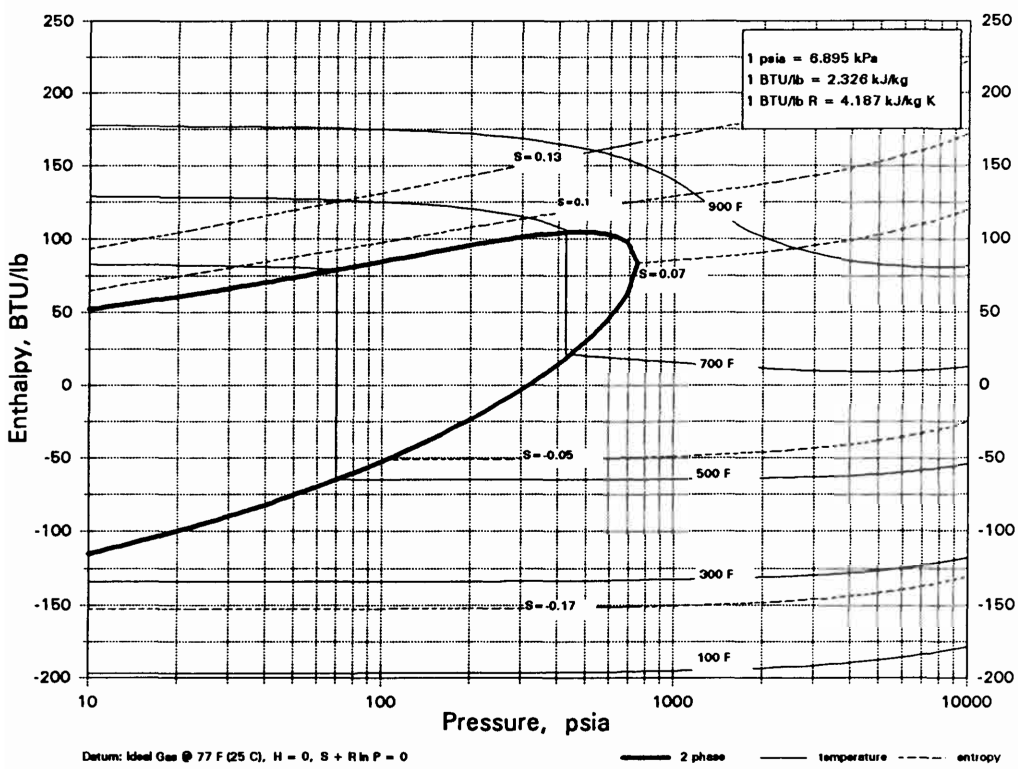
C2H2Cl2O DICHLOROACETALDEHYDE



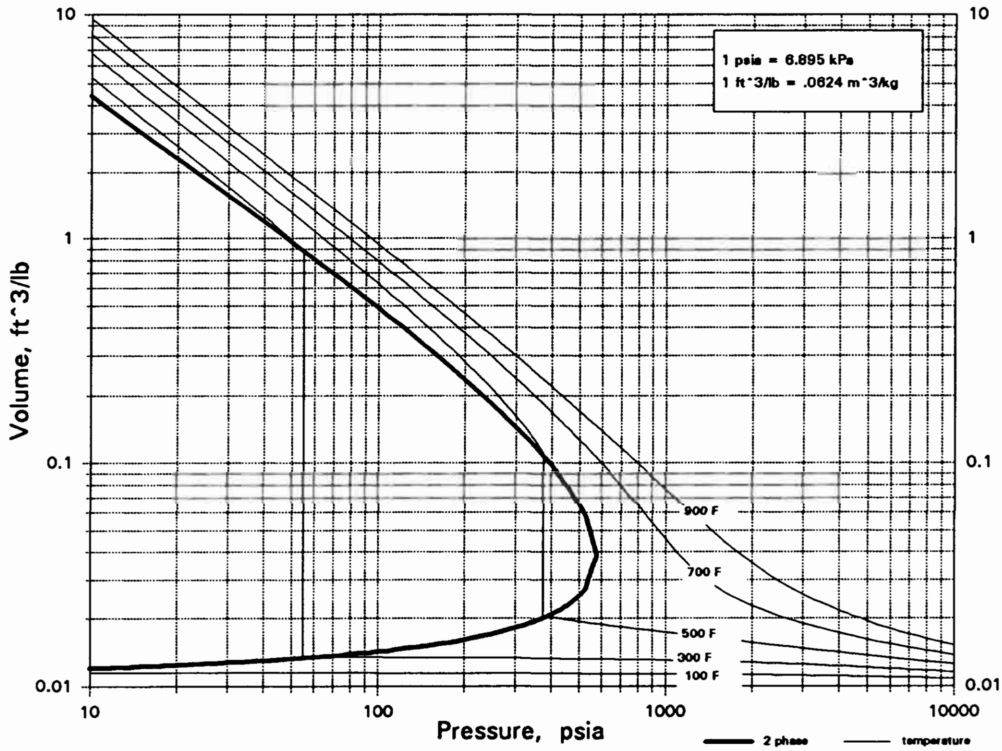


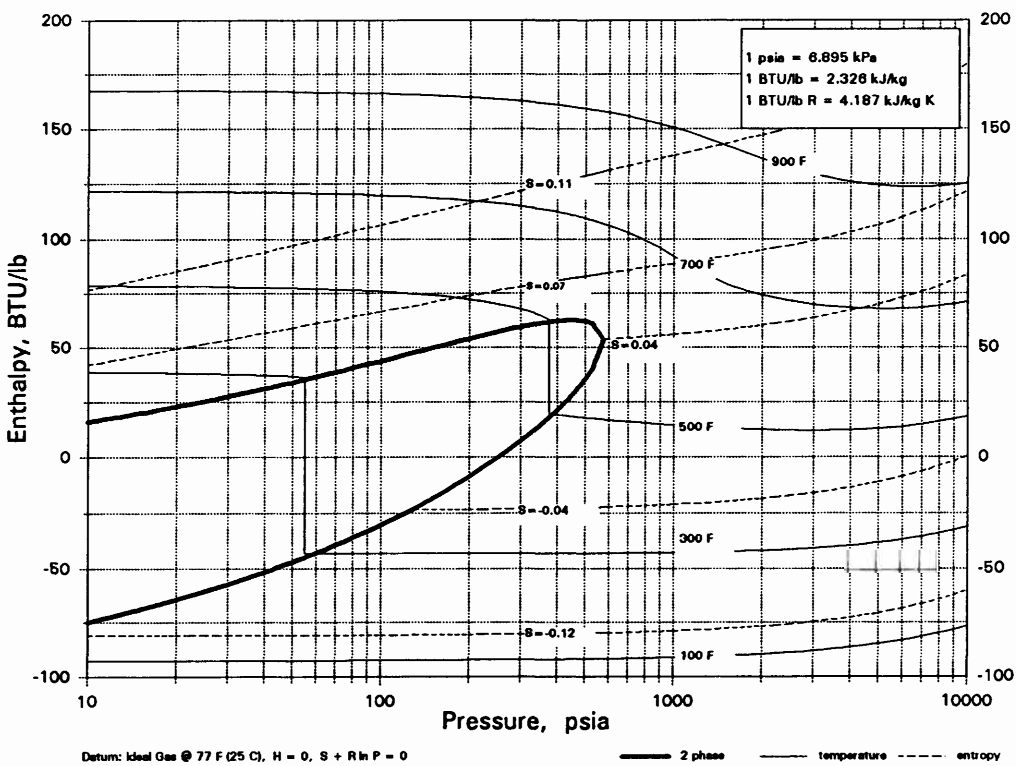
C2H2Cl2O2 DICHLOROACETIC ACID



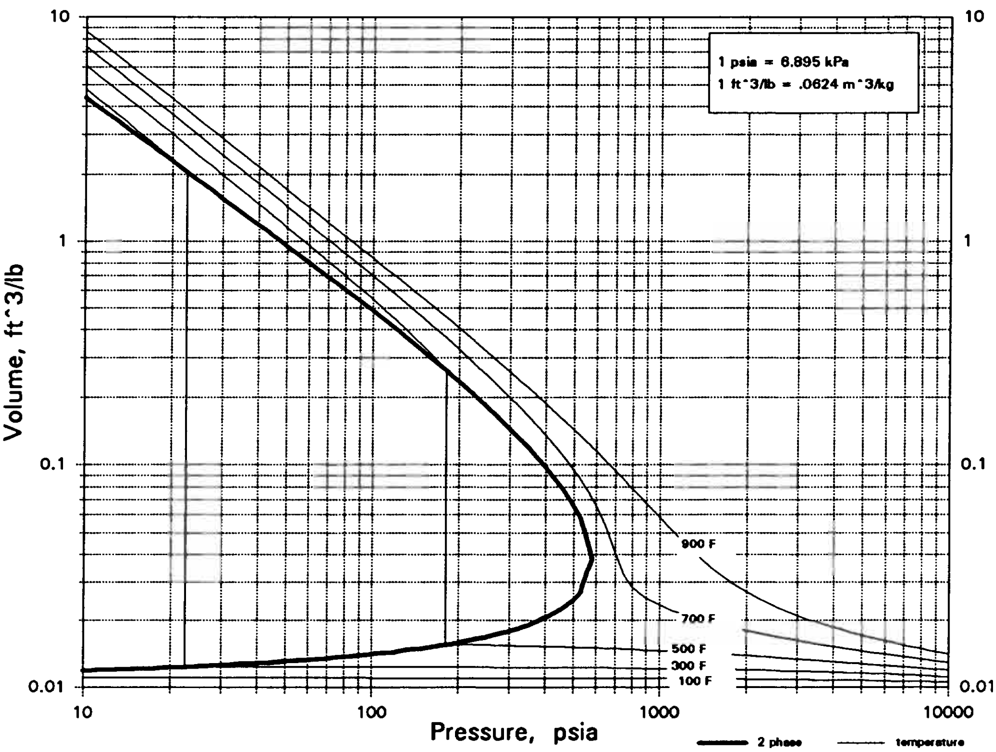


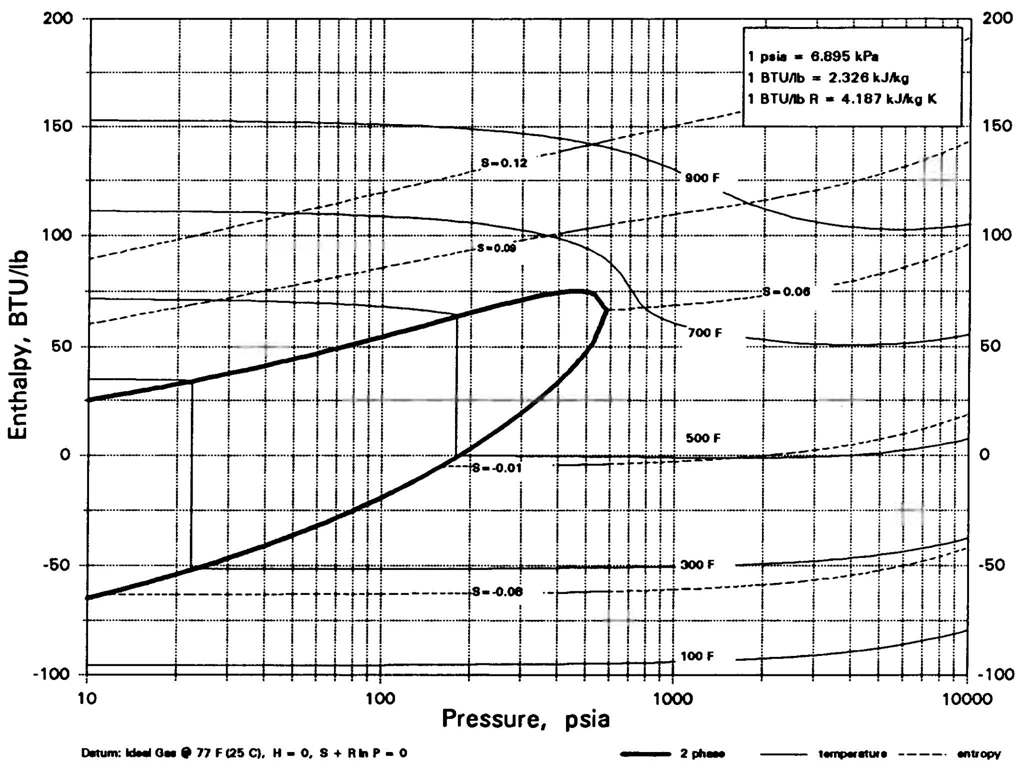
C2H2Cl3F 1-1-1-TRICHLOROFLUOROETHANE



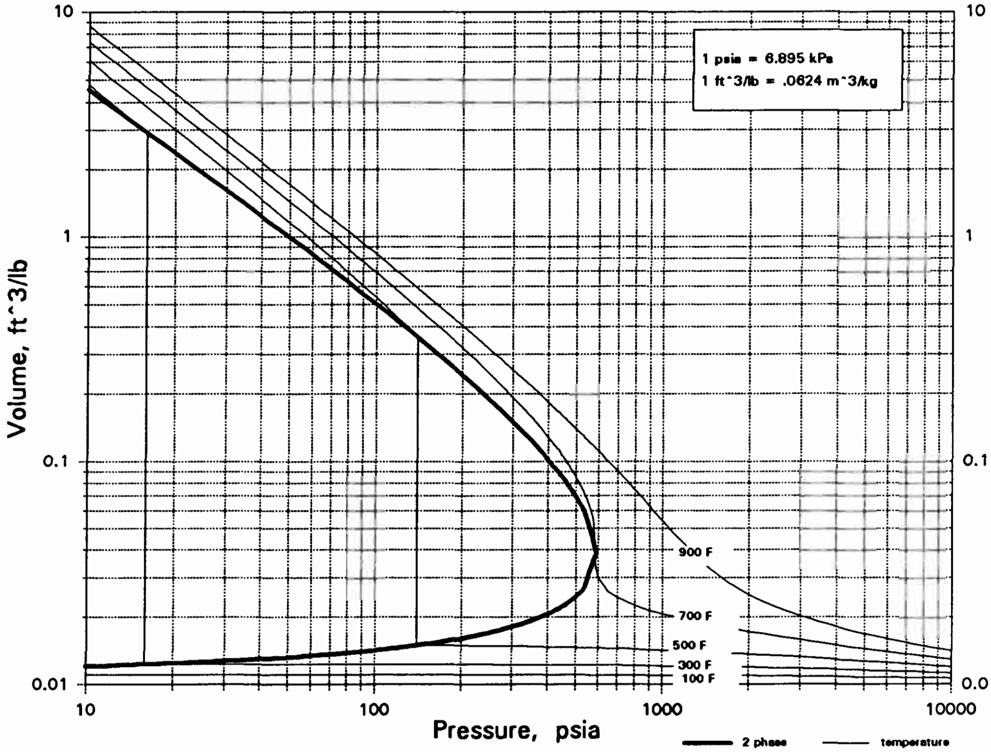


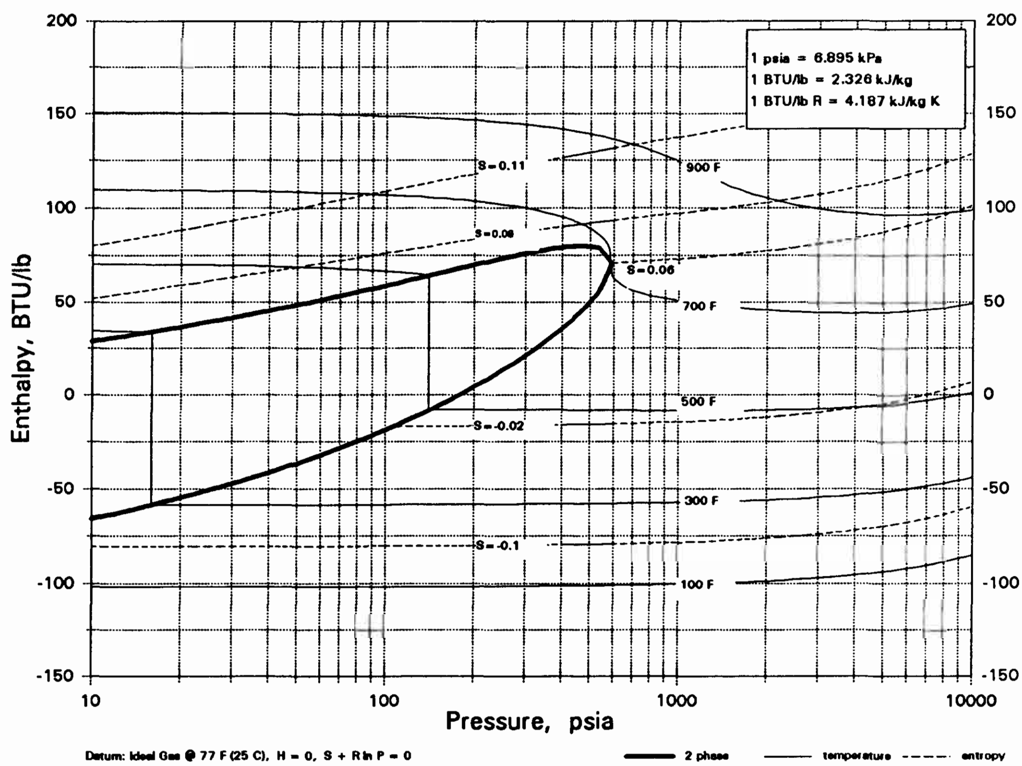
C2H2Cl4 1-1-1-2-TETRACHLOROETHANE



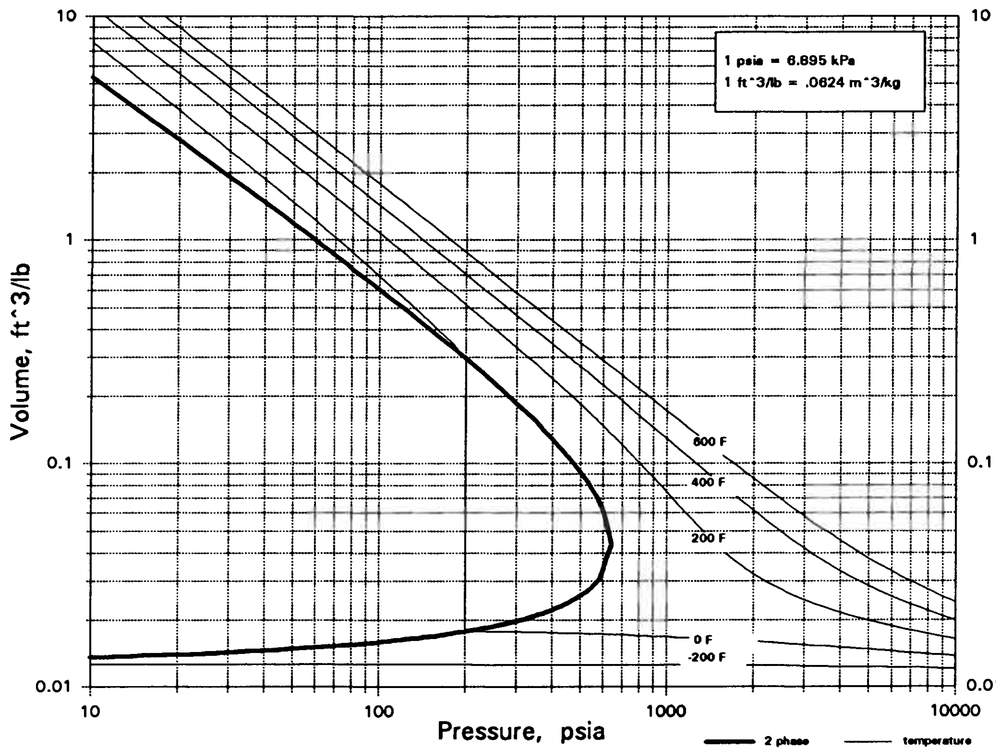


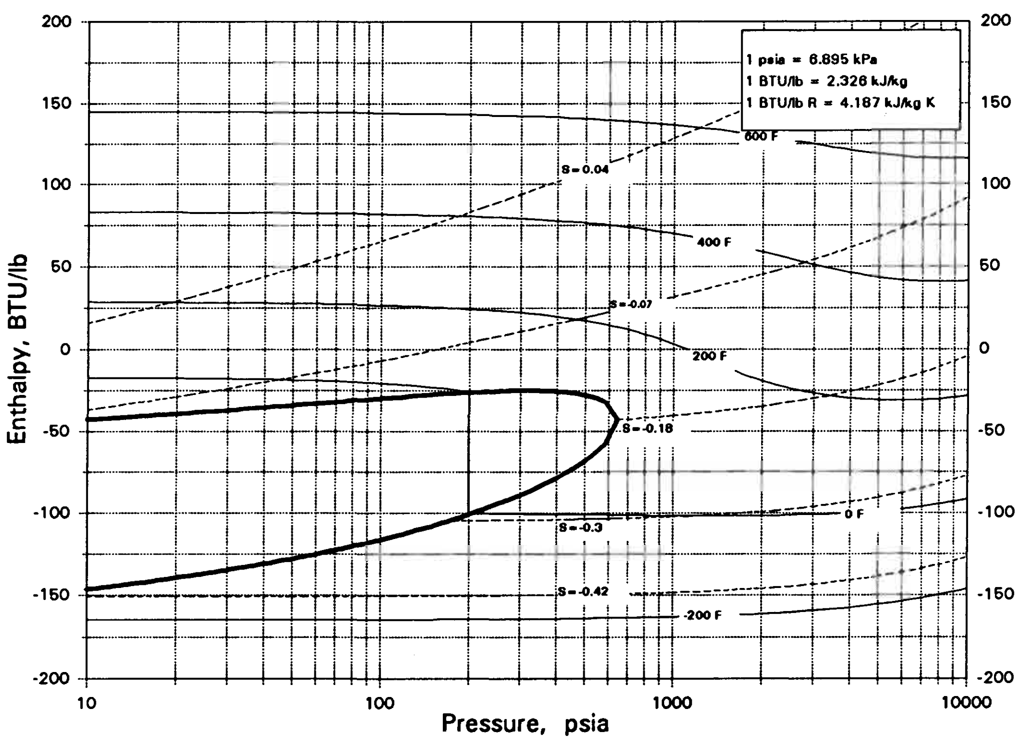
C2H2Cl4 1-1-2-2-TETRACHLOROETHANE



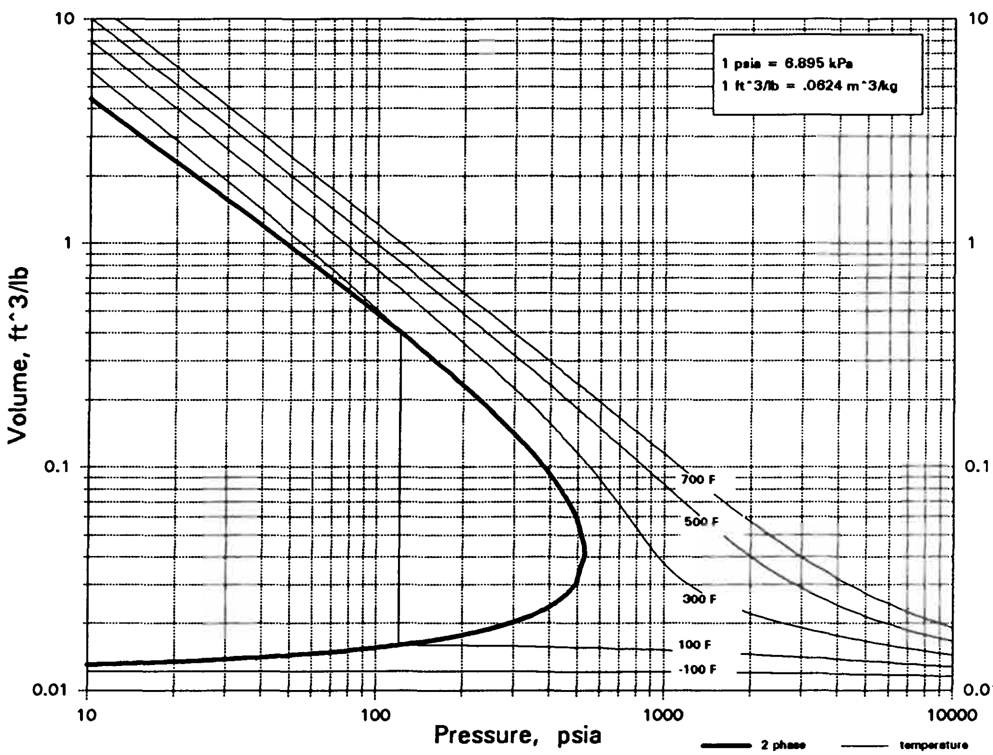


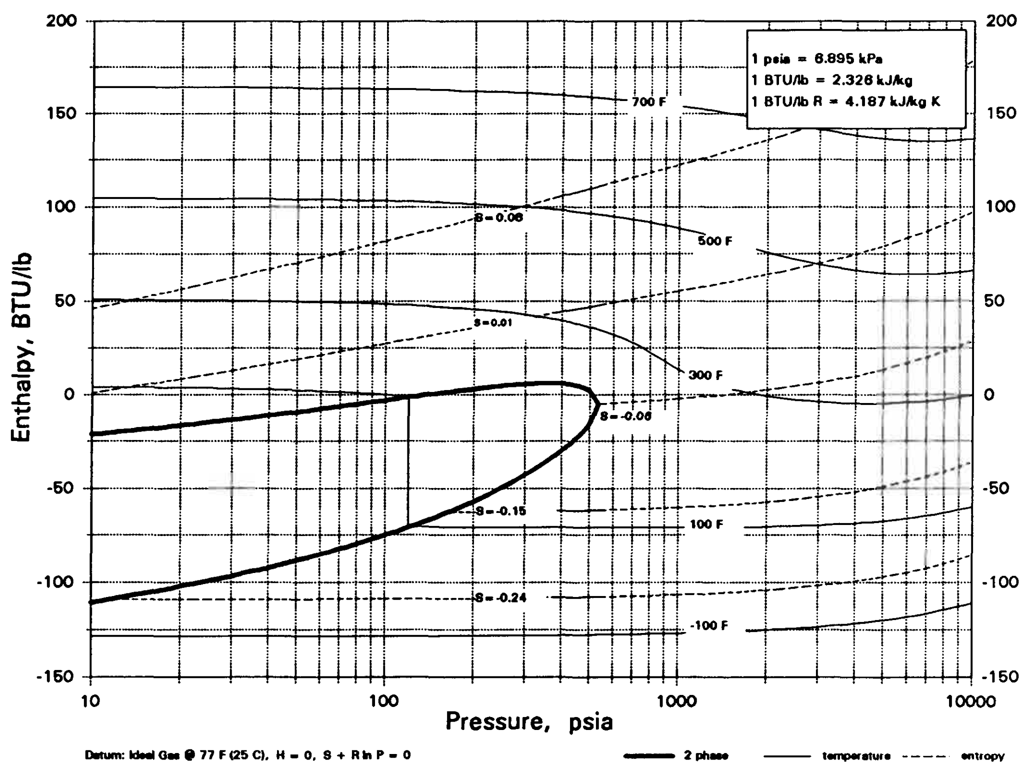
C2H2F2 1-1-DIFLUOROETHYLENE



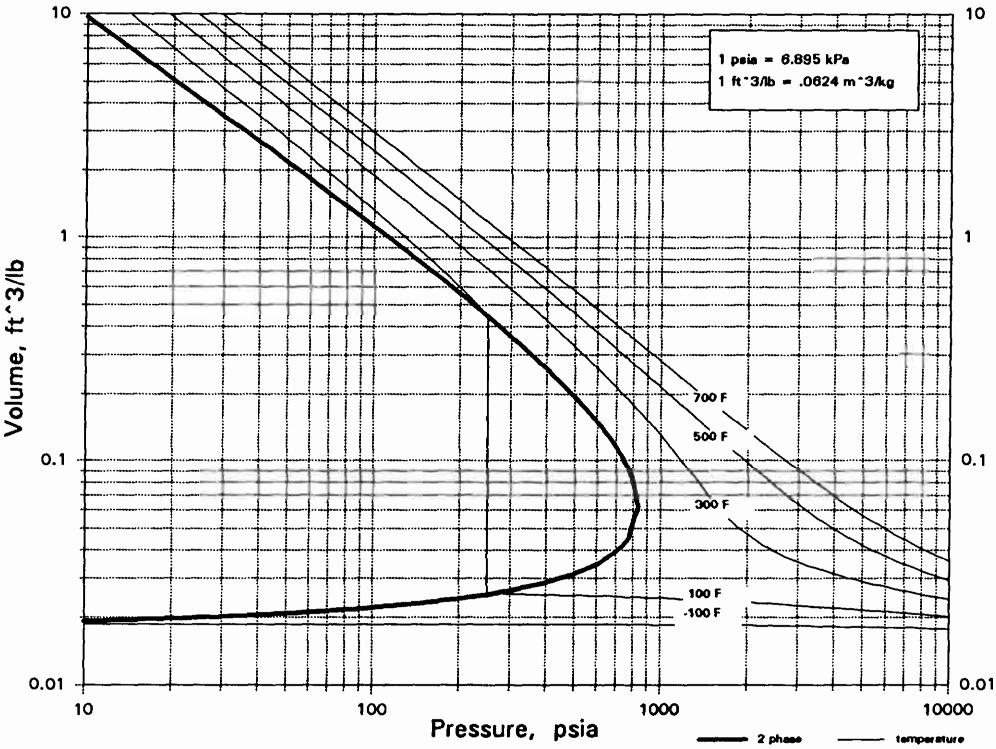


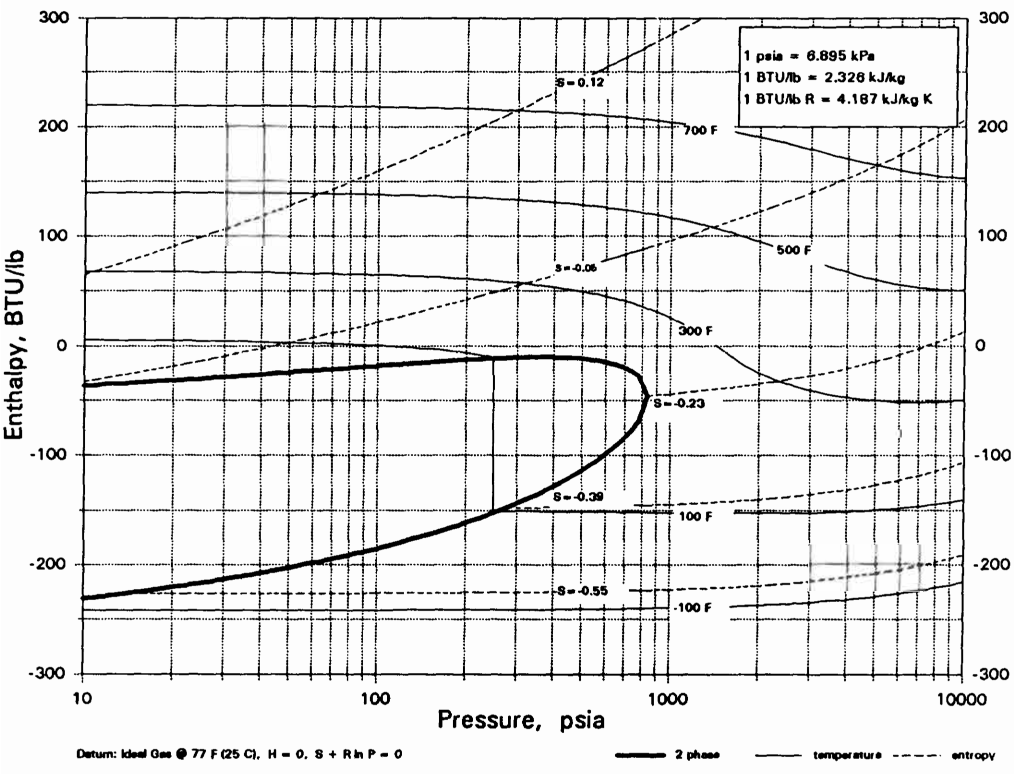
C2H2F4 1-1-1-2-TETRAFLUOROETHANE



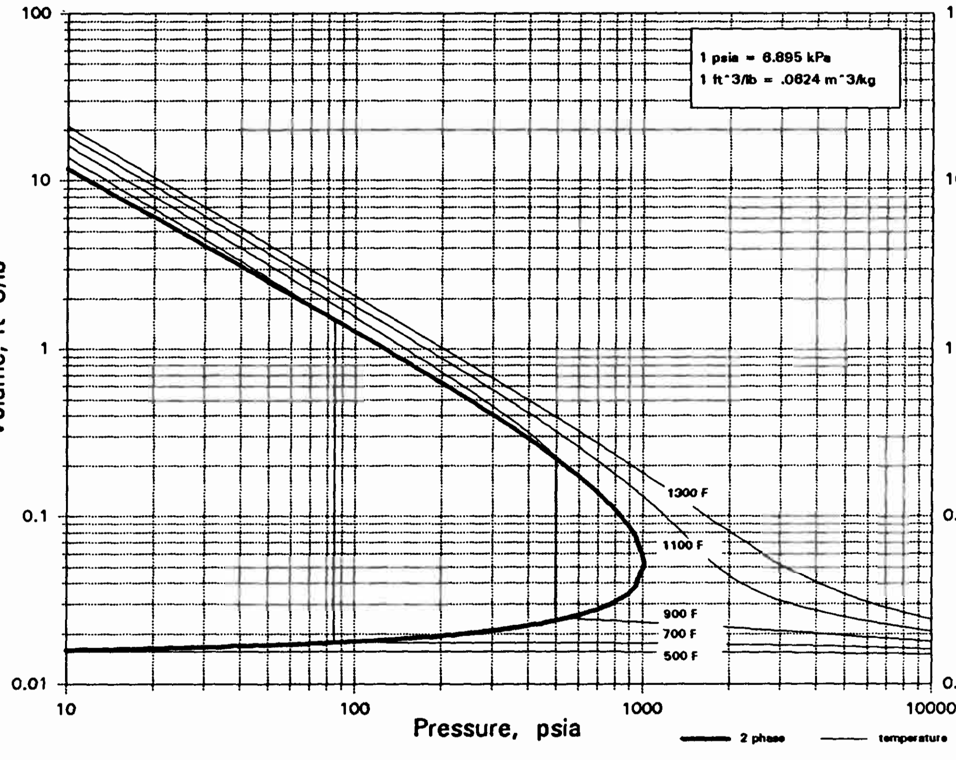


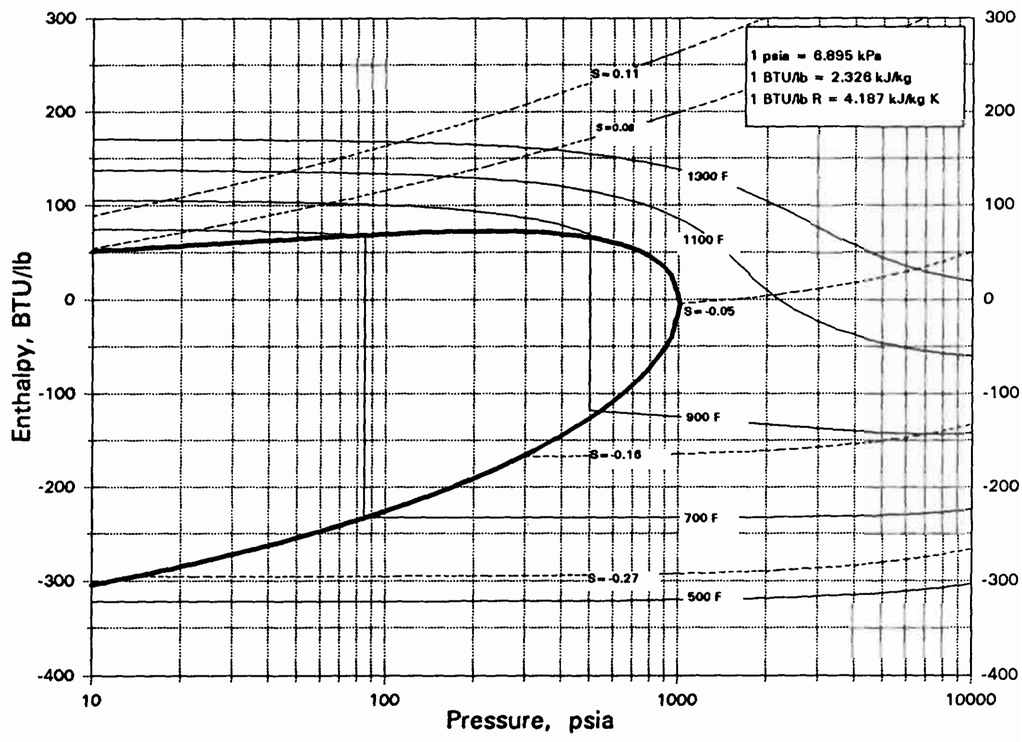
C2H2O KETENE





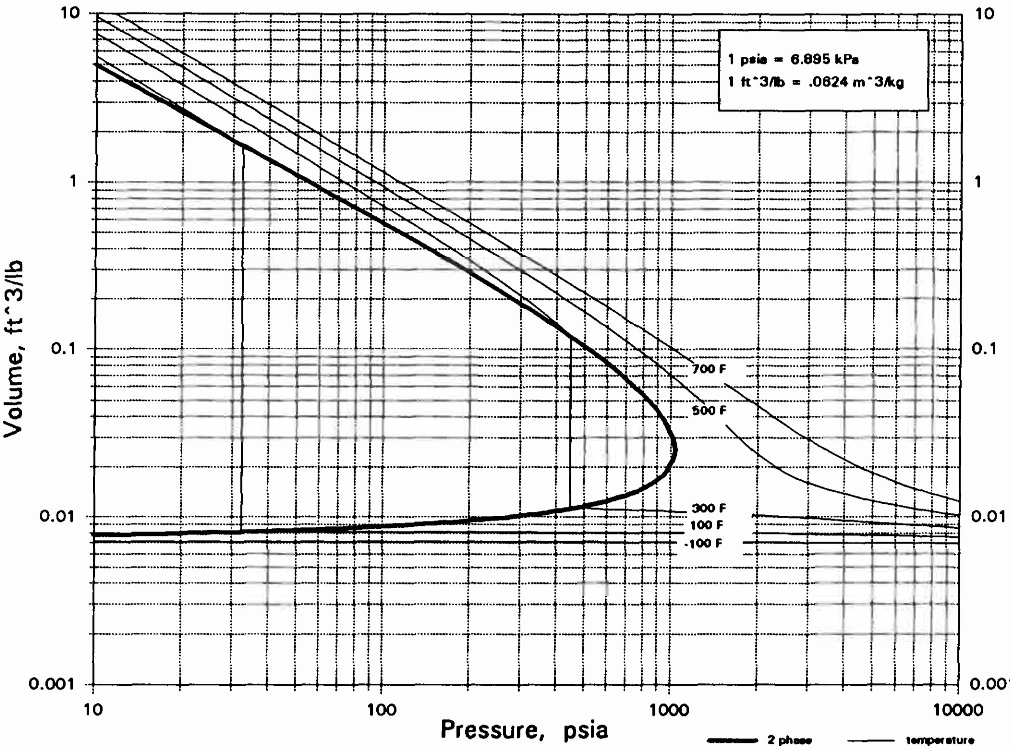
C2H2O4 OXALIC ACID

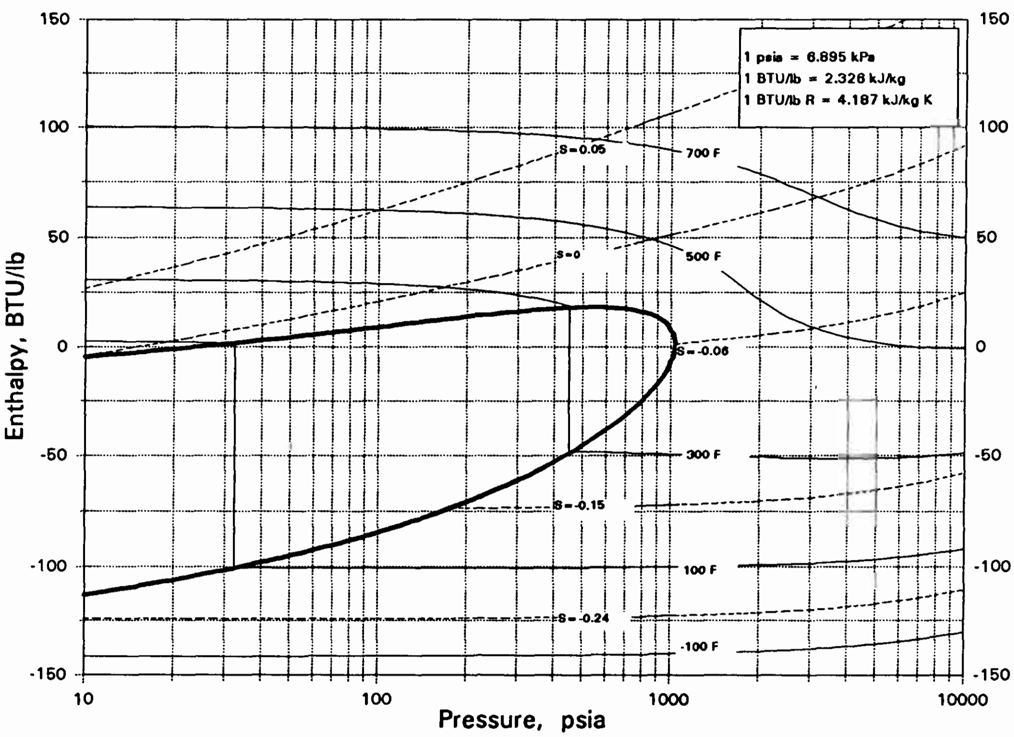




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

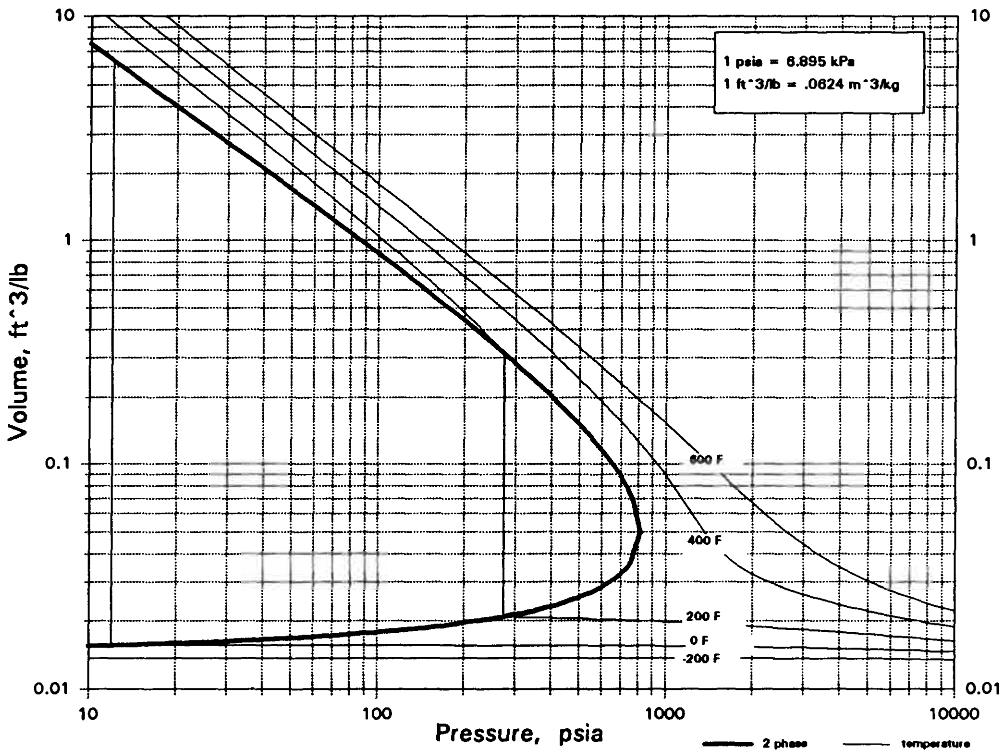
C2H3Br VINYL BROMIDE

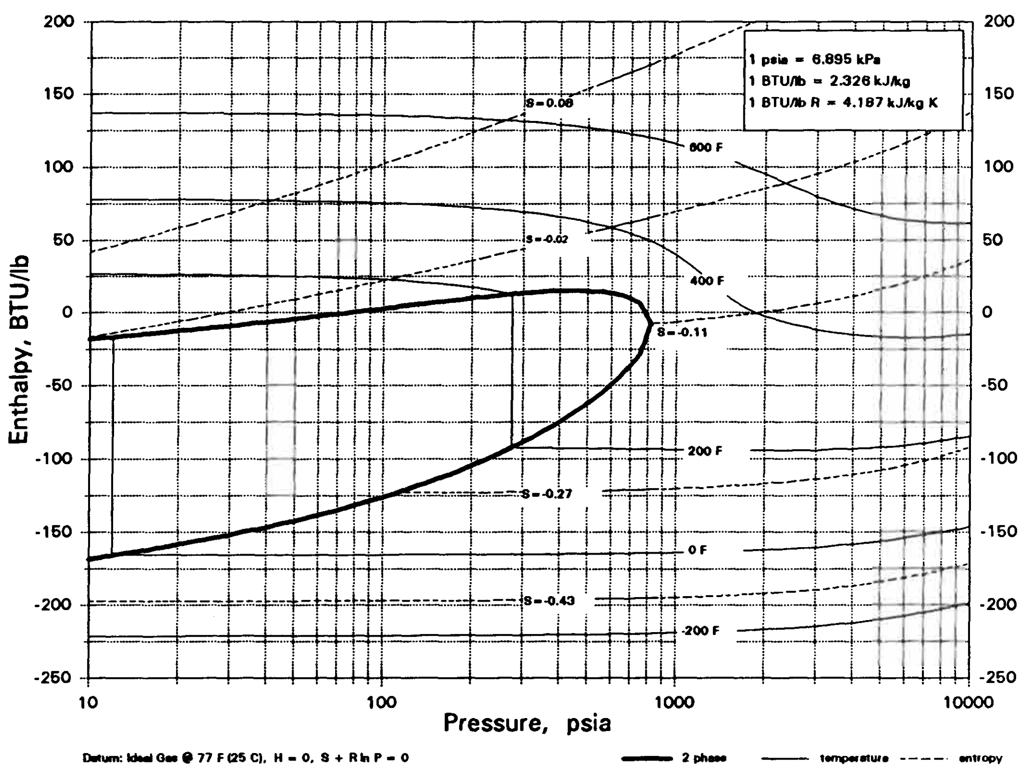




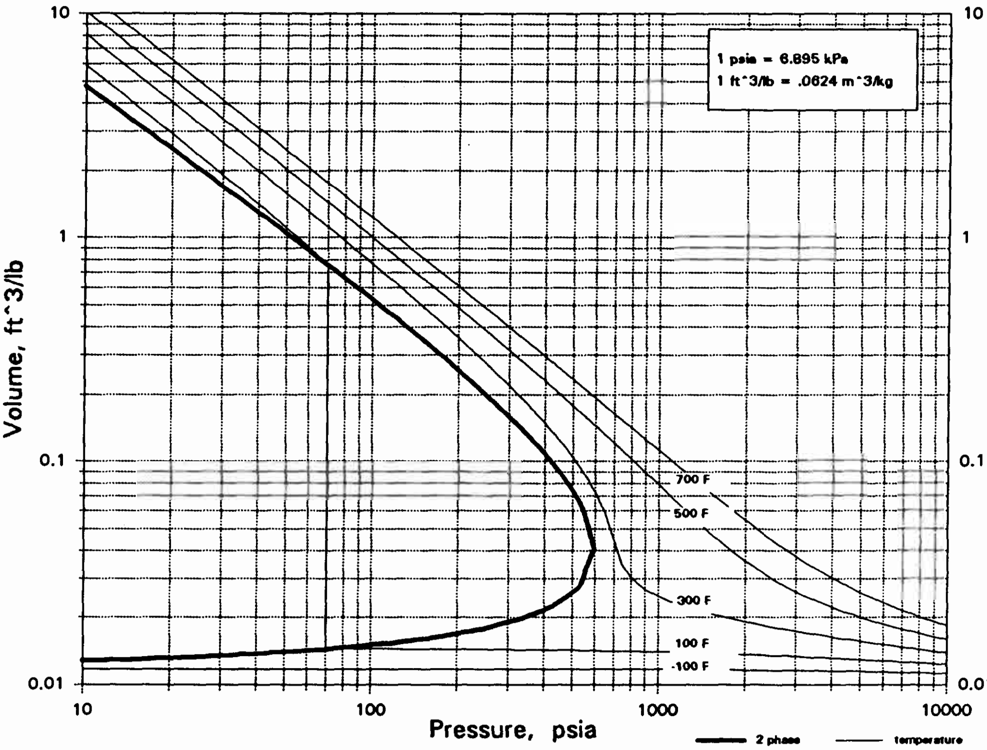
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

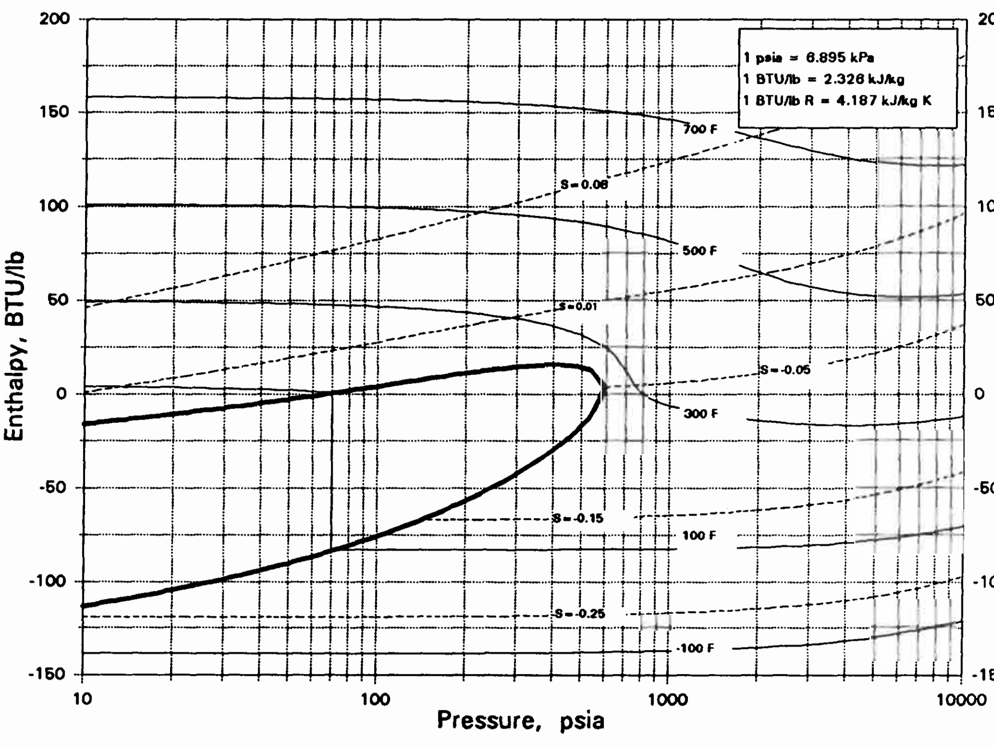
C_2H_3Cl	VINYL CHLORIDE



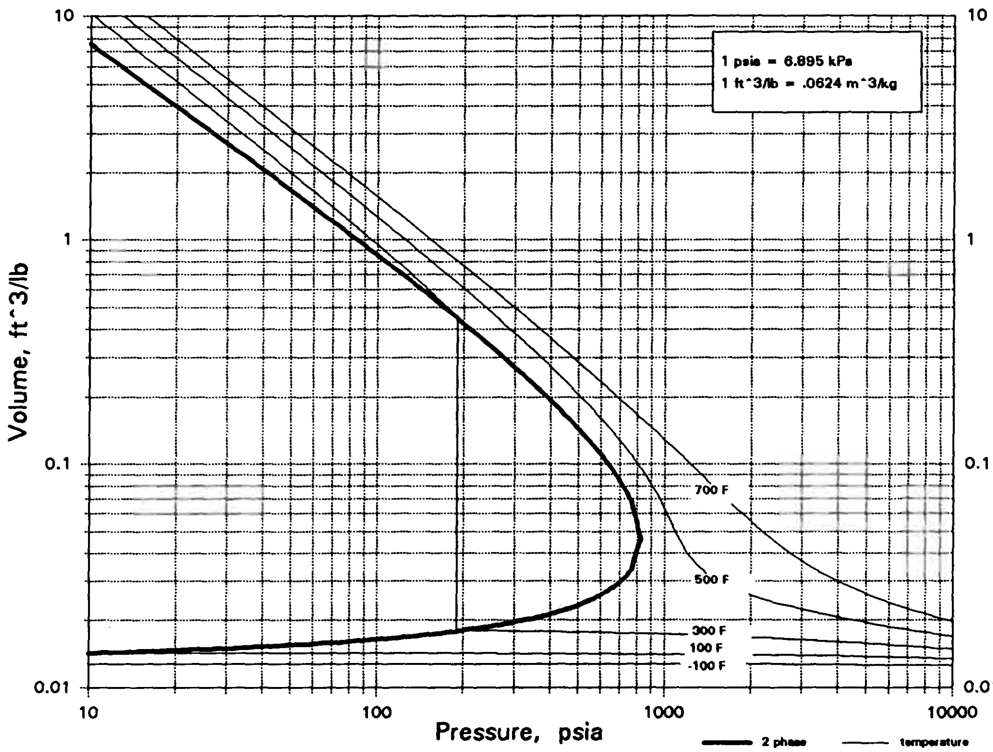


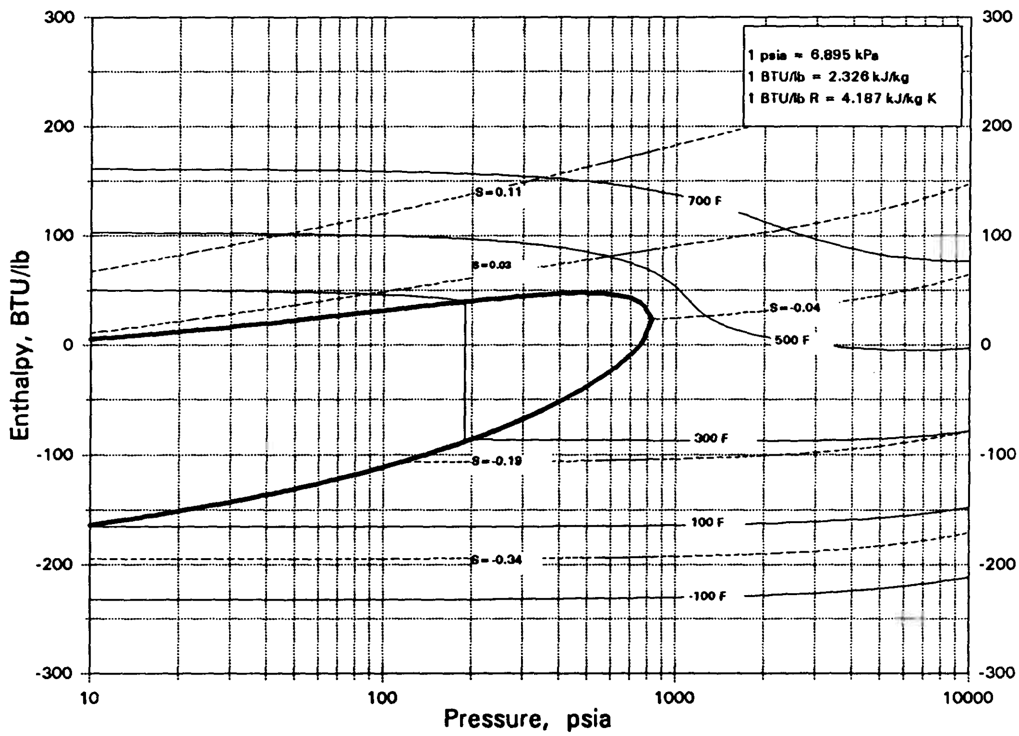
C2H3ClF2 1-CHLORO-1-1-DIFLUOROETHANE





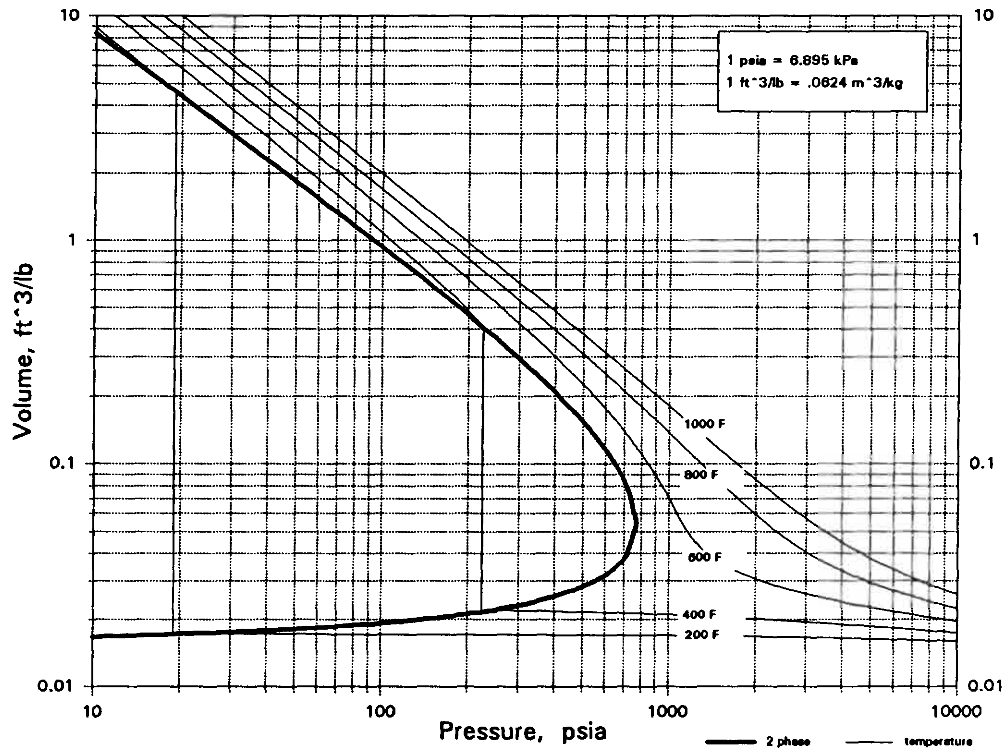
C2H3ClO ACETYL CHLORIDE

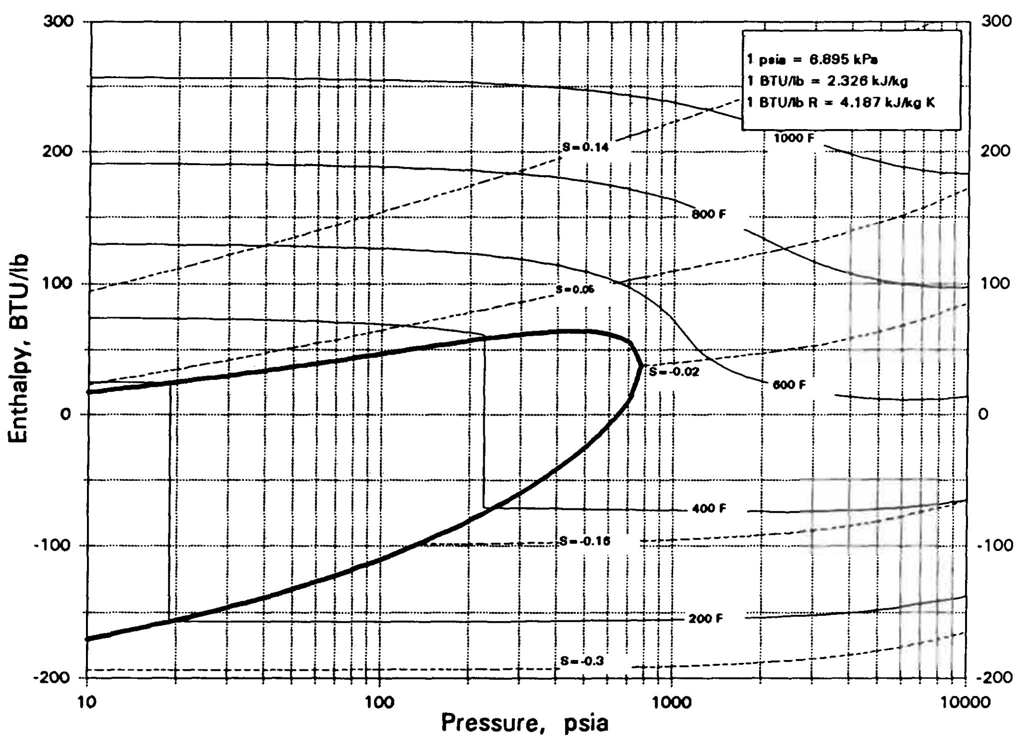




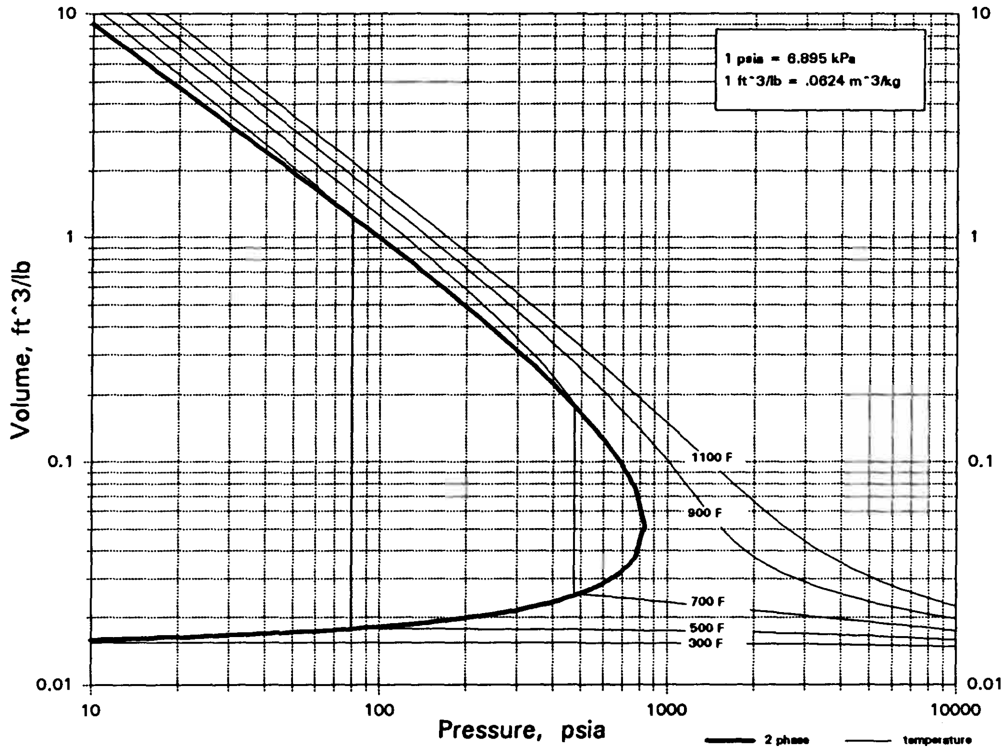
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

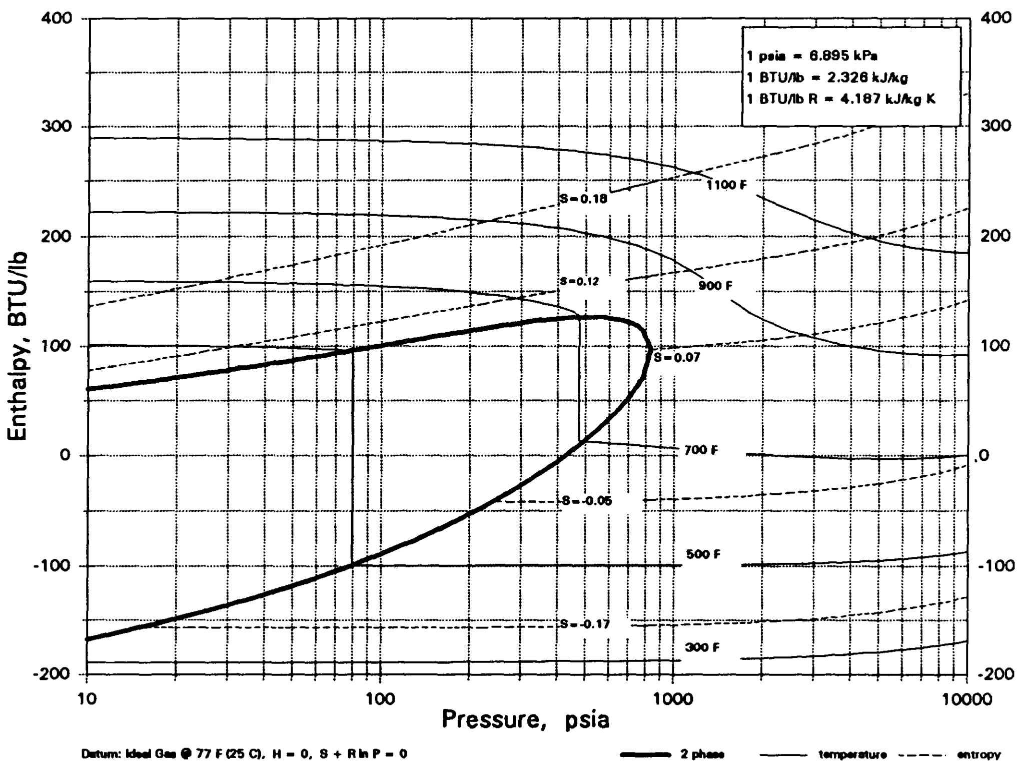
C2H3ClO	CHLOROACETALDEHYDE



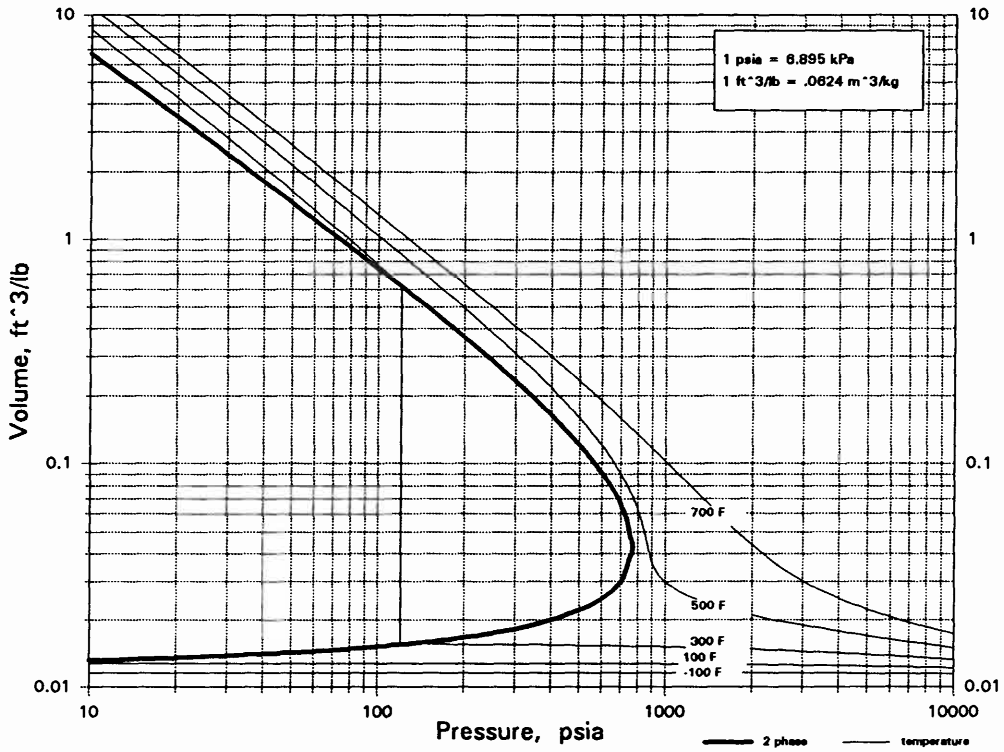


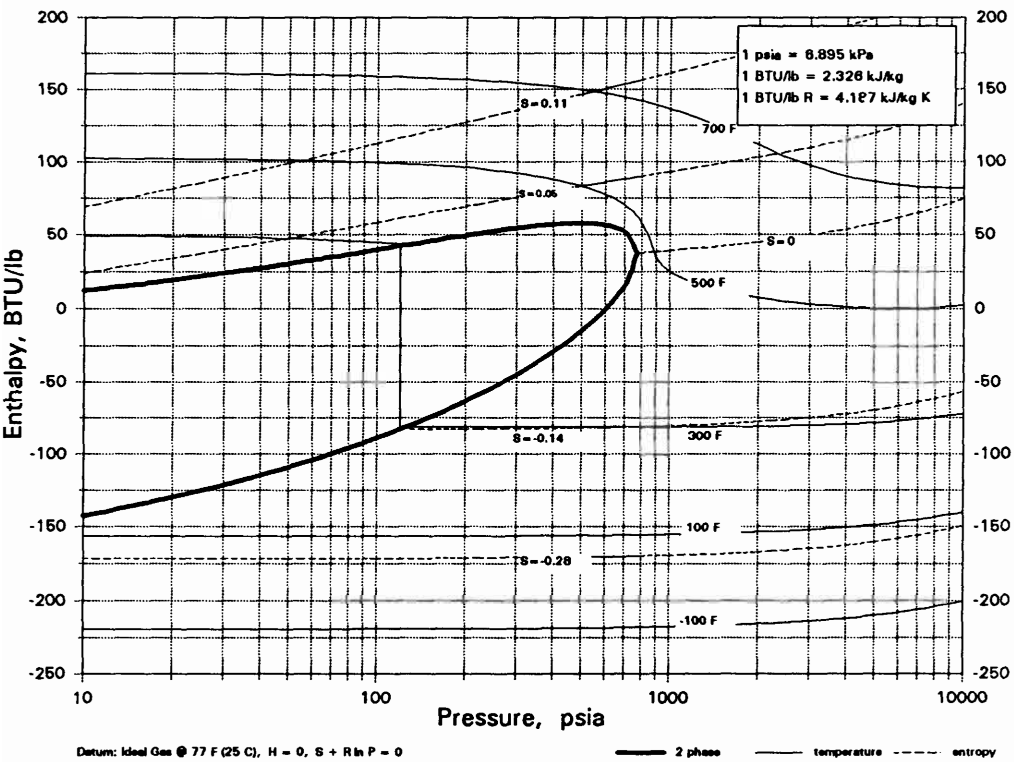
C2H3ClO2	CHLOROACETIC ACID



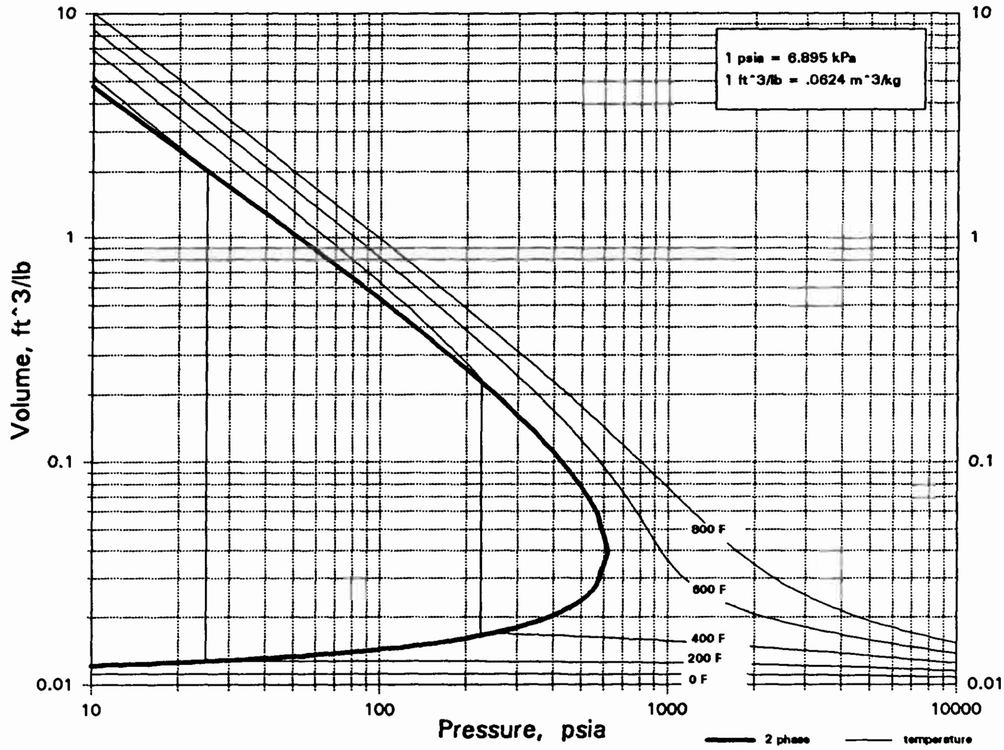


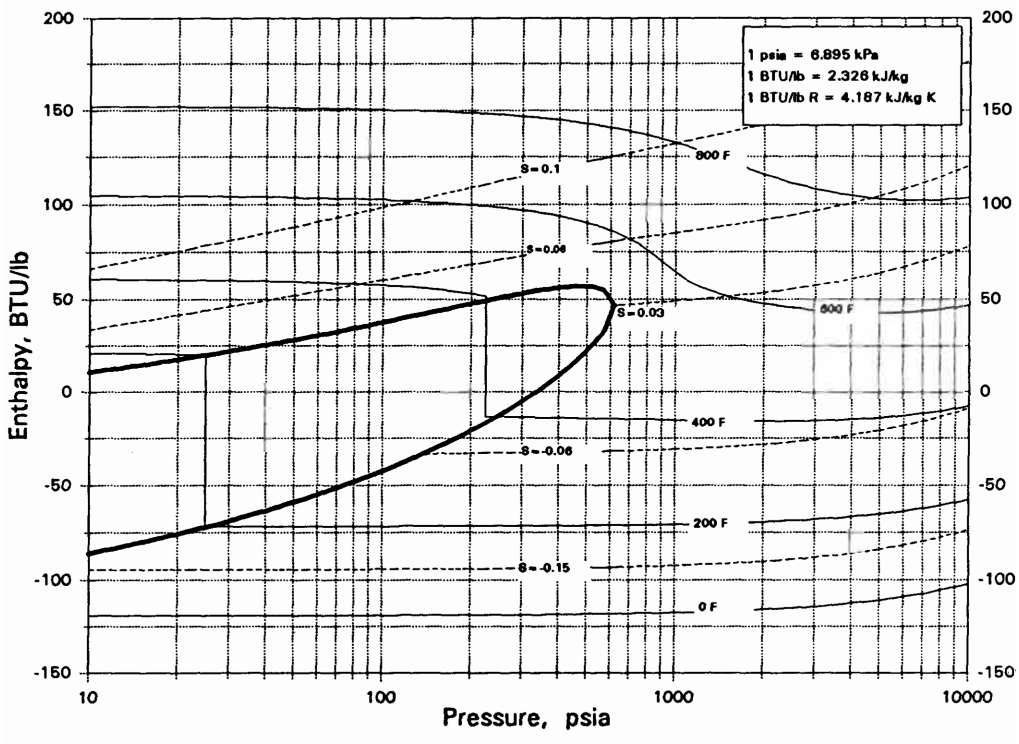
C2H3ClO2 METHYL CHLOROFORMATE



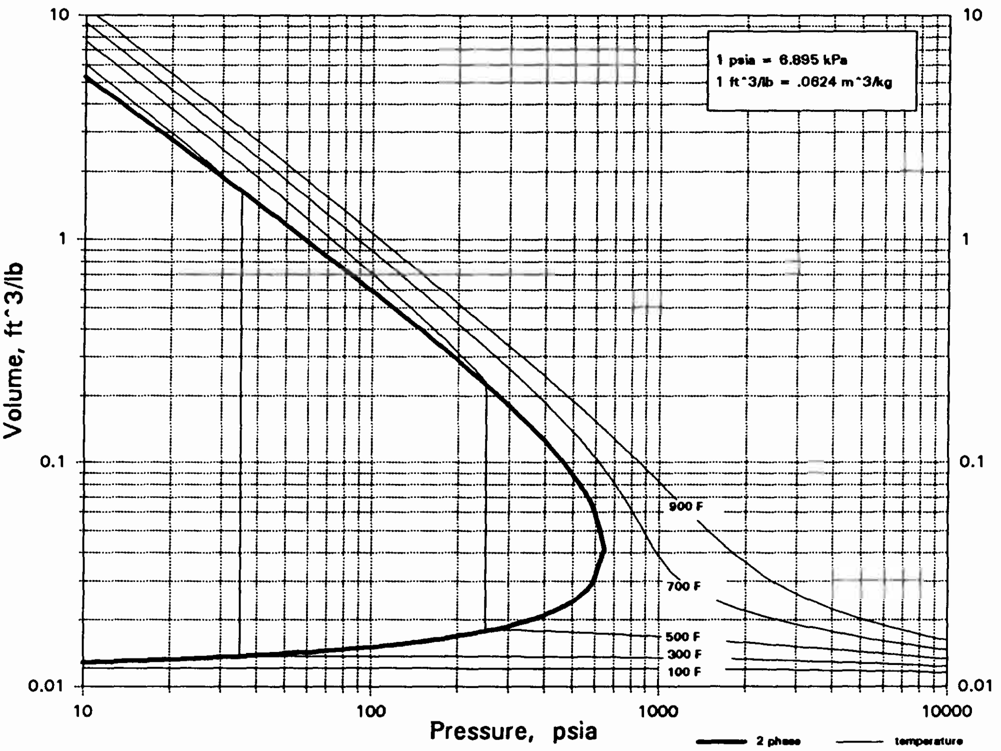


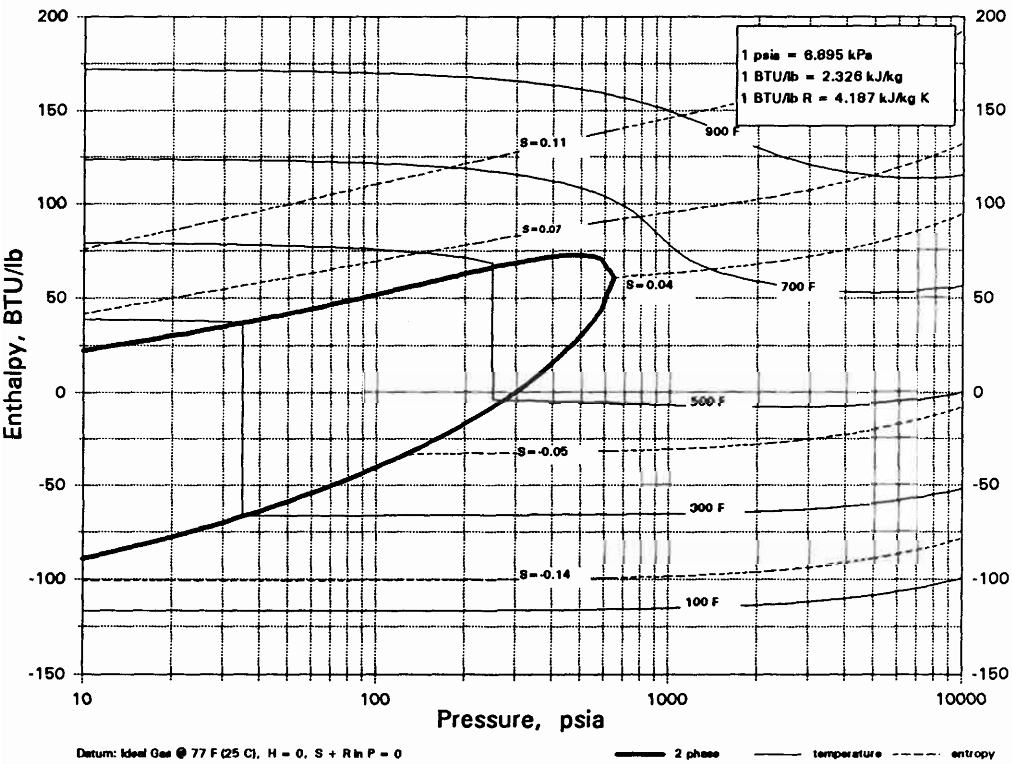
C2H3Cl3 1-1-1-TRICHLOROETHANE



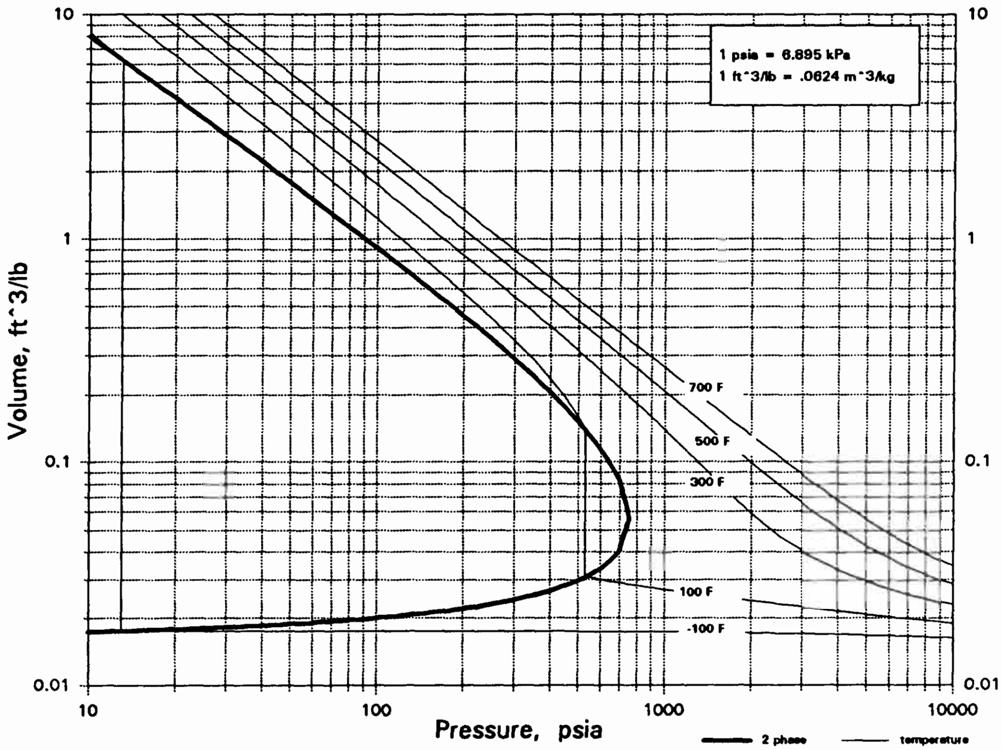


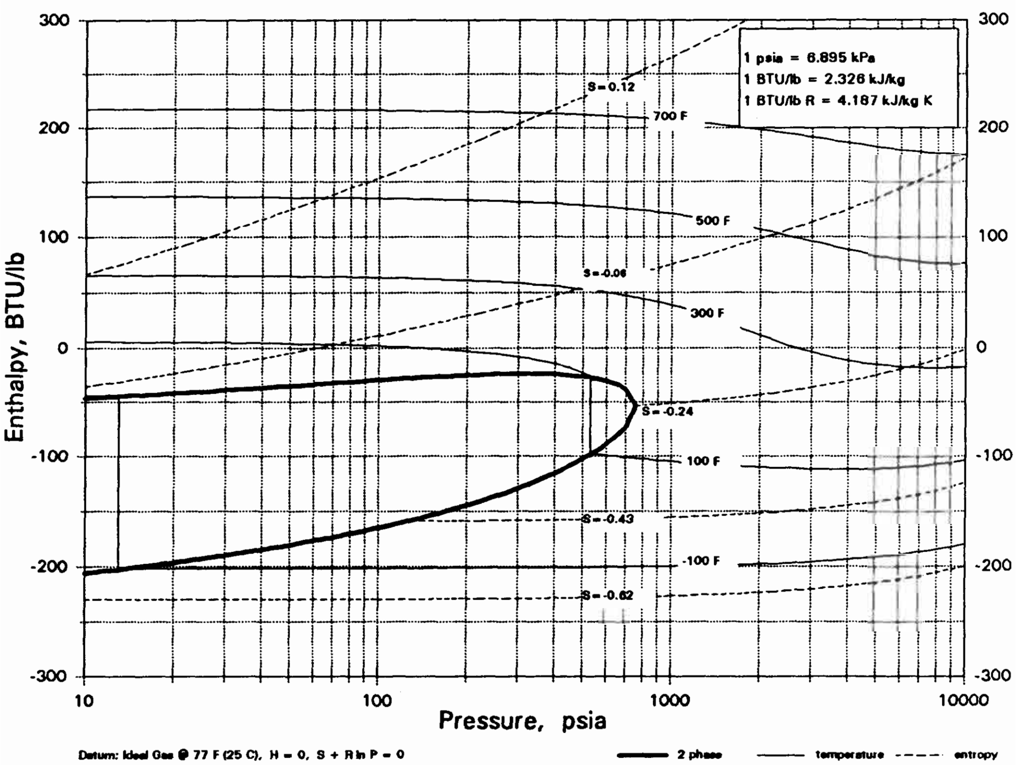
C2H3Cl3 1-1-2-TRICHLOROETHANE



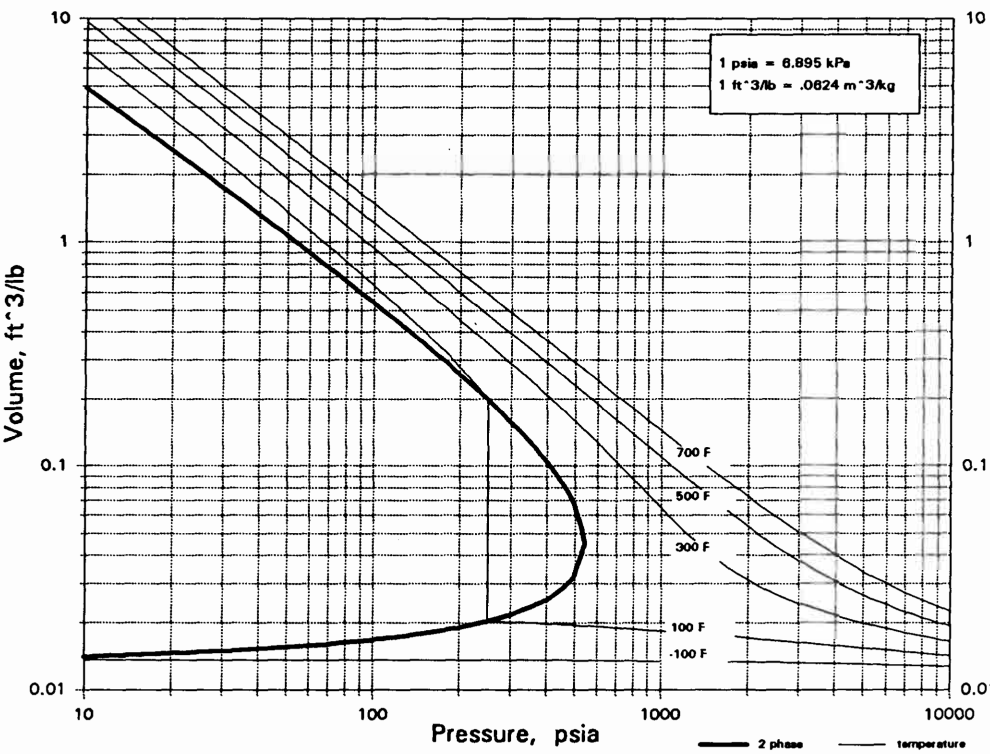


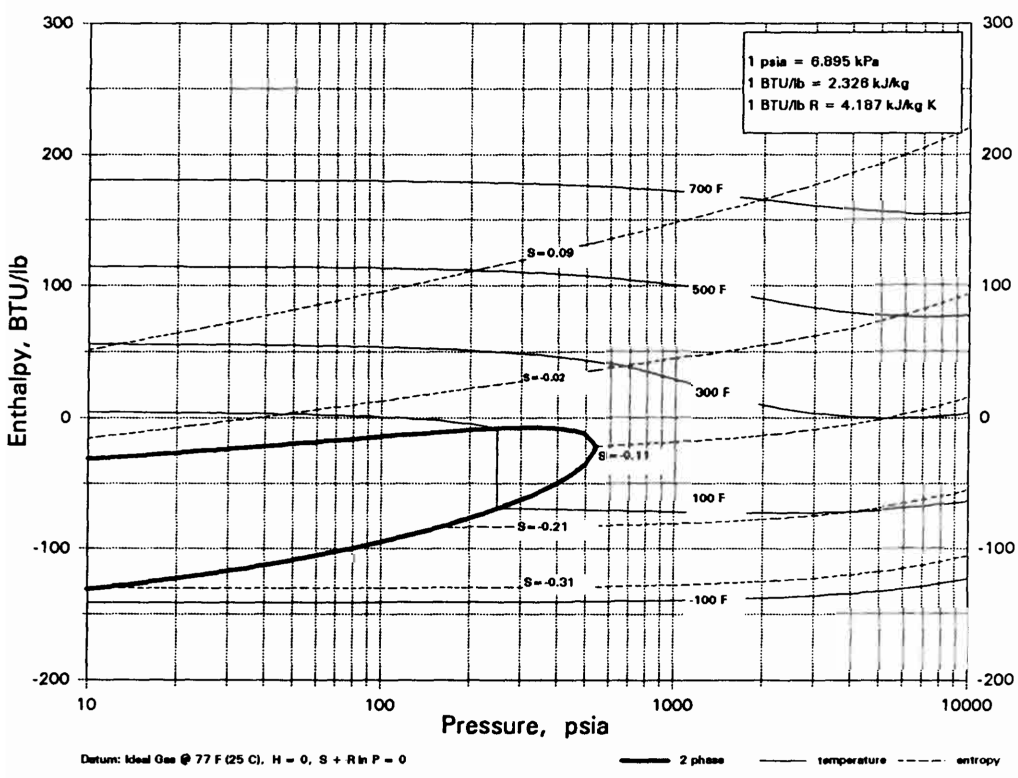
C2H3F VINYL FLUORIDE



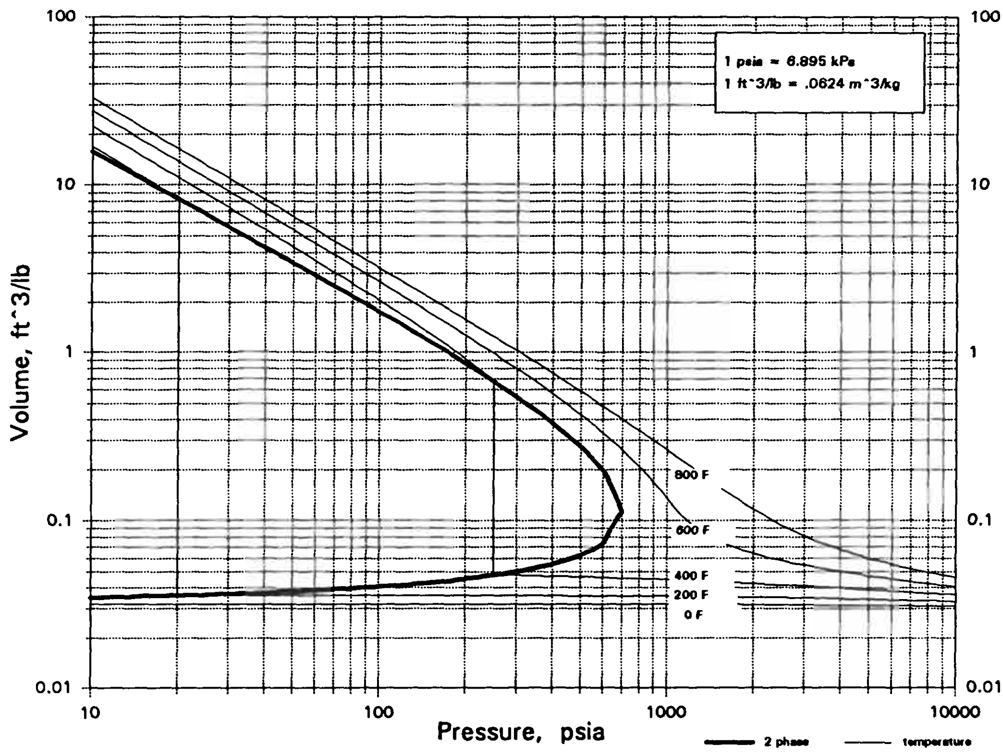


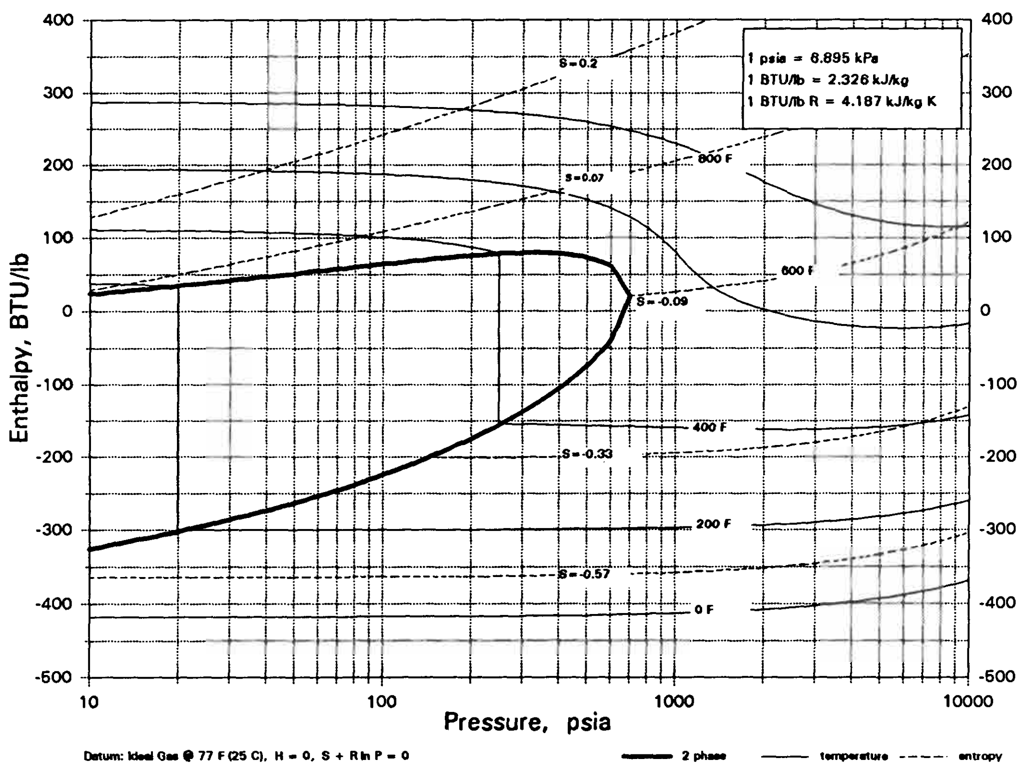
C2H3F3 1-1-1-TRIFLUOROETHANE



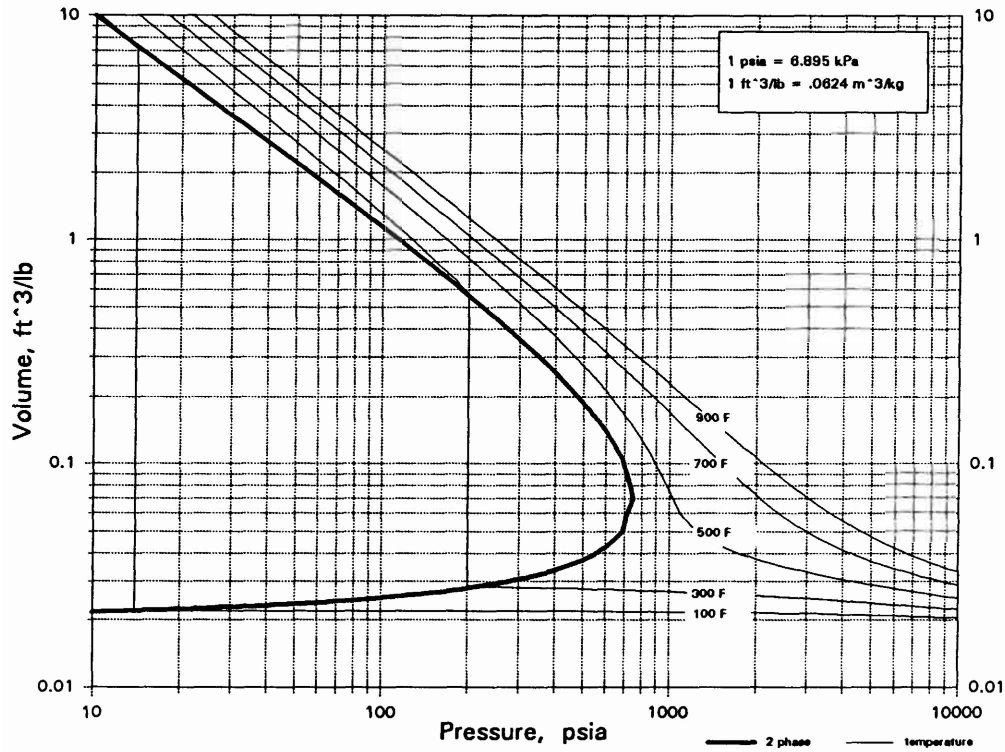


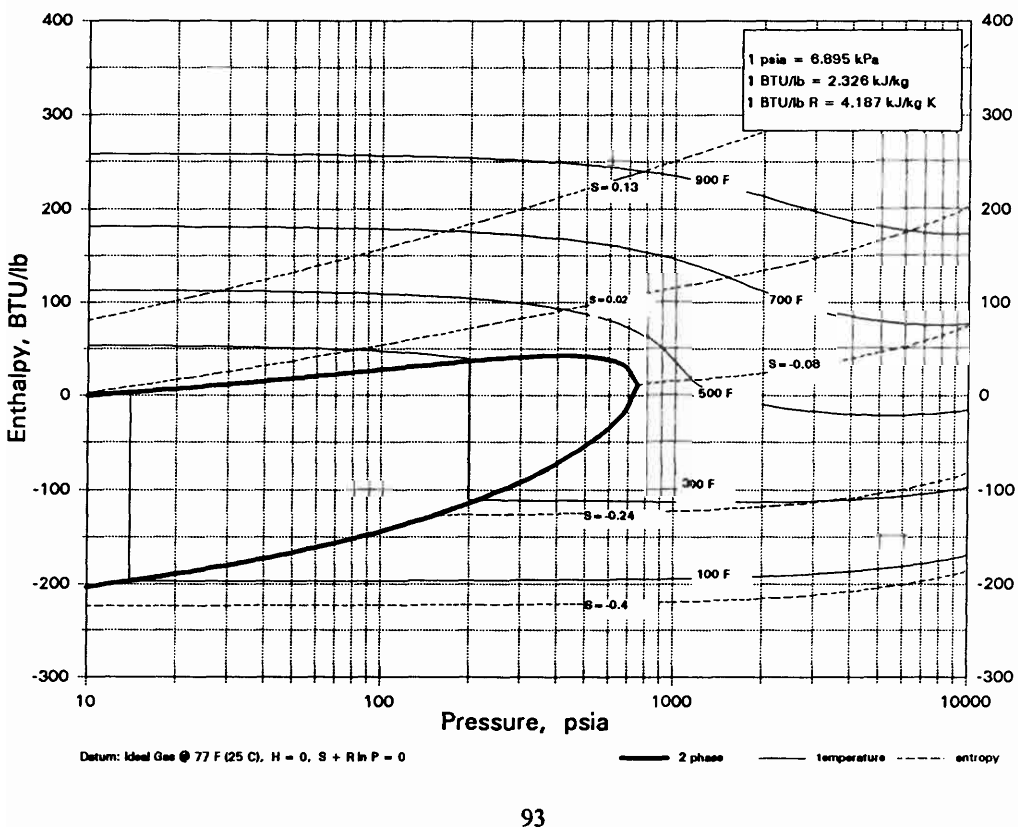
C2H3N ACETONITRILE



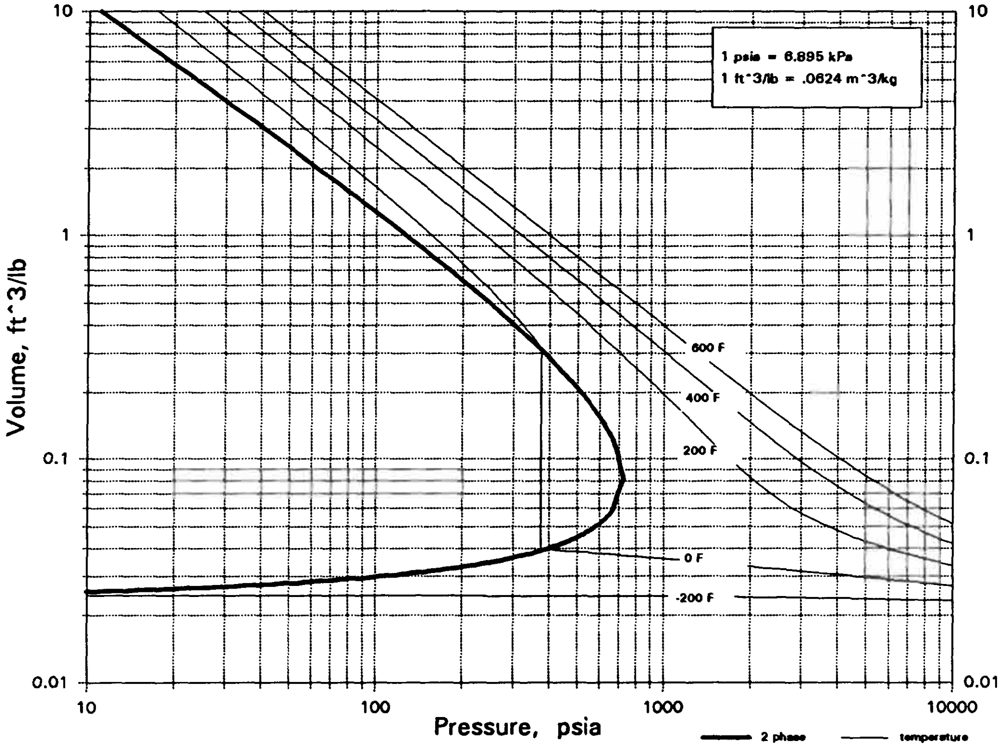


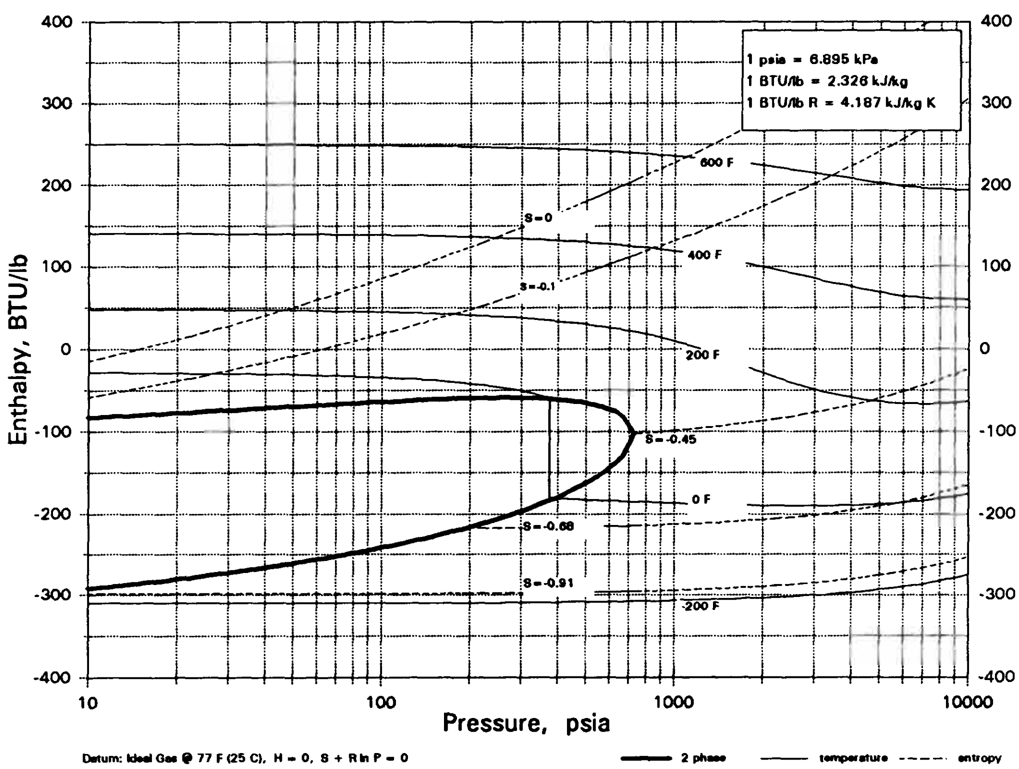
C2H3NO METHYL ISOCYANATE



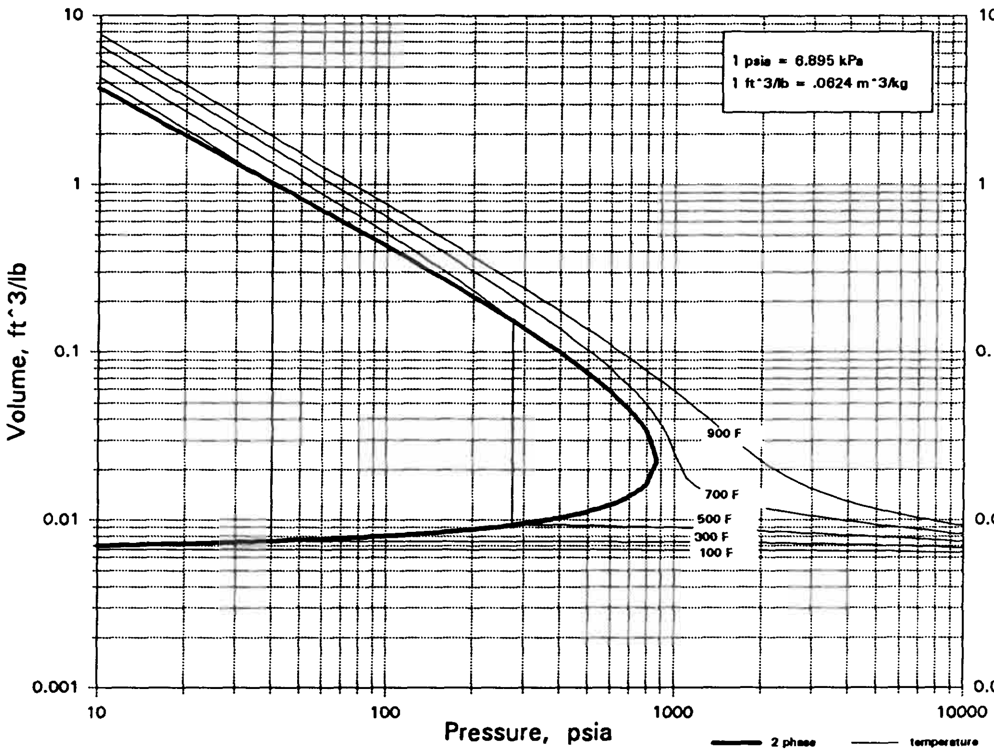


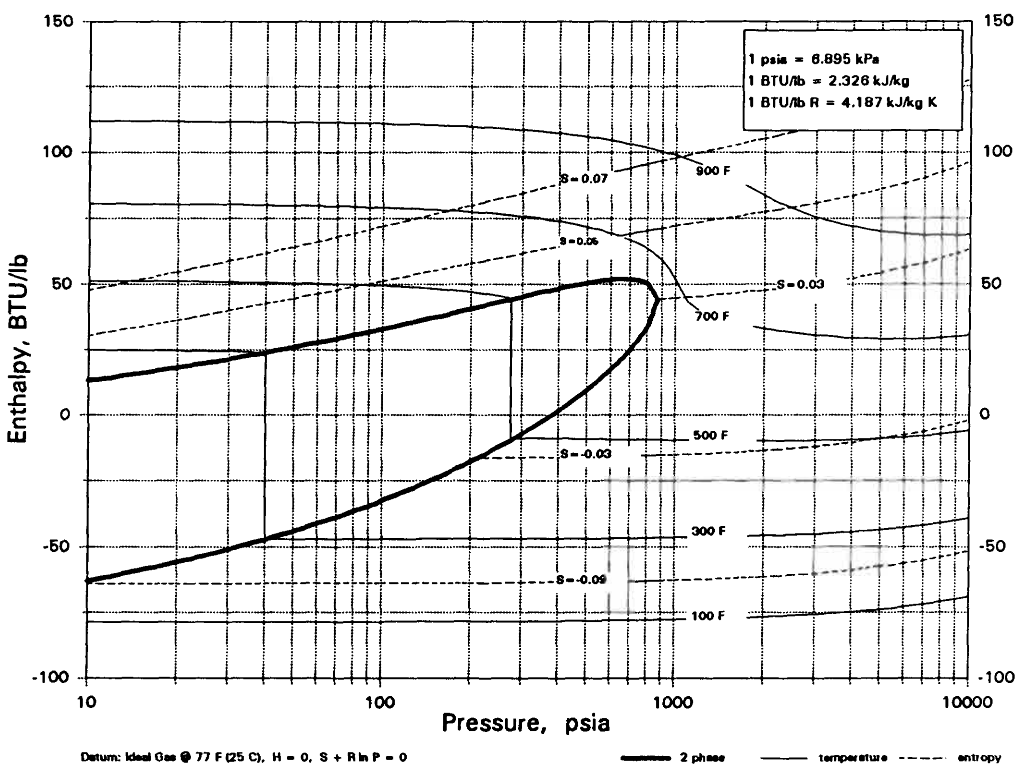
C2H4 ETHYLENE



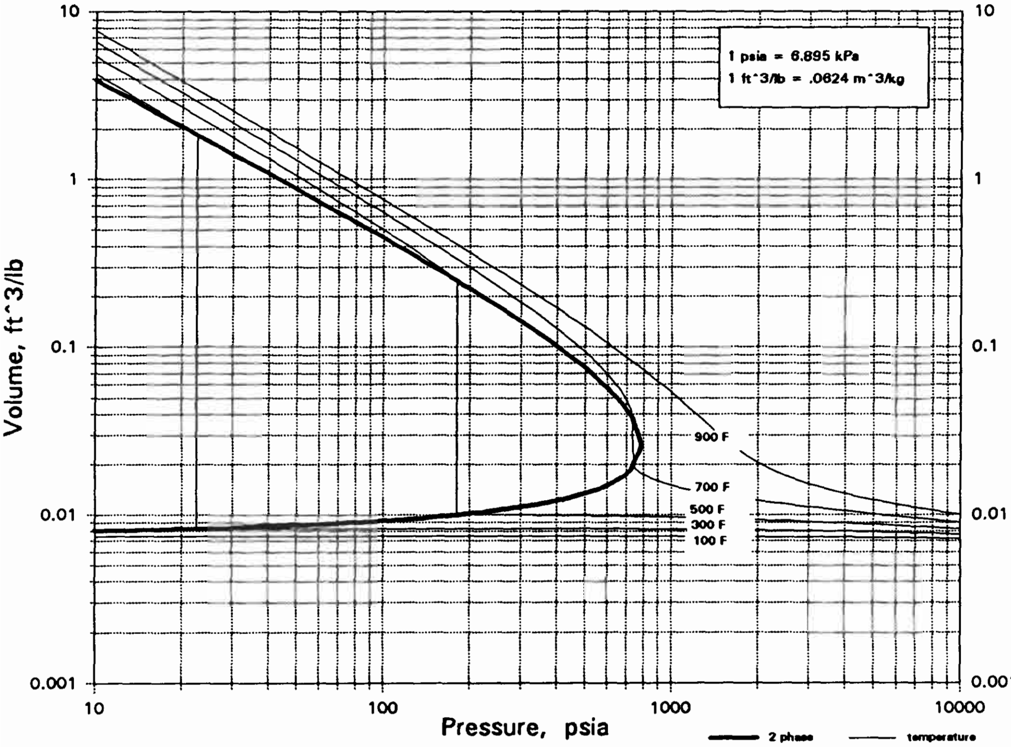


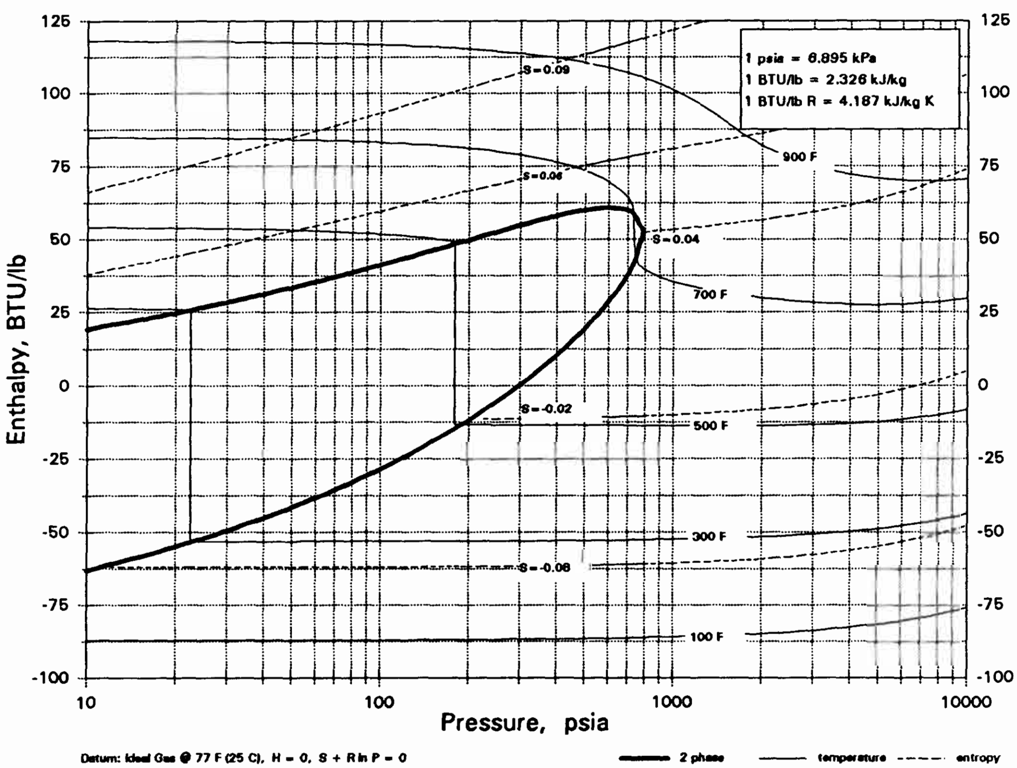
C2H4Br2 1-1-DIBROMOETHANE



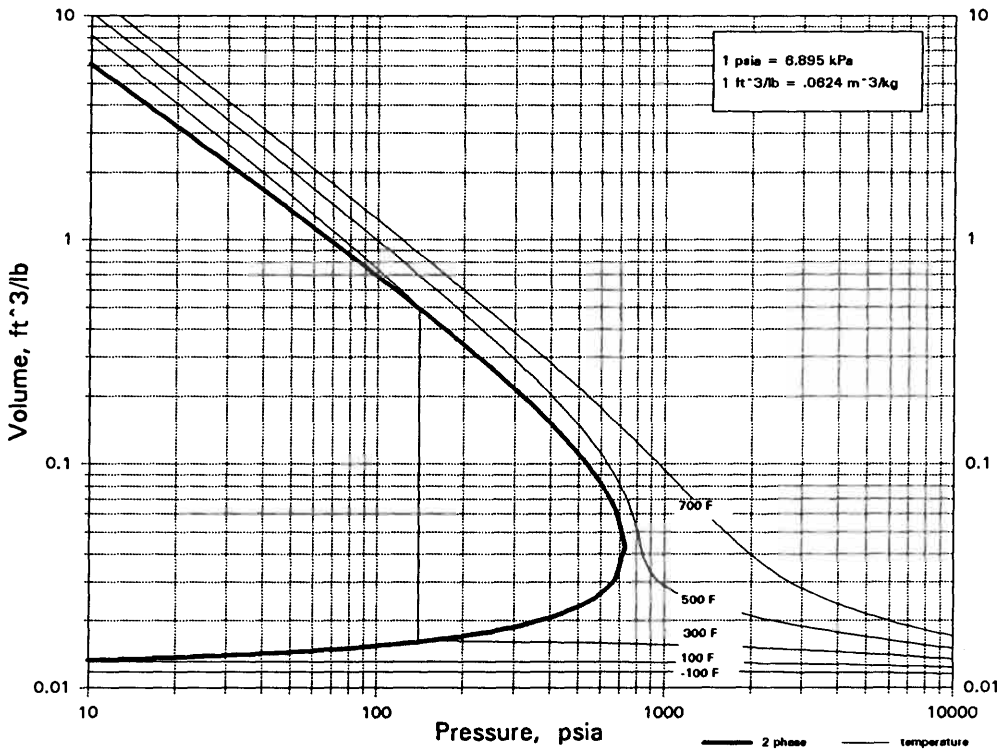


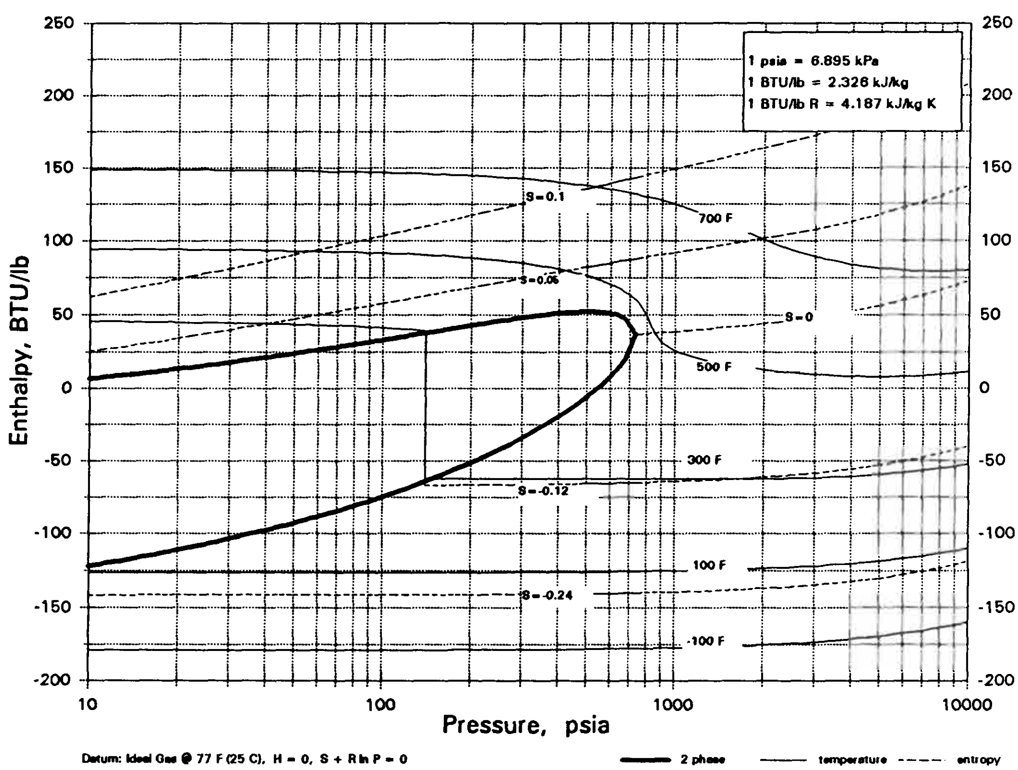
C2H4Br2 1-2-DIBROMOETHANE





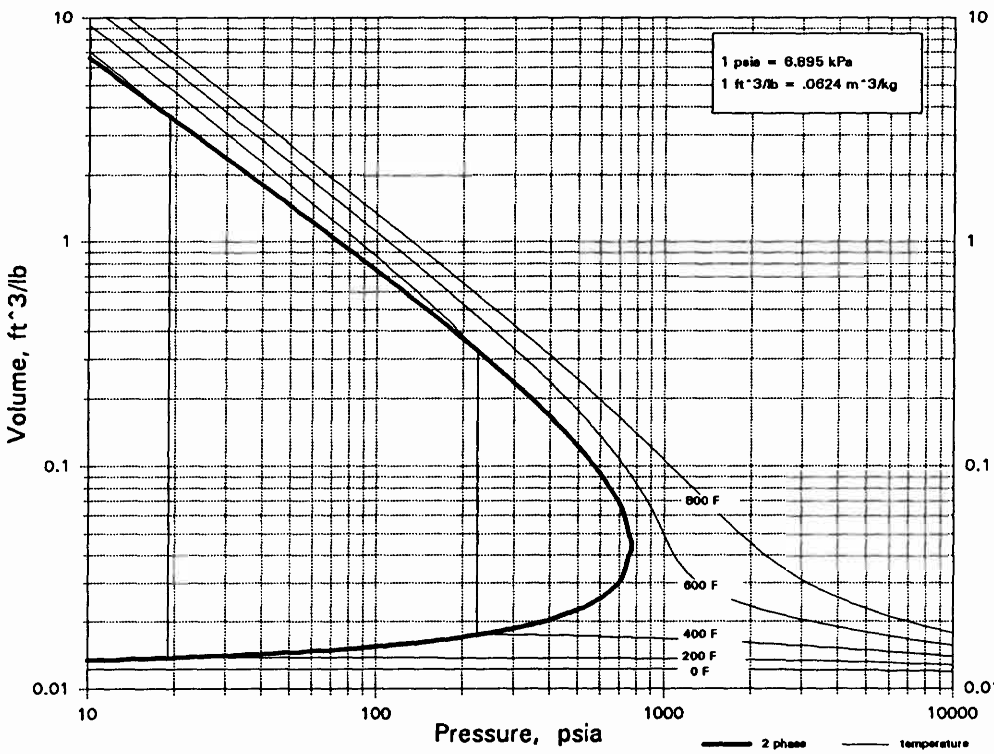
C2H4Cl2 1-1-DICHLOROETHANE

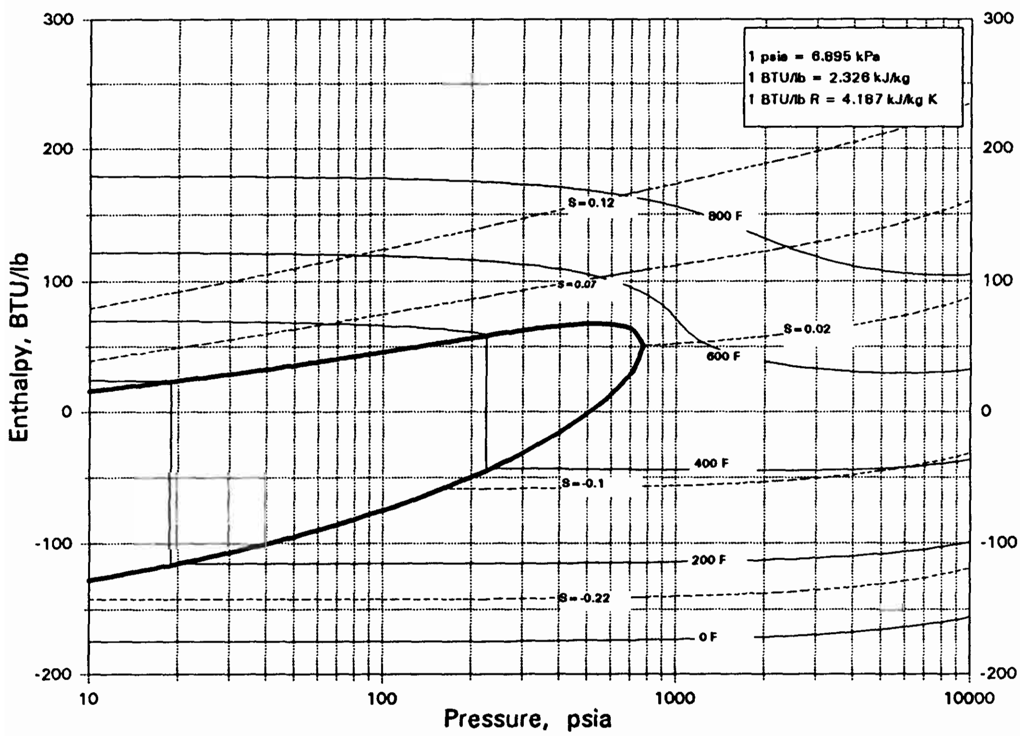




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

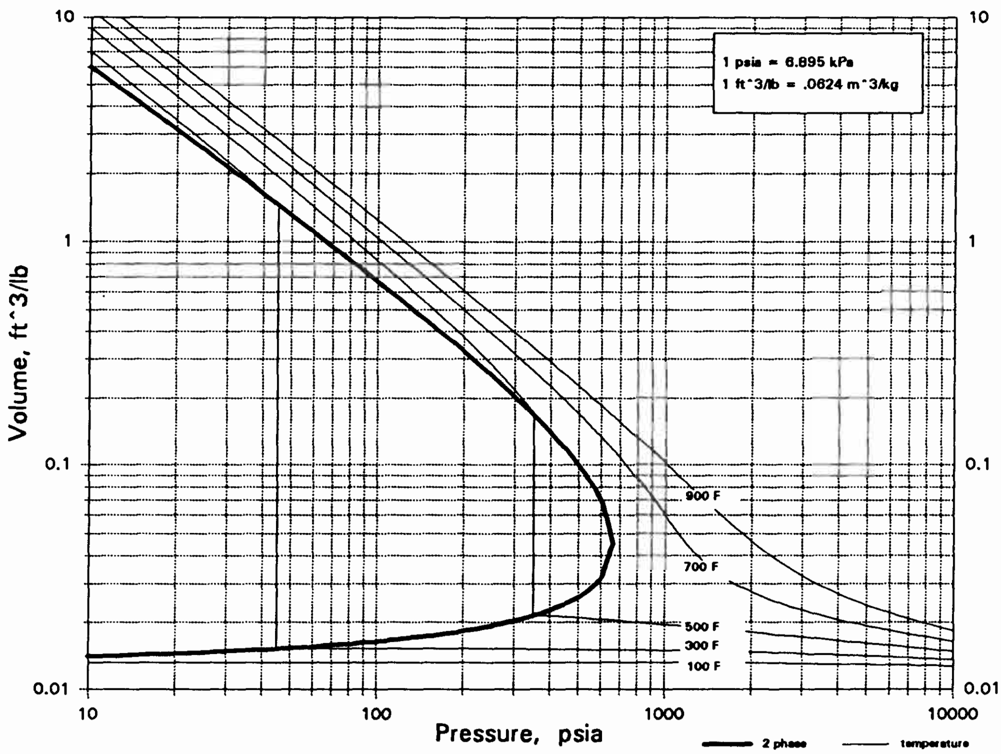
C2H4Cl2 1-2-DICHLOROETHANE

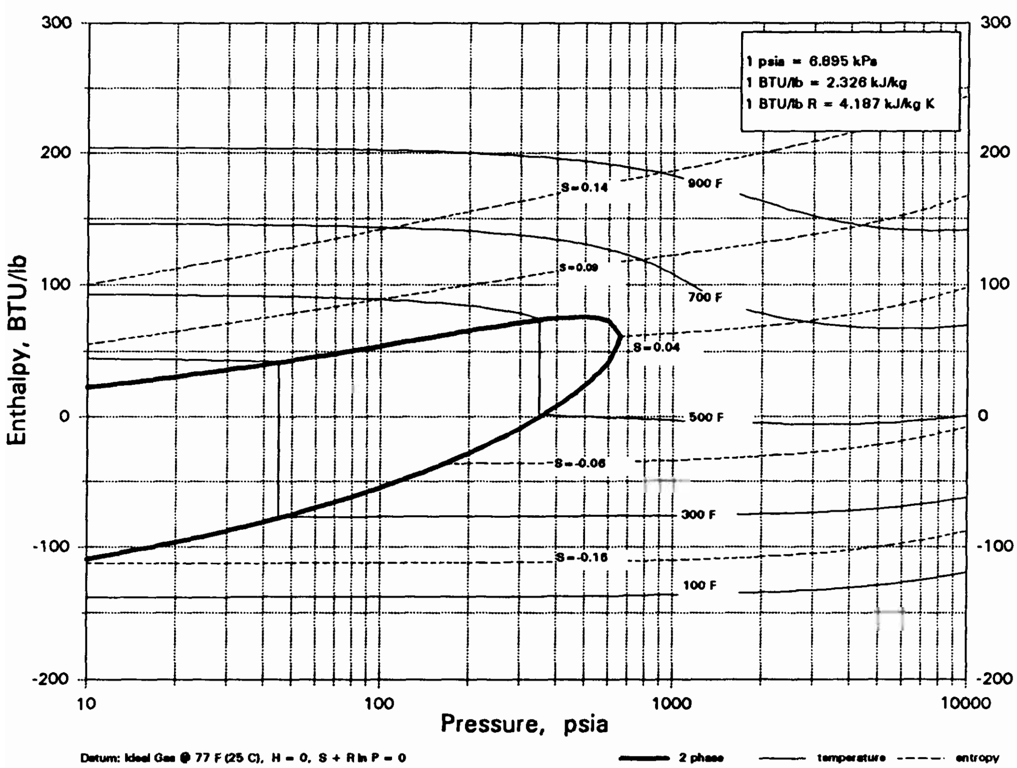




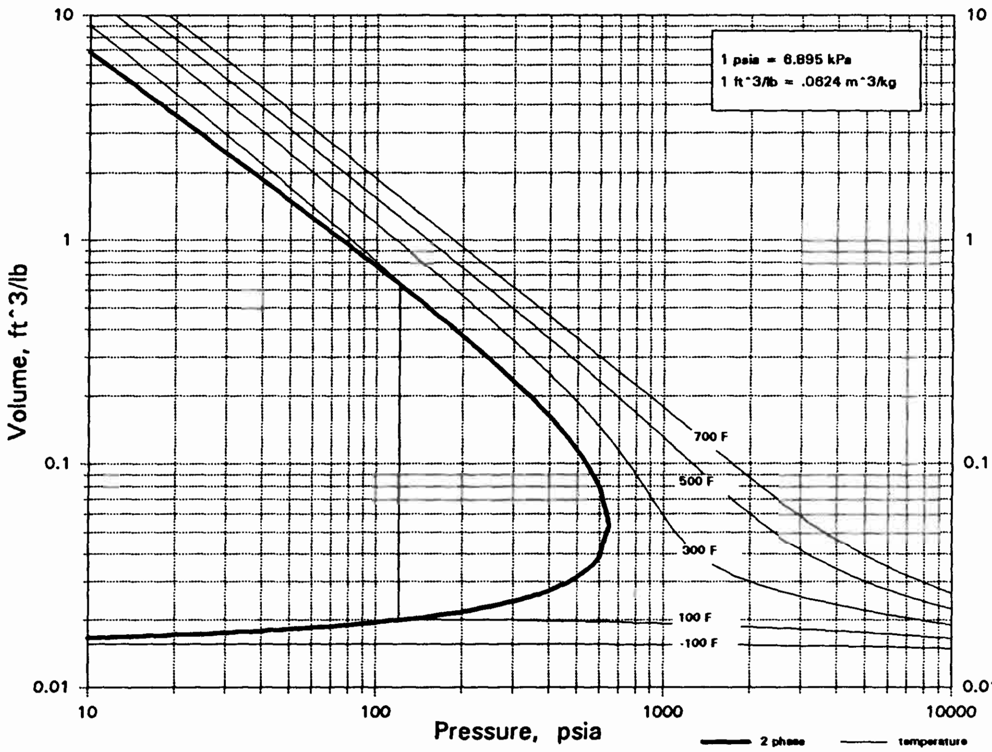
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

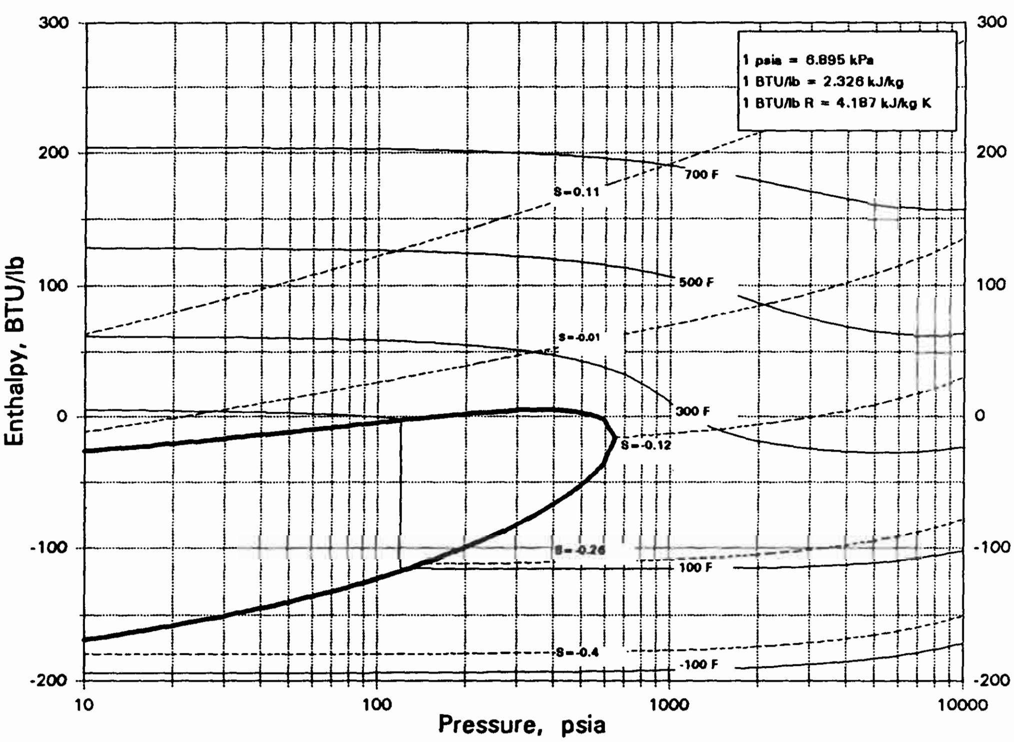
C2H4Cl2O BIS(CHLOROMETHYL)ETHER





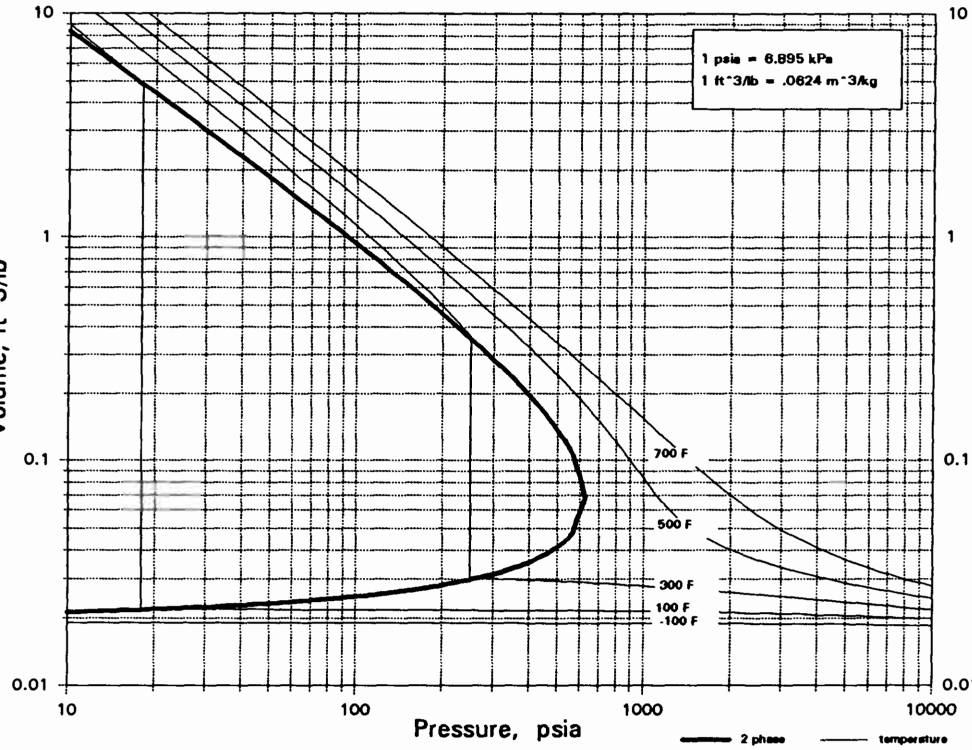
C2H4F2	1-1-DIFLUOROETHANE

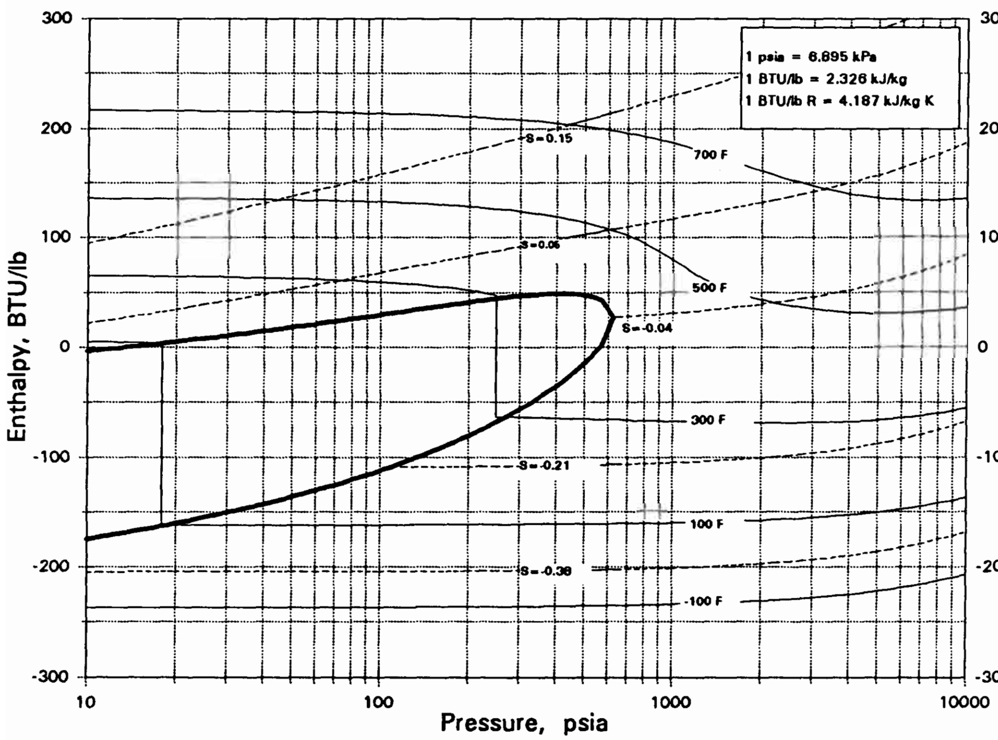




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

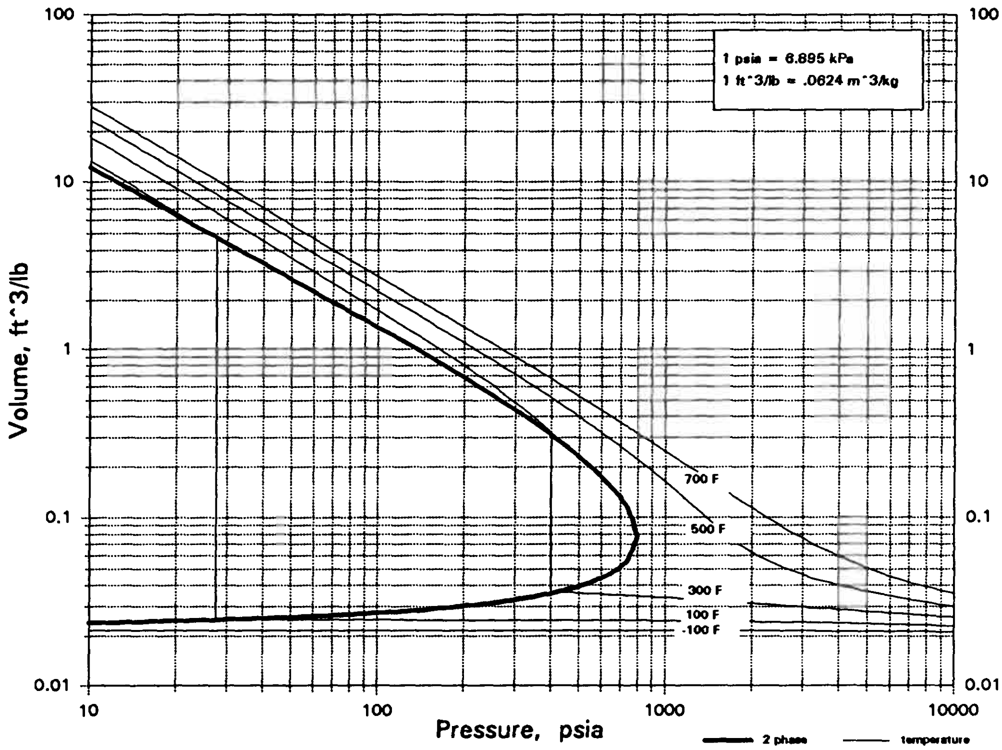
C2H4F2 1-2-DIFLUOROETHANE

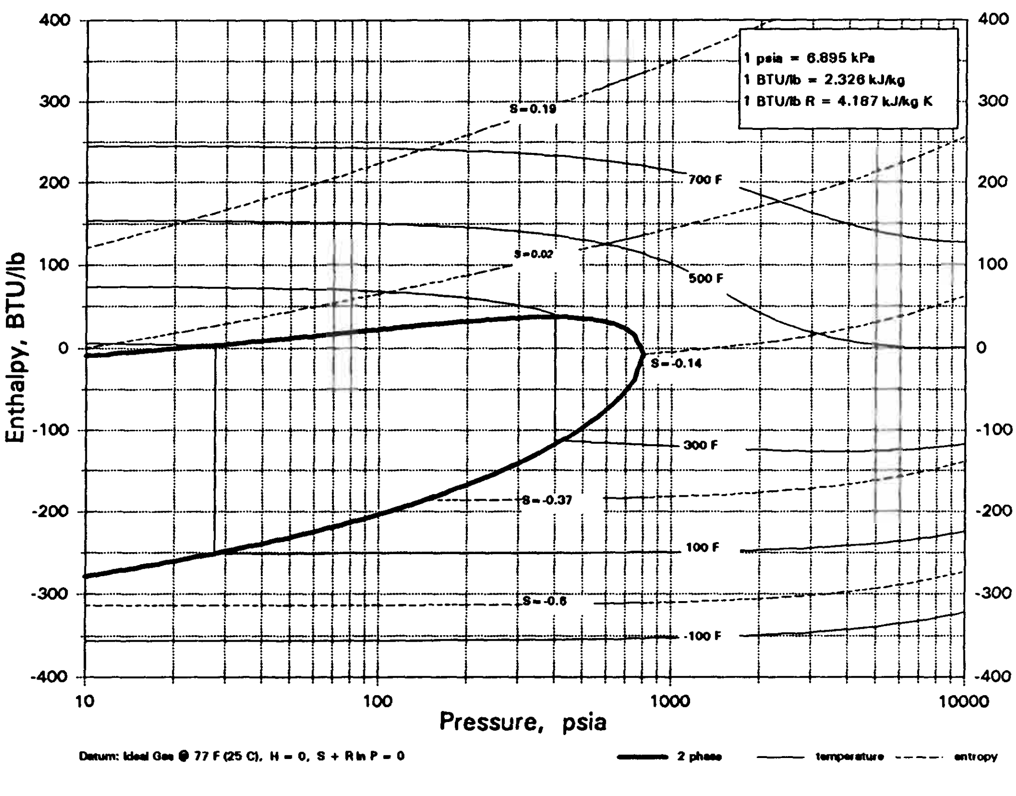




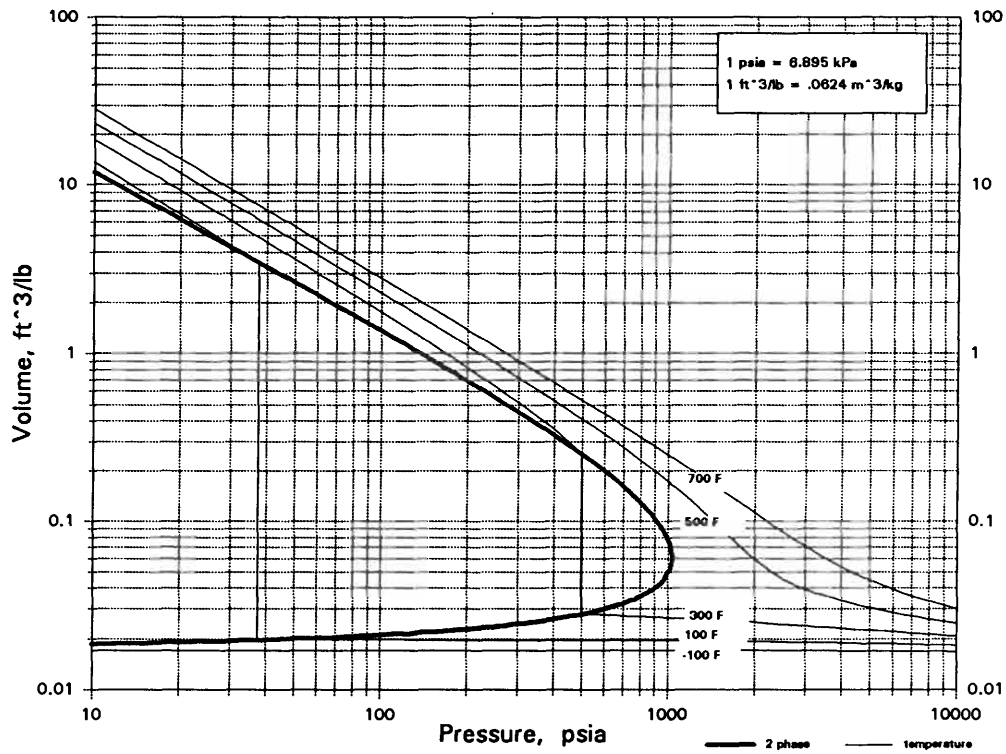
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

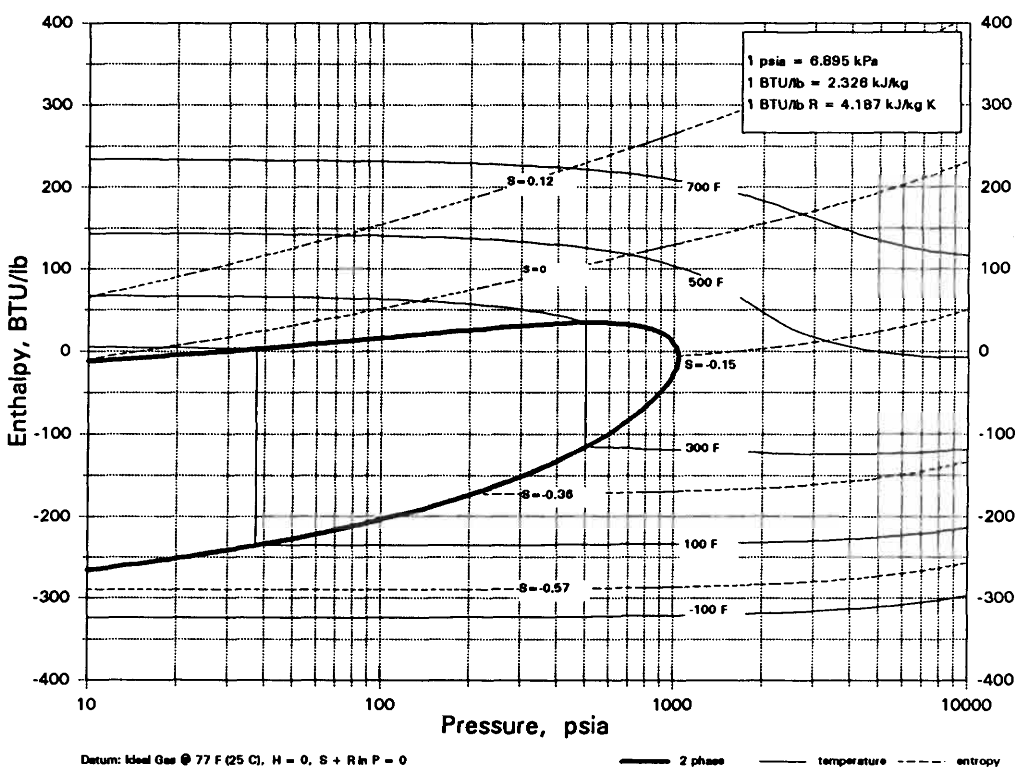
C2H4O ACETALDEHYDE



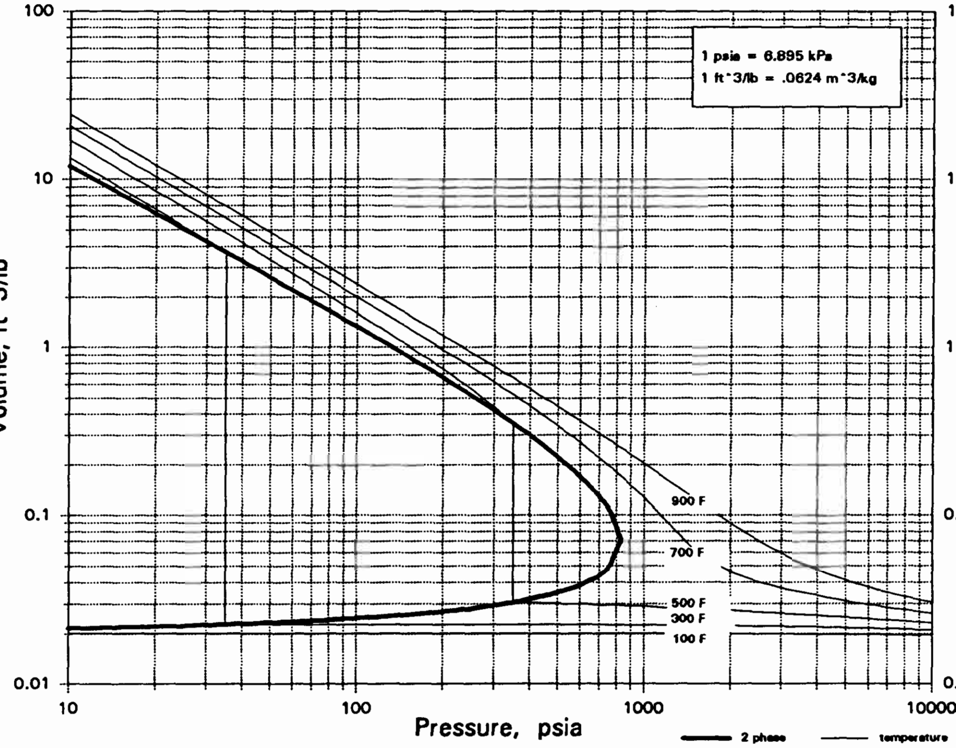


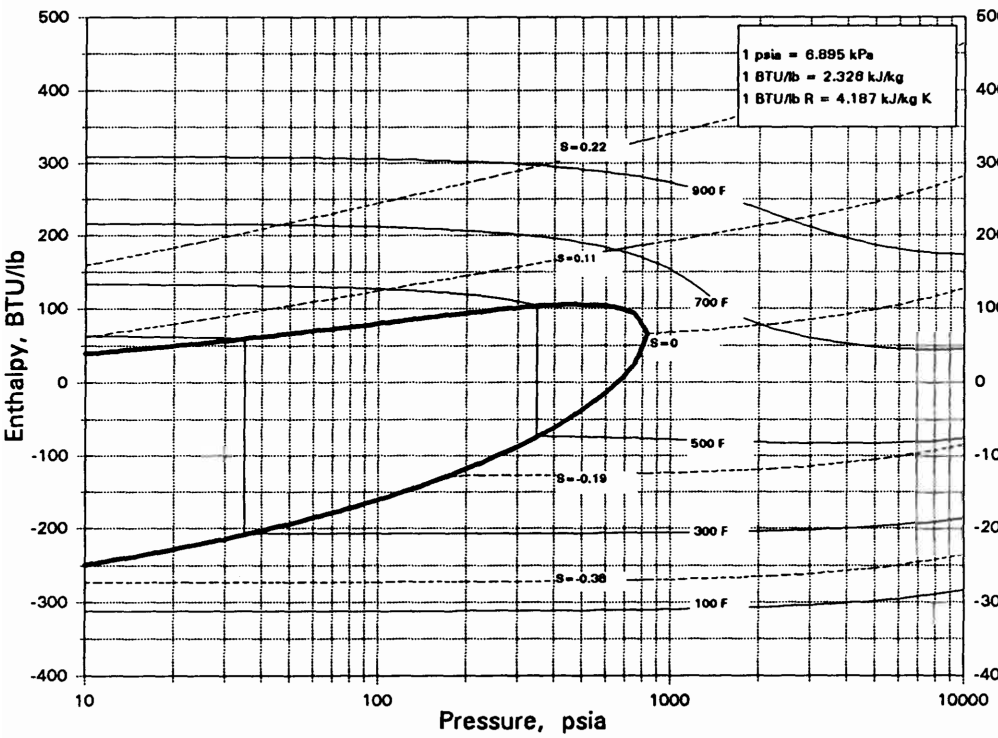
C2H4O ETHYLENE OXIDE





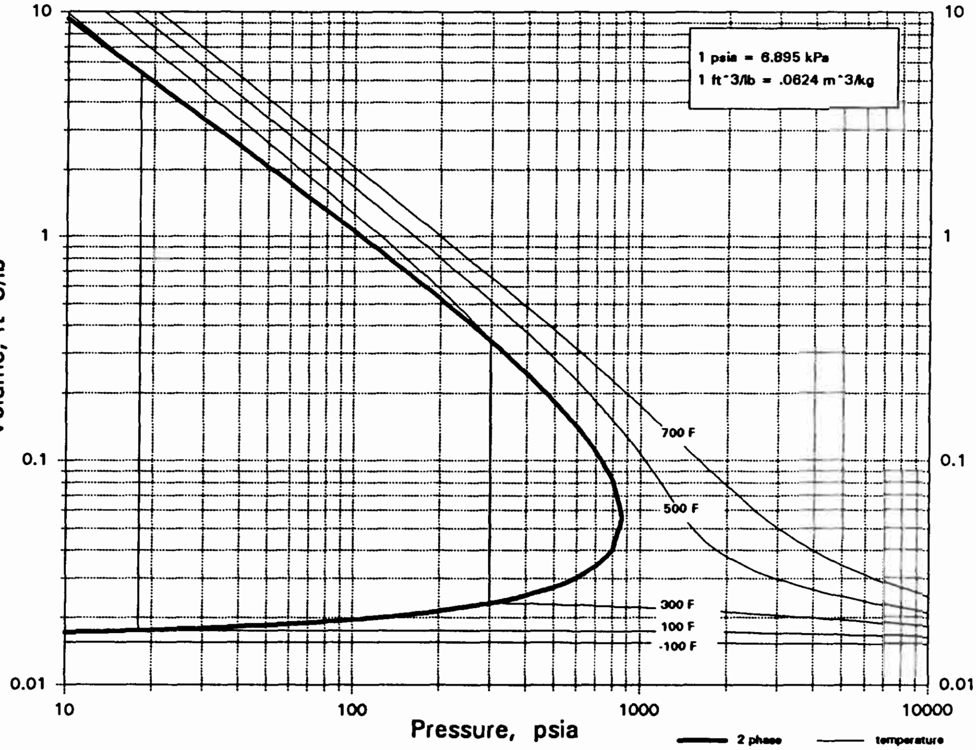
C2H4O2 ACETIC ACID

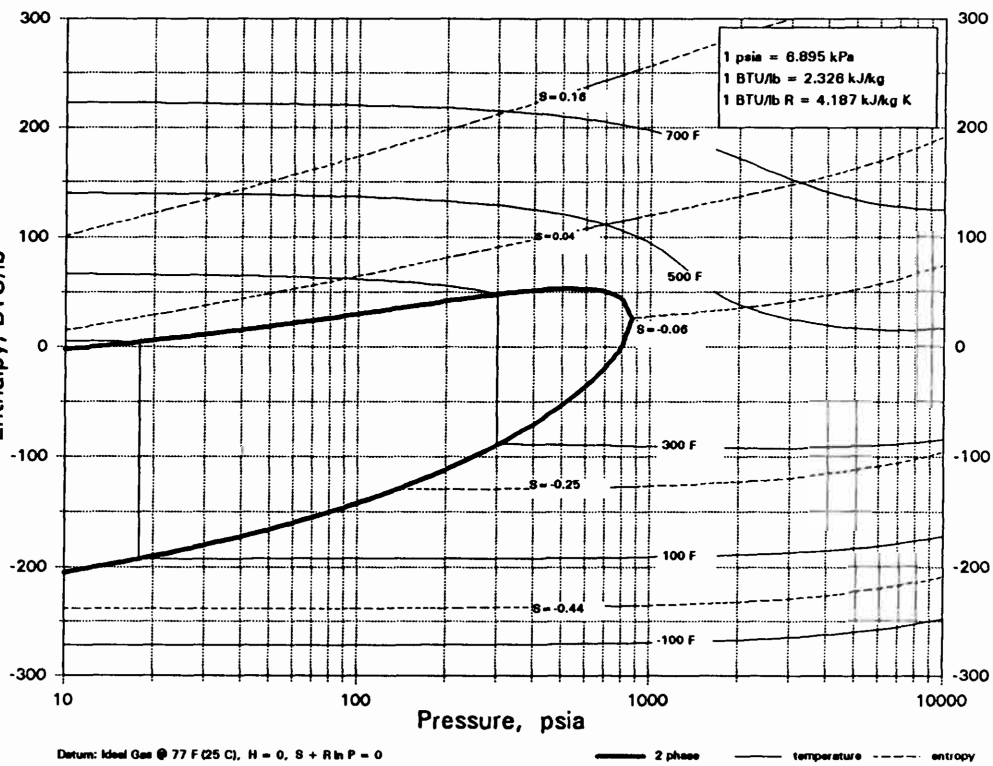




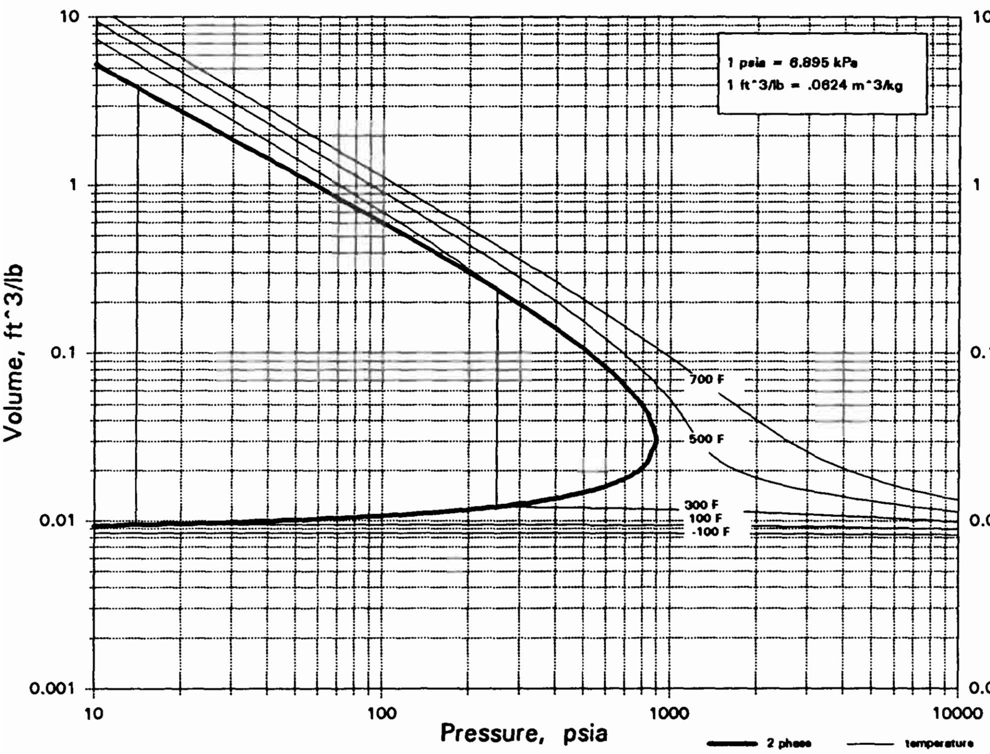
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

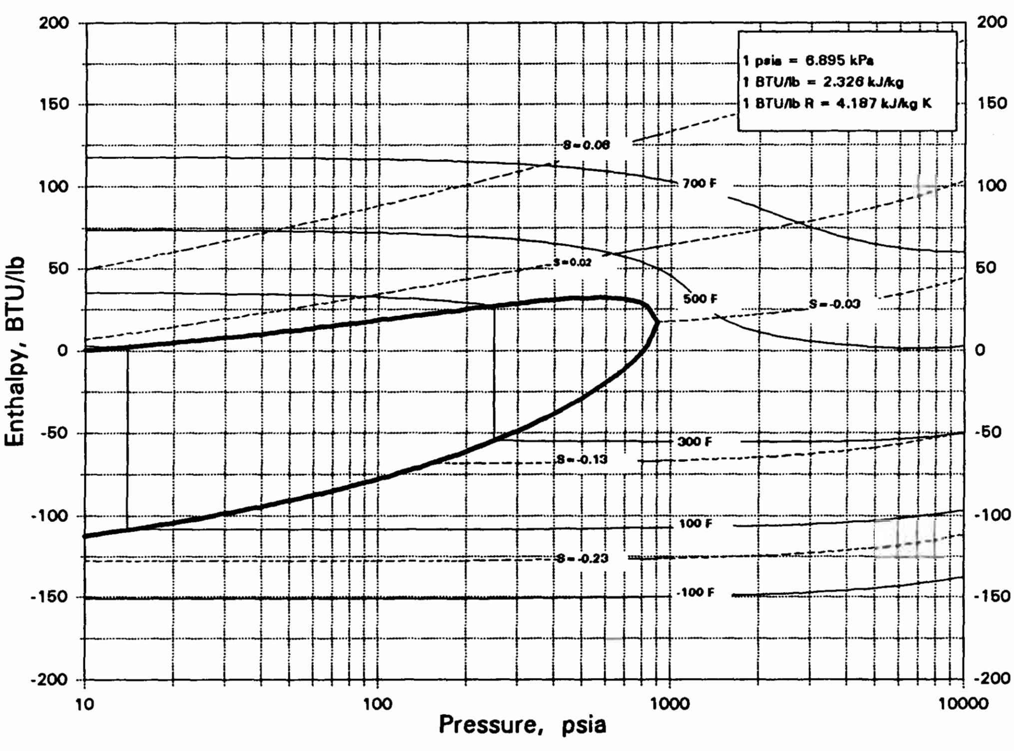
C2H4O2 METHYL FORMATE



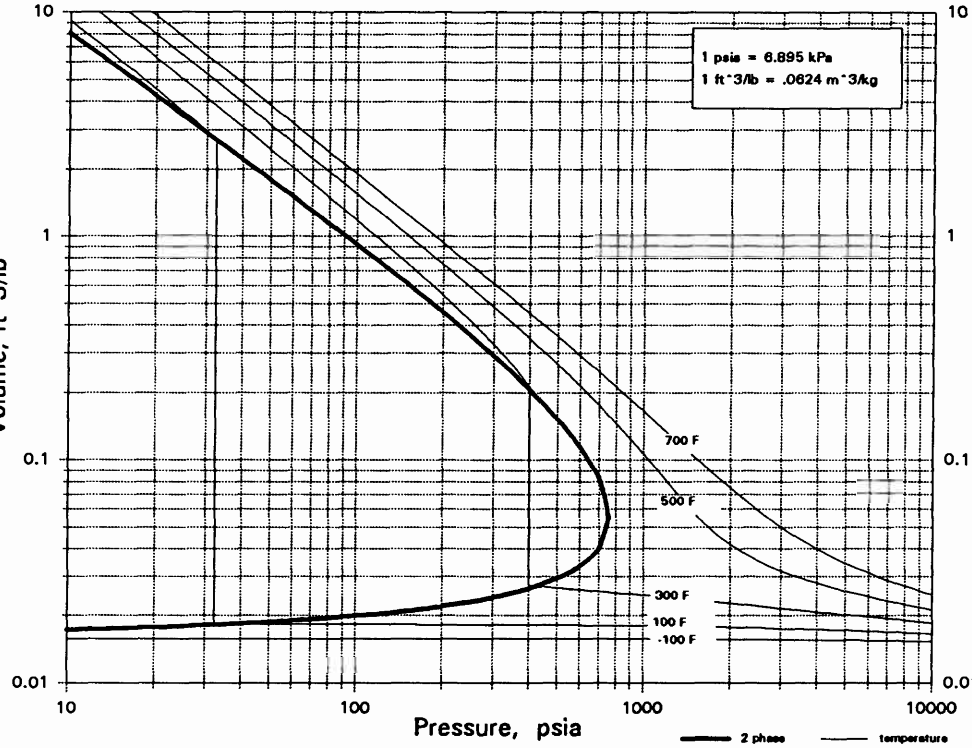


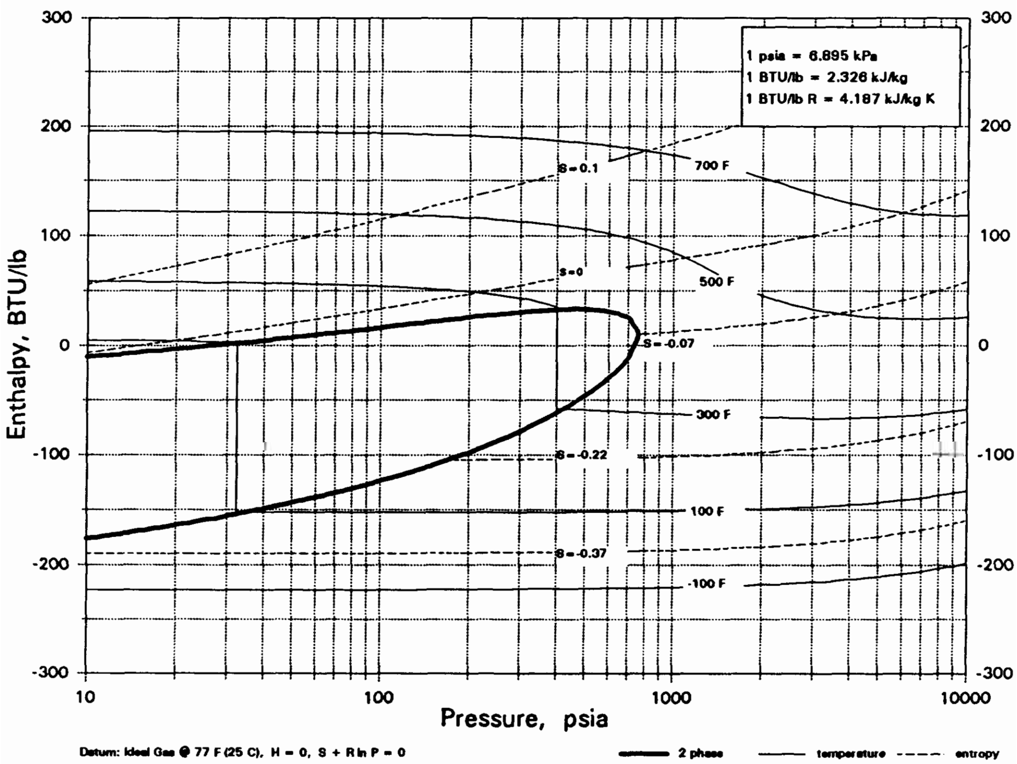
C2H5Br BROMOETHANE



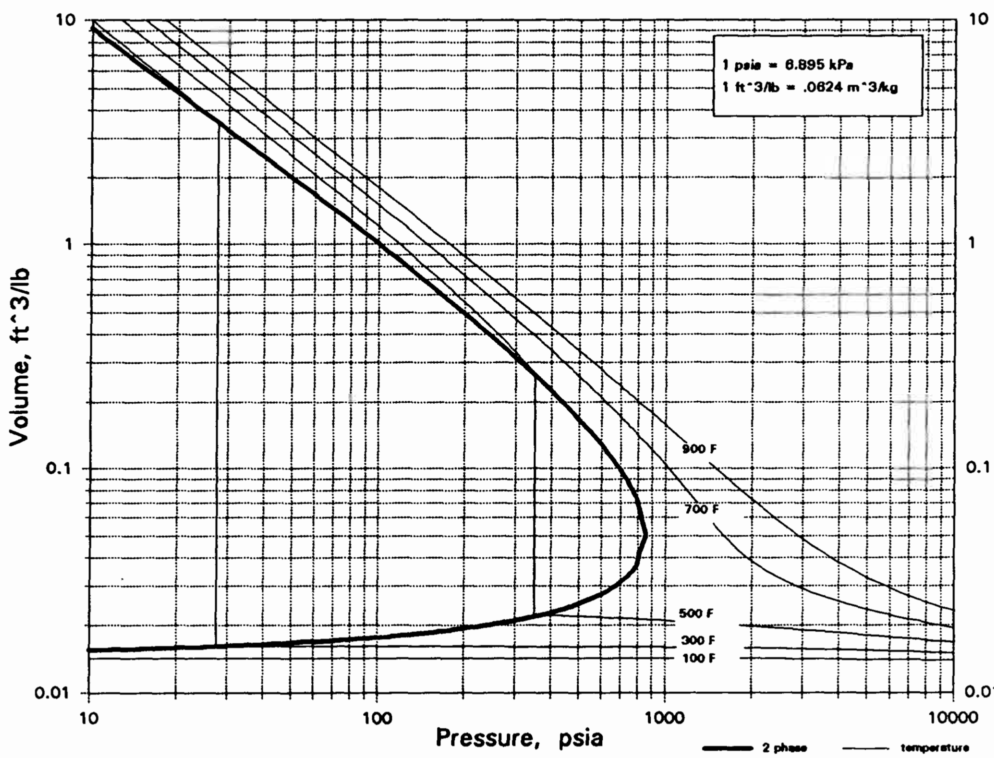


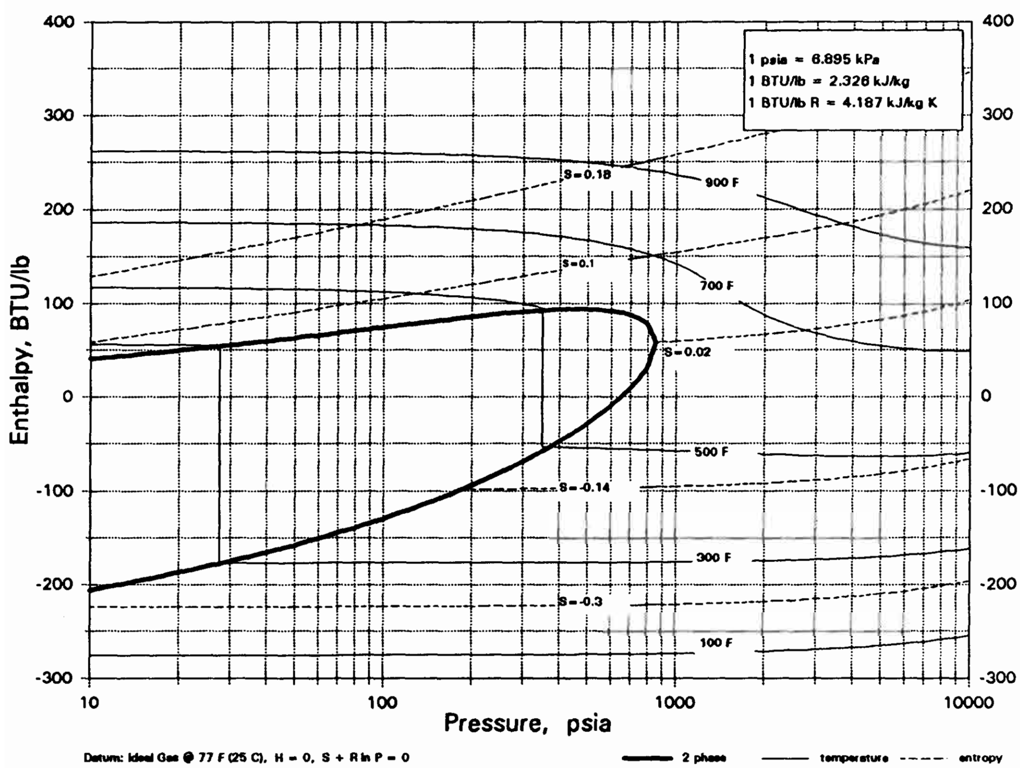
C2H5Cl	ETHYL CHLORIDE



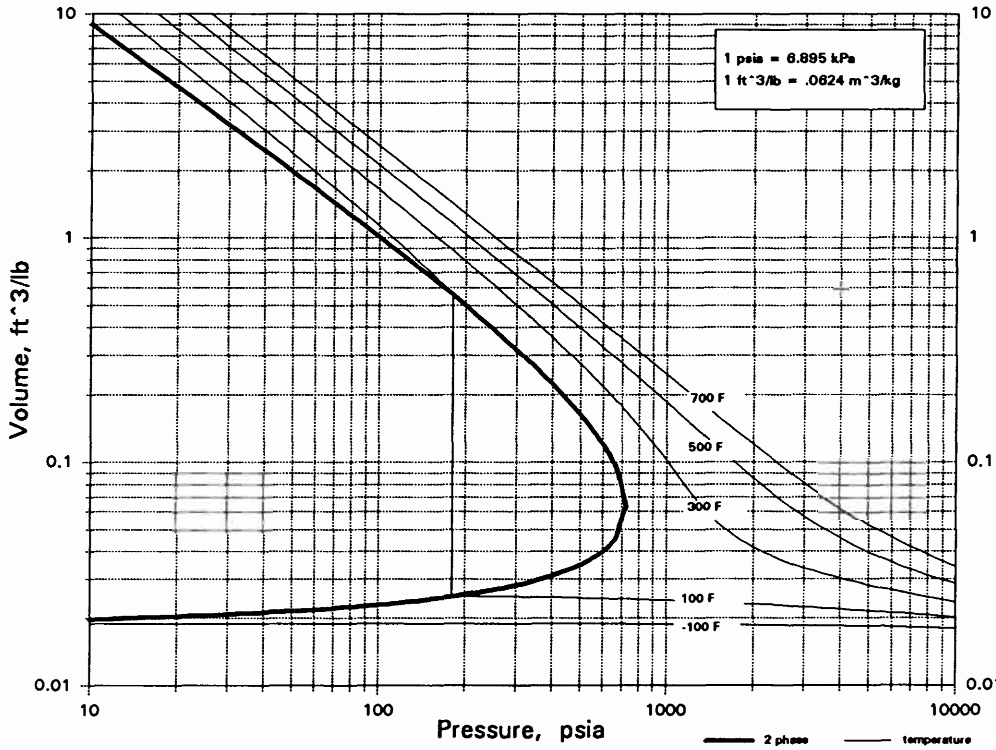


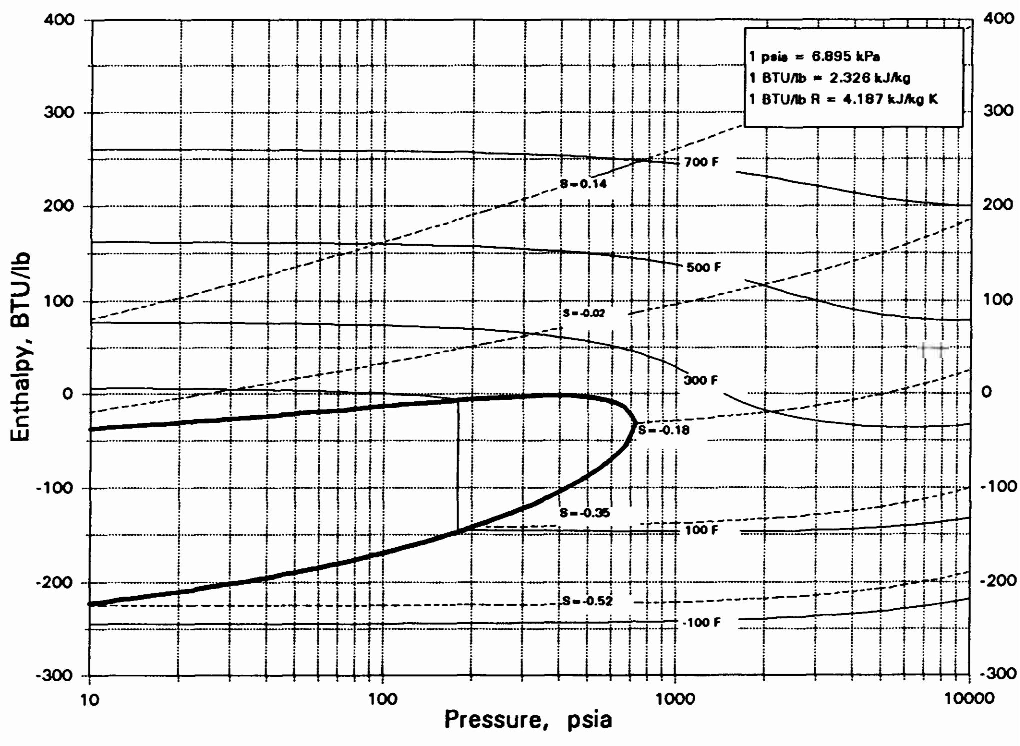
C2H5ClO 2-CHLOROETHANOL





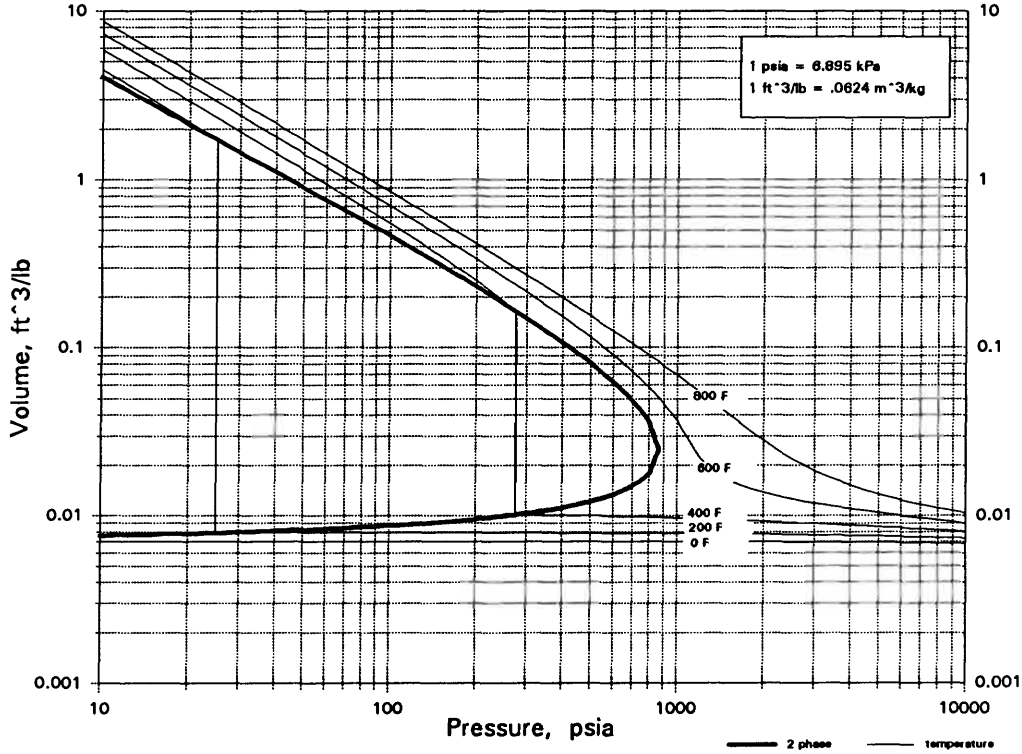
C2H5F ETHYL FLUORIDE

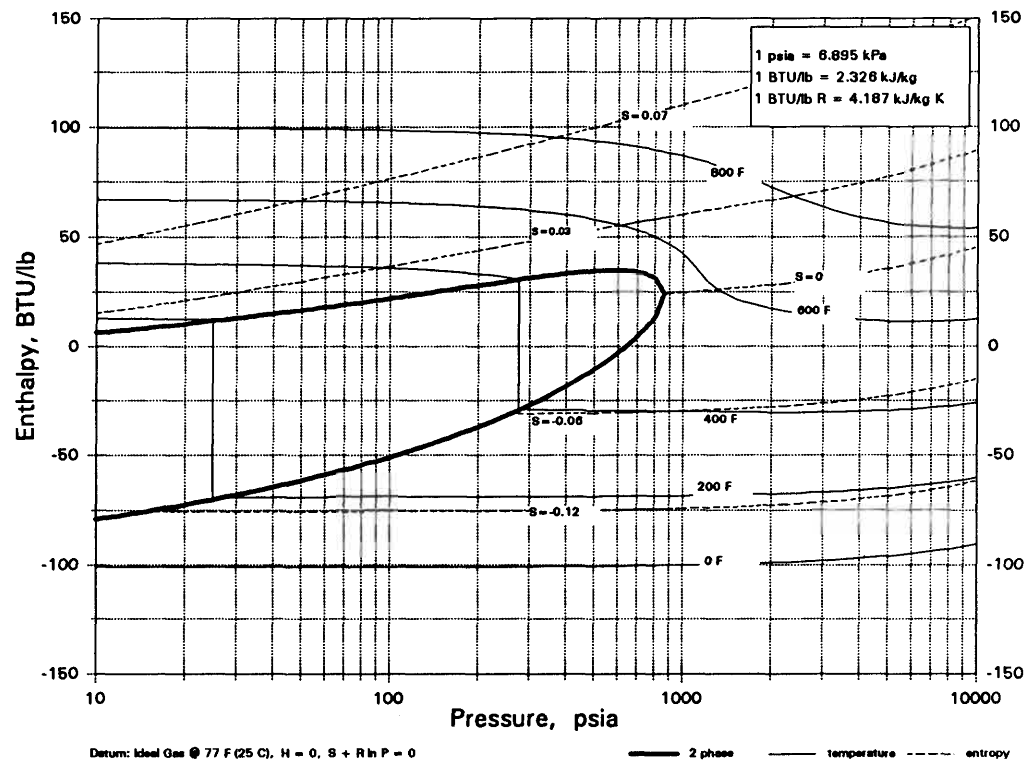




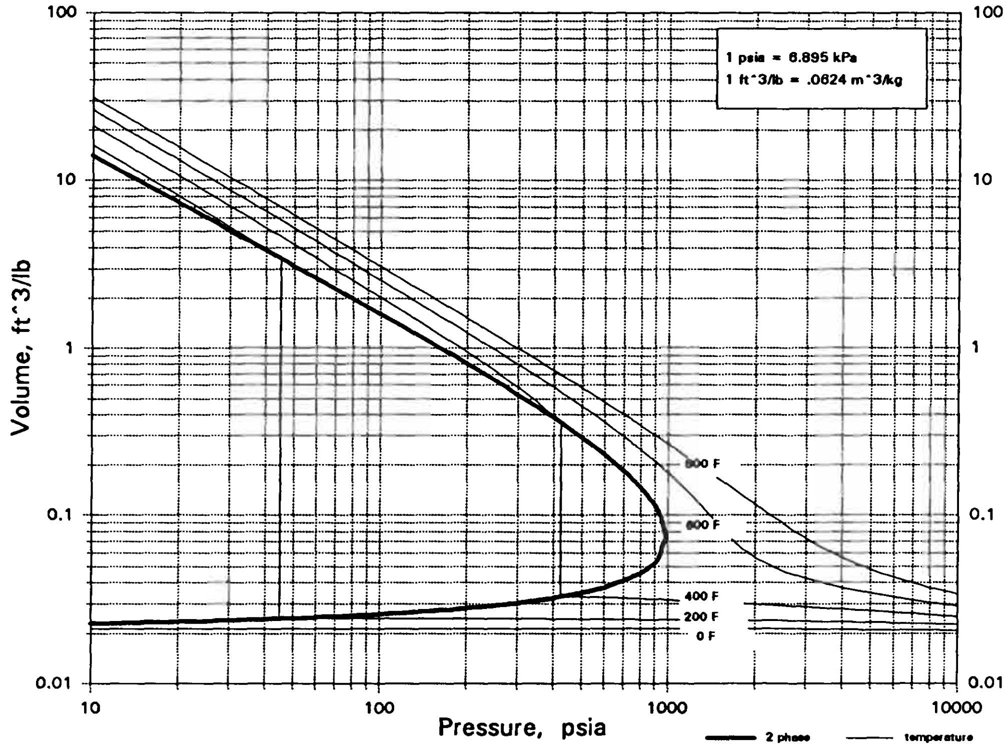
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

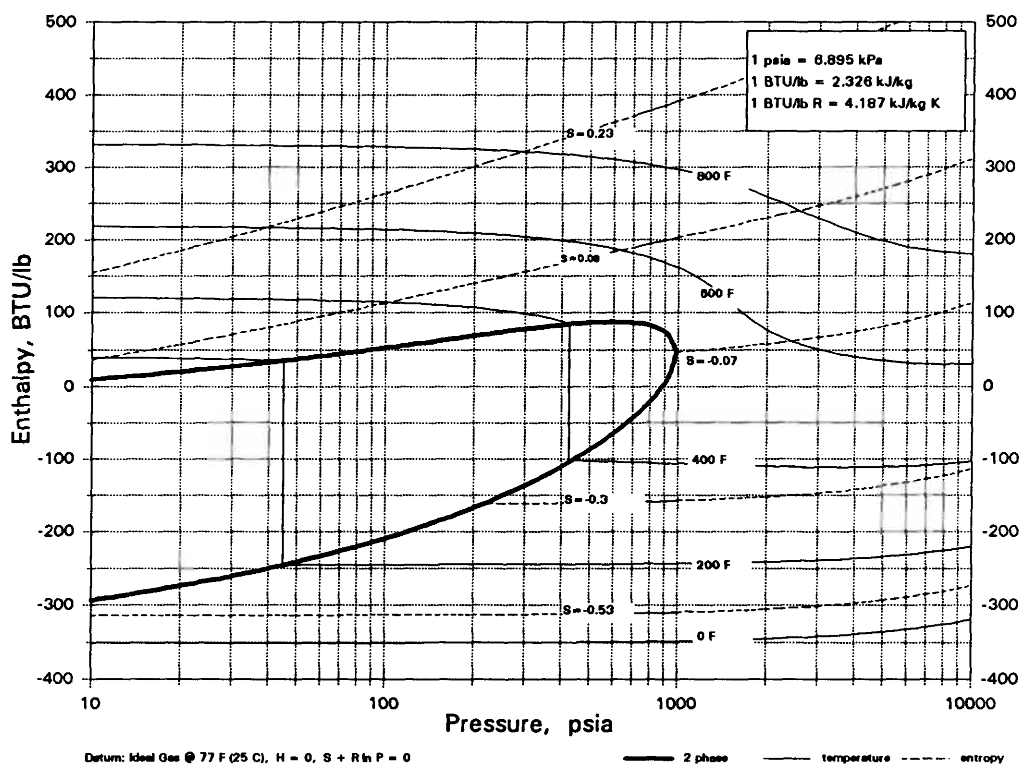
C2H5I ETHYL IODIDE



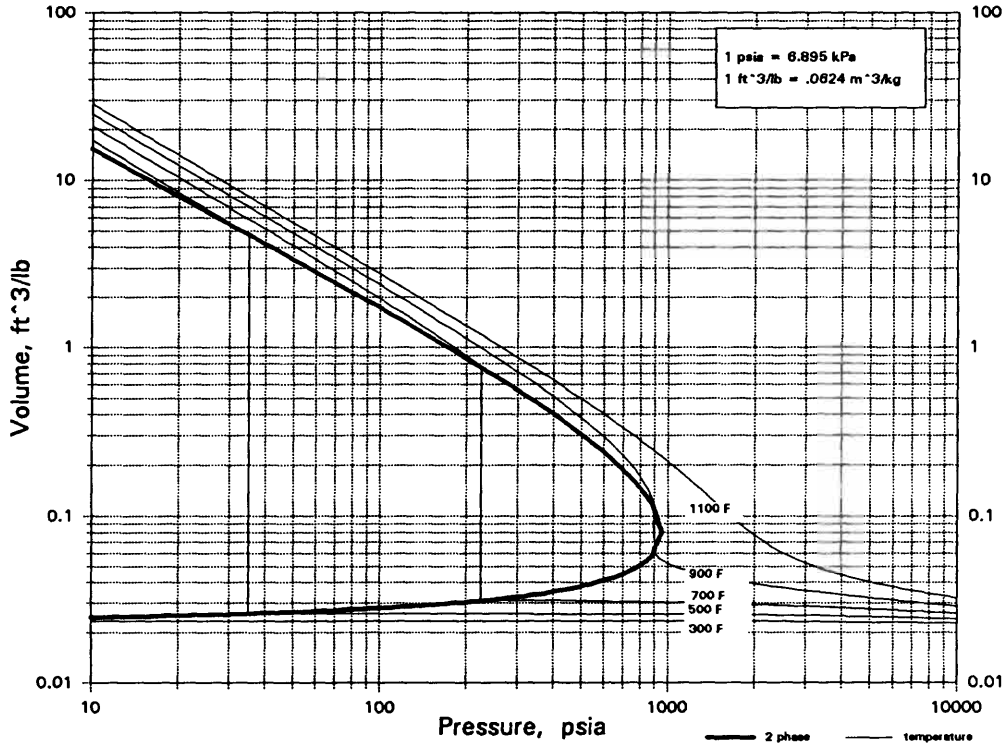


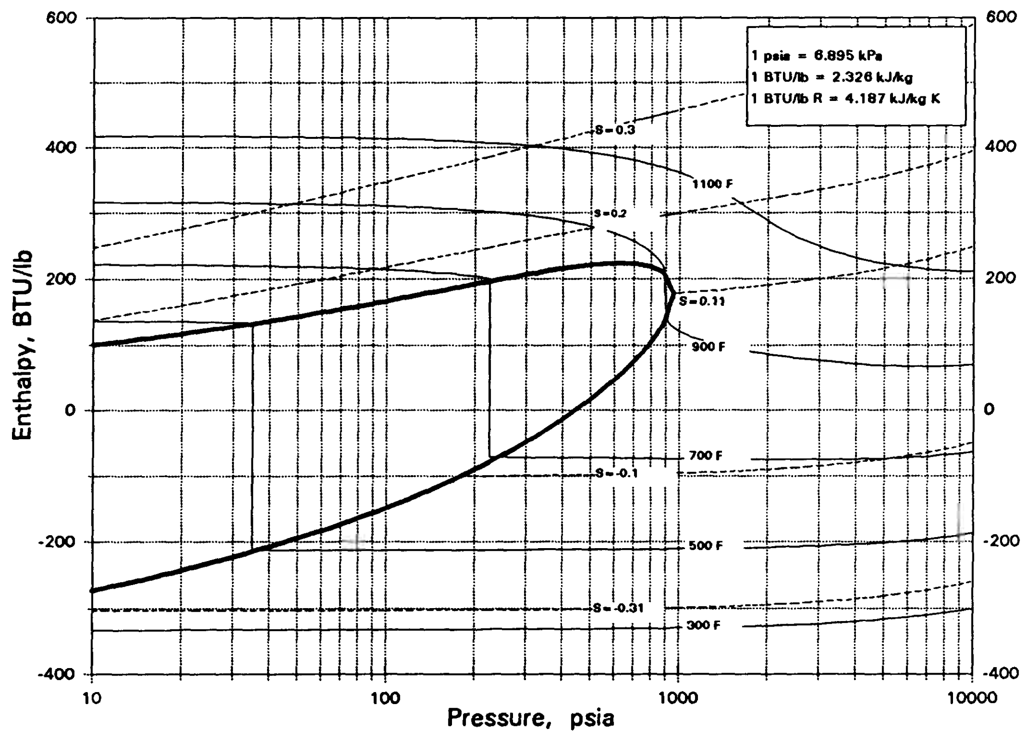
C2H5N ETHYLENEIMINE



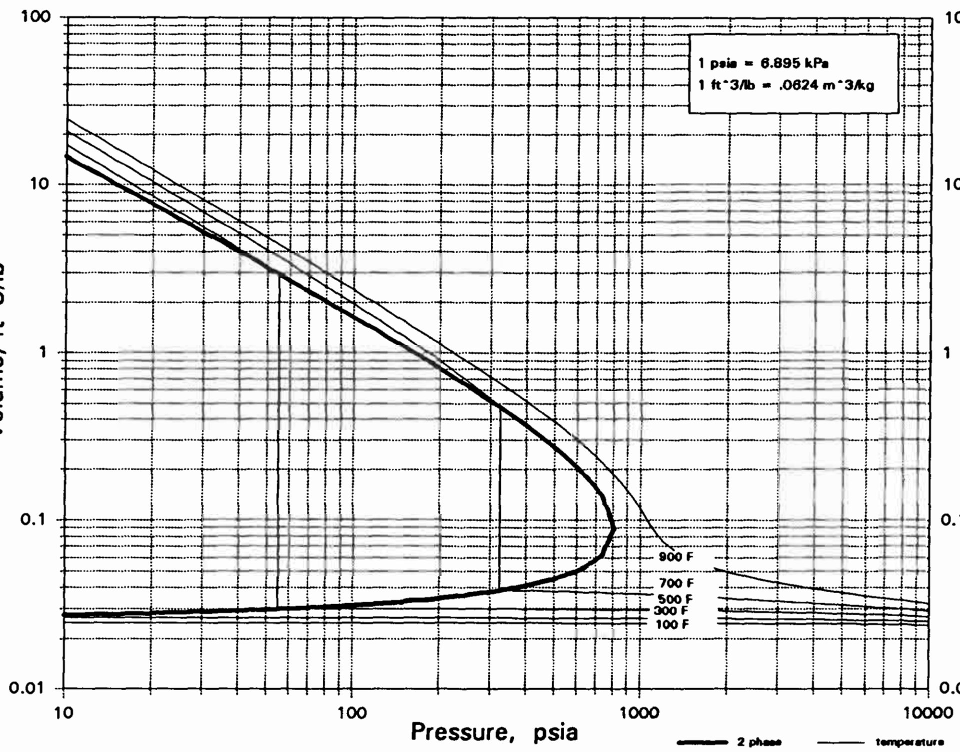


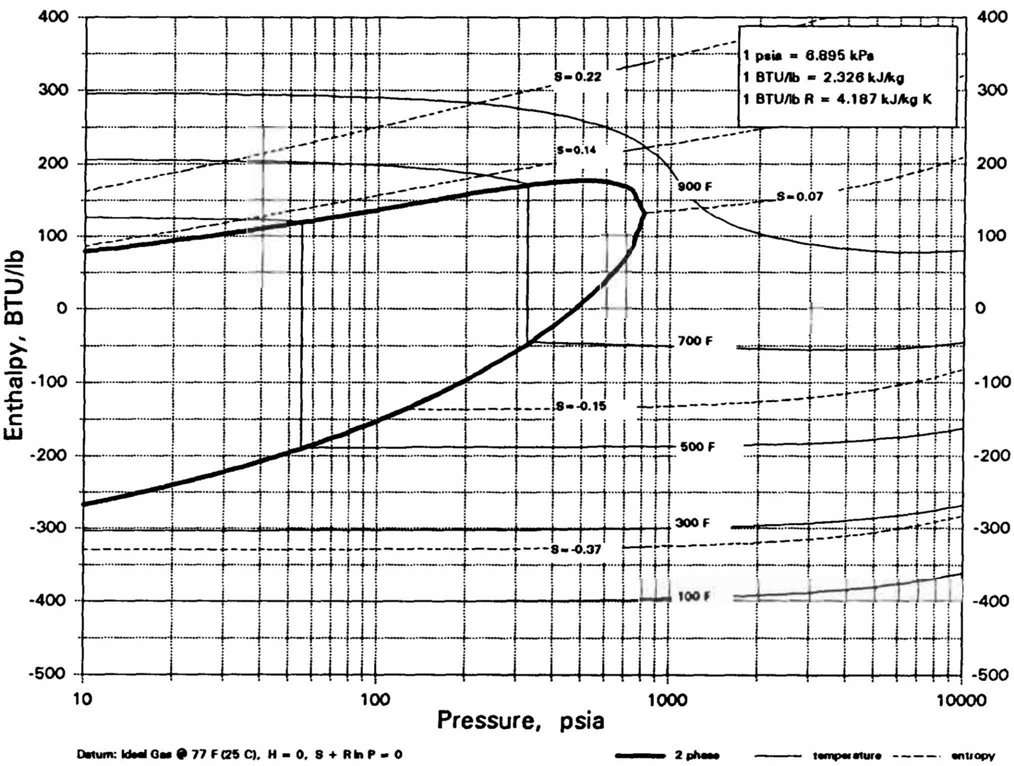
C2H5NO ACETAMIDE





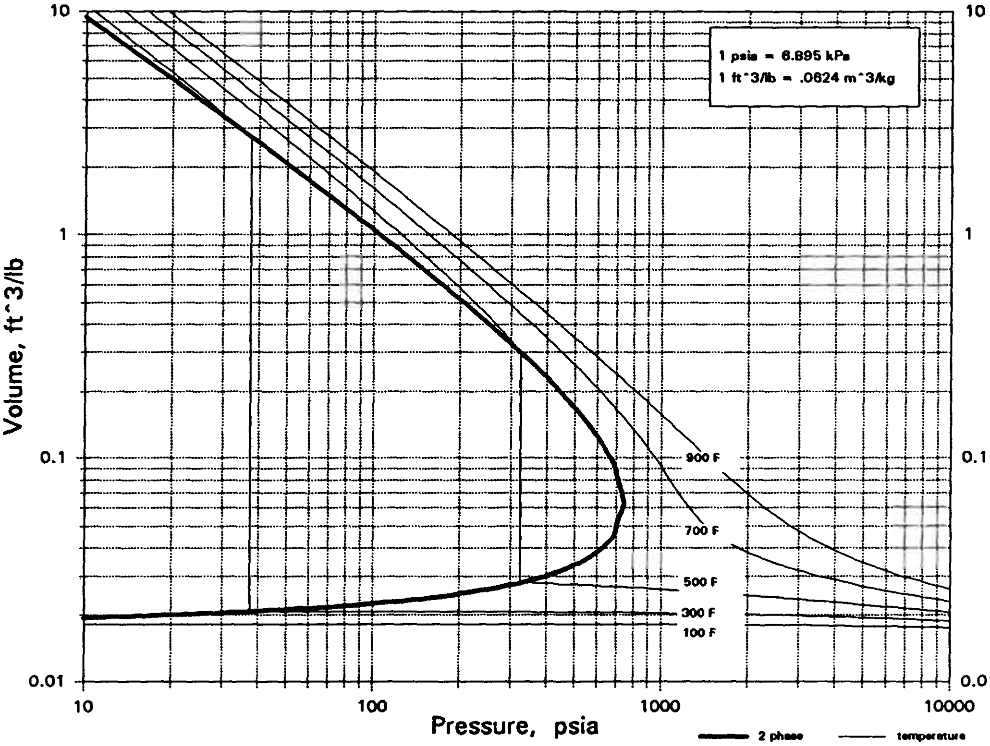
C2H5NO N-METHYLFORMAMIDE

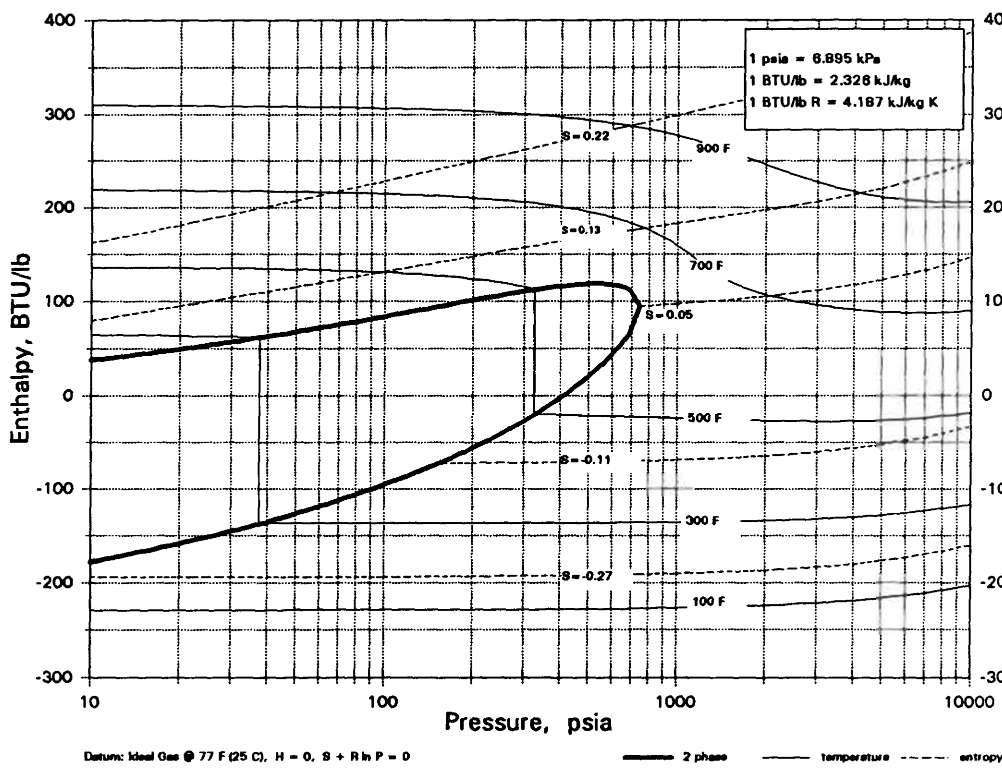




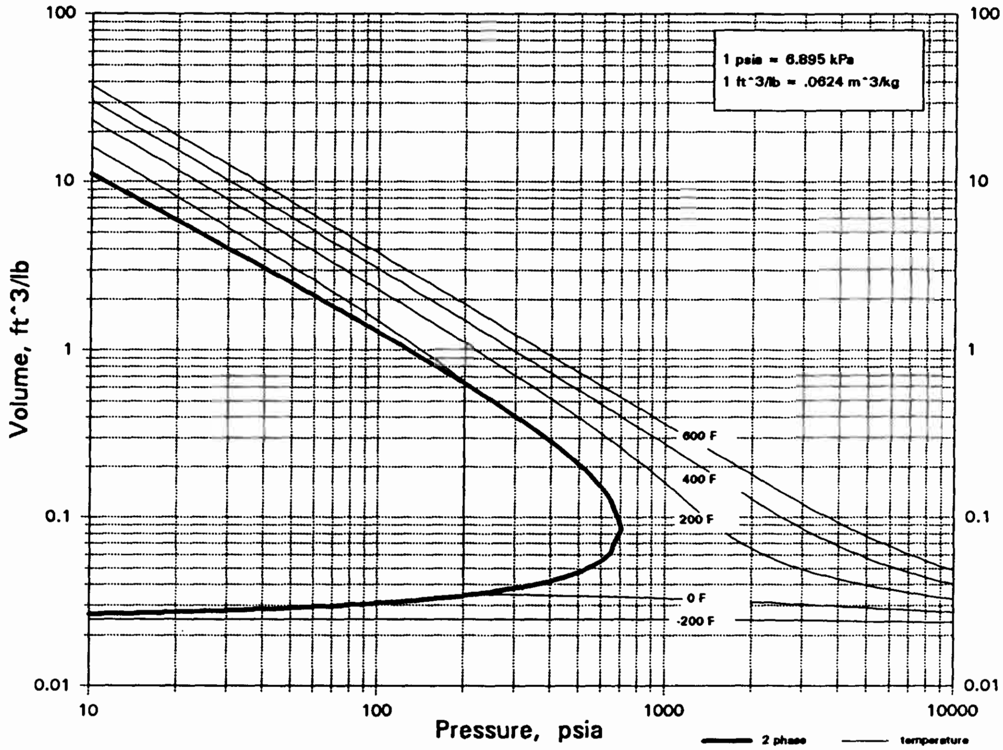
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

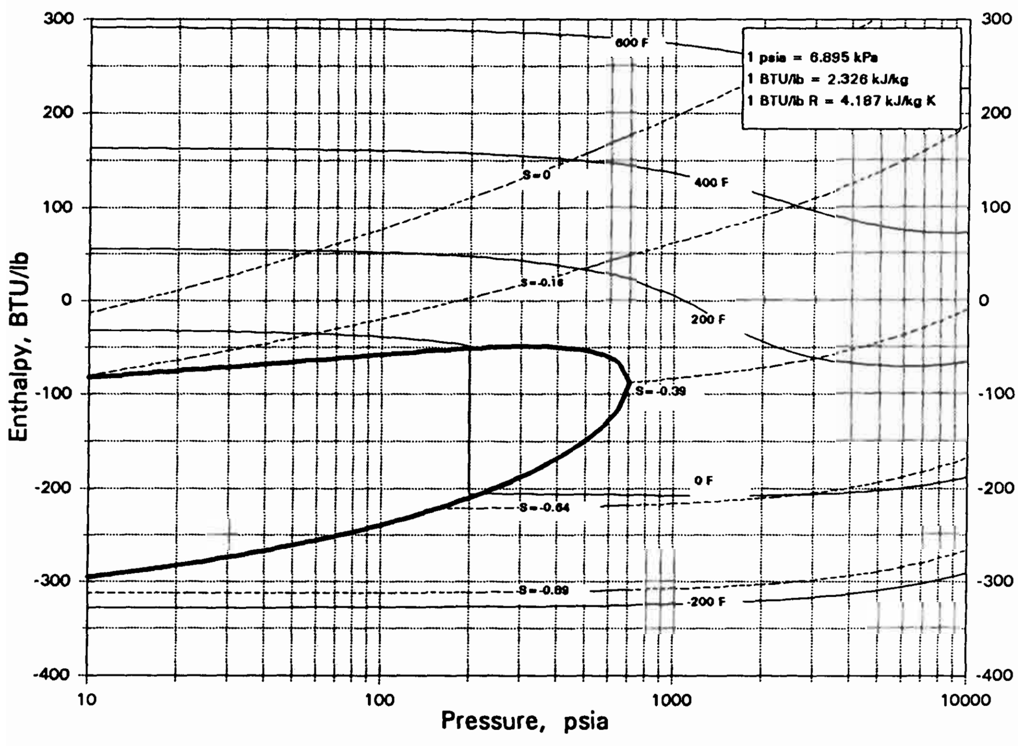
C2H5NO2 NITROETHANE





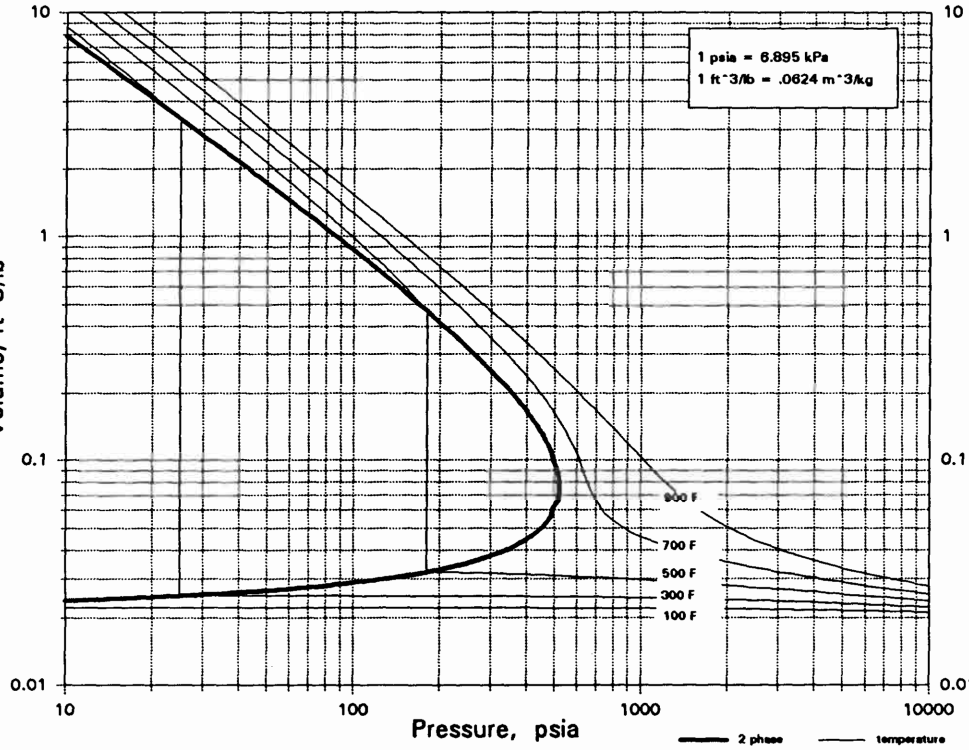
C2H6 ETHANE

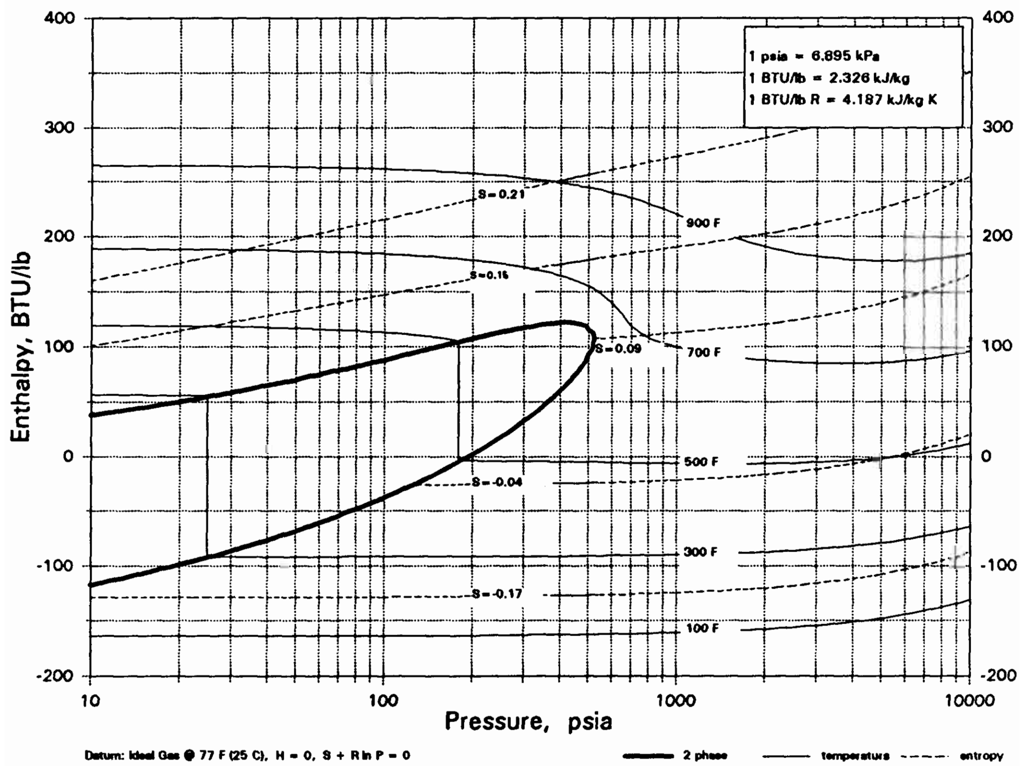




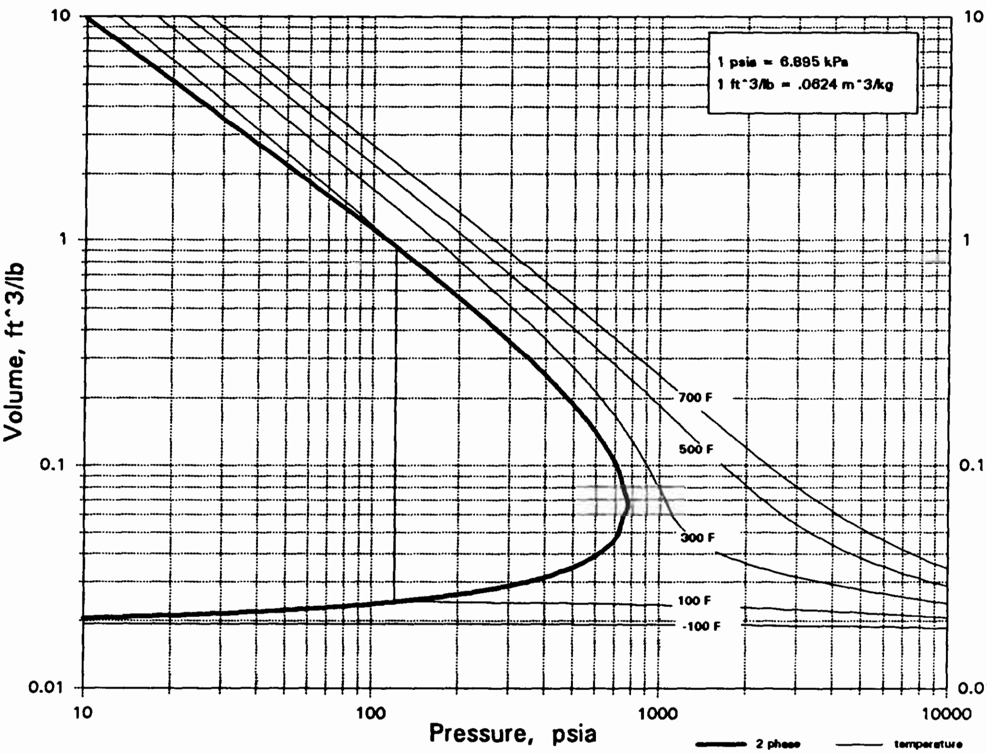
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

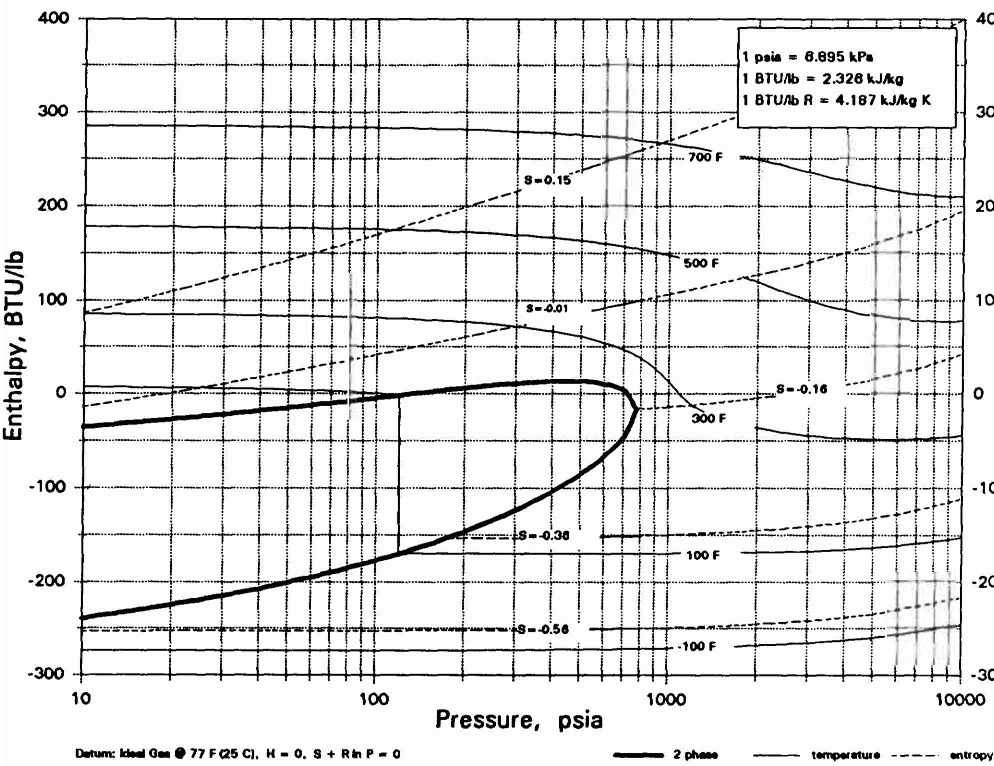
C2H6AlCl DIMETHYLALUMINUM CHLORIDE



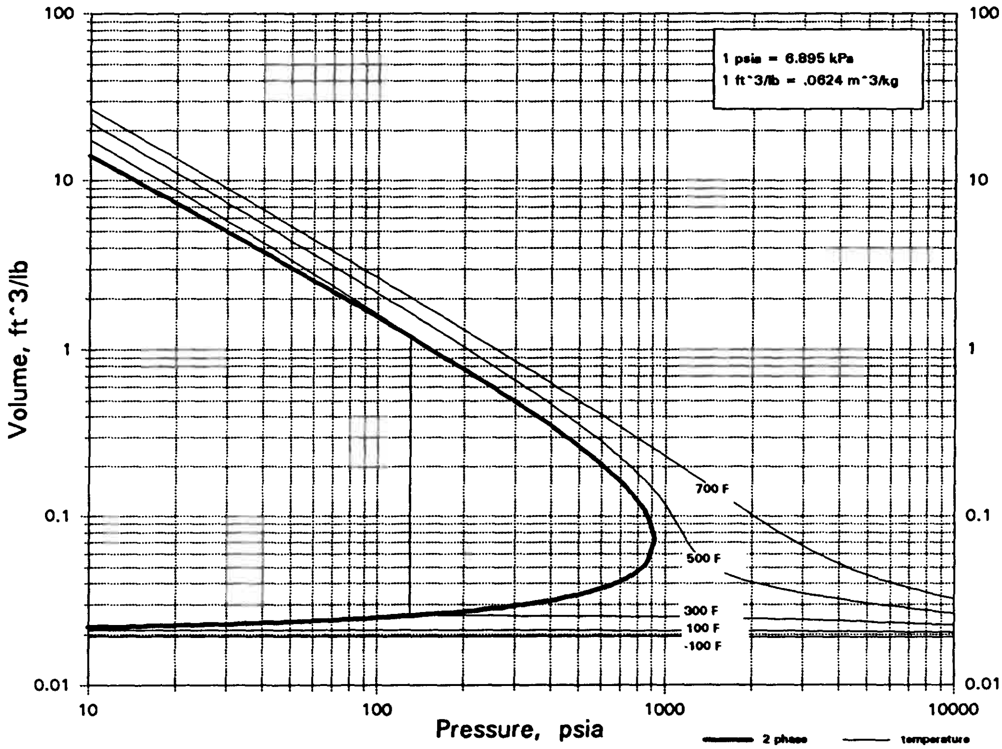


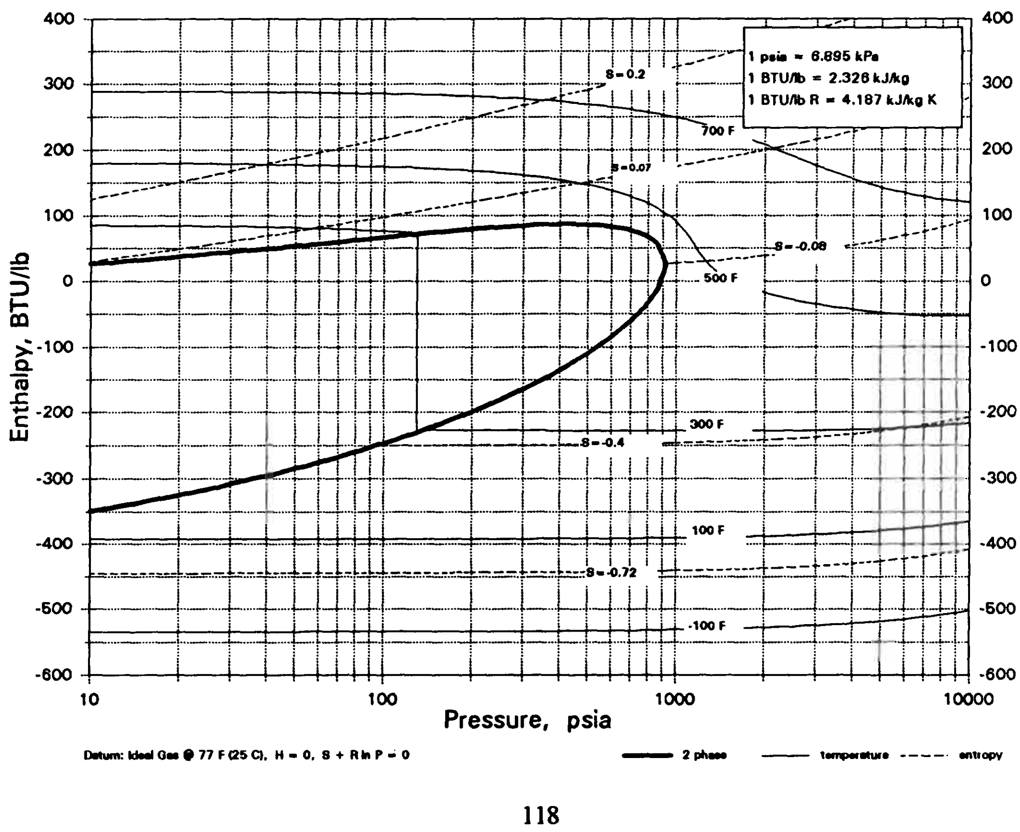
C2H6O DIMETHYL ETHER



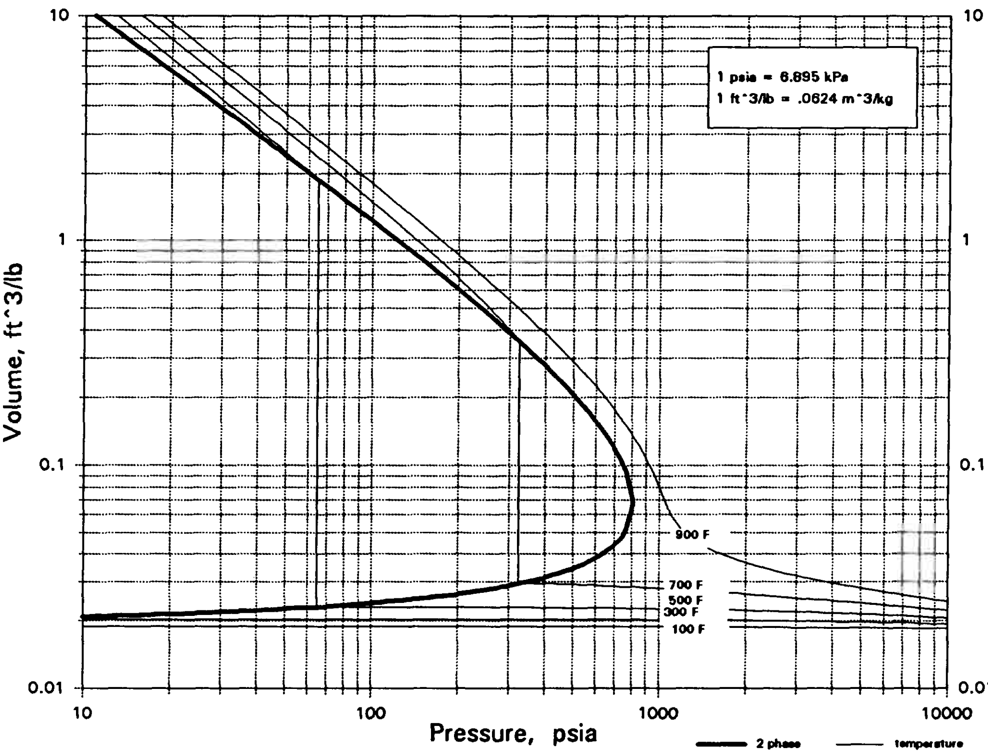


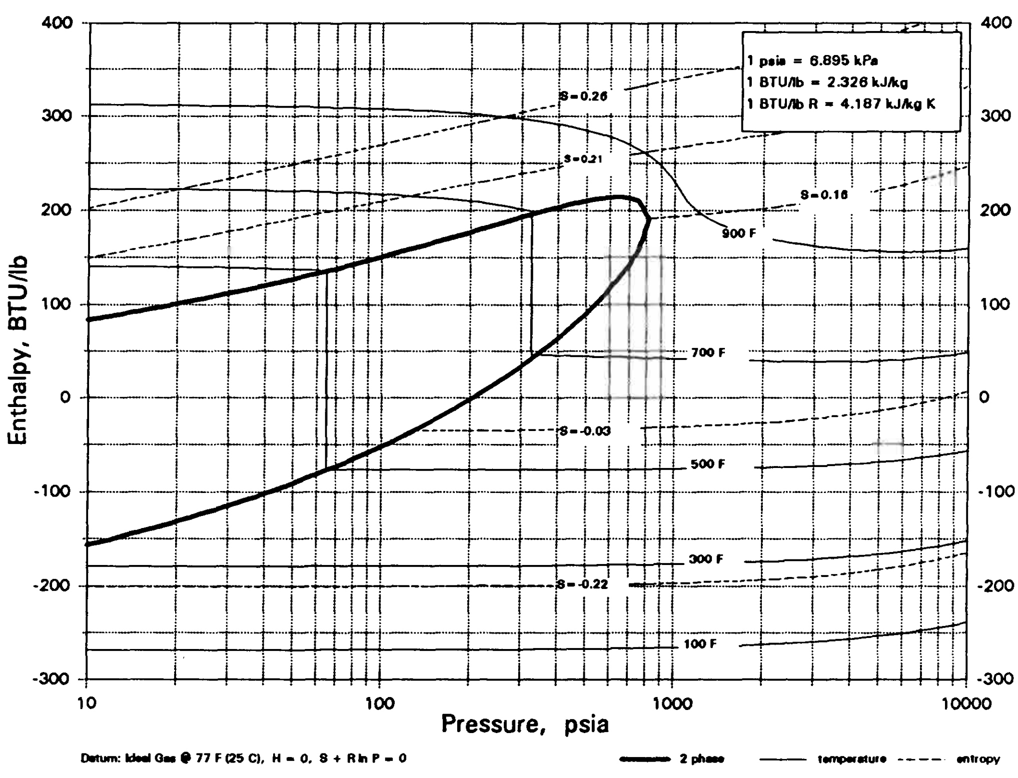
C2H6O	ETHANOL



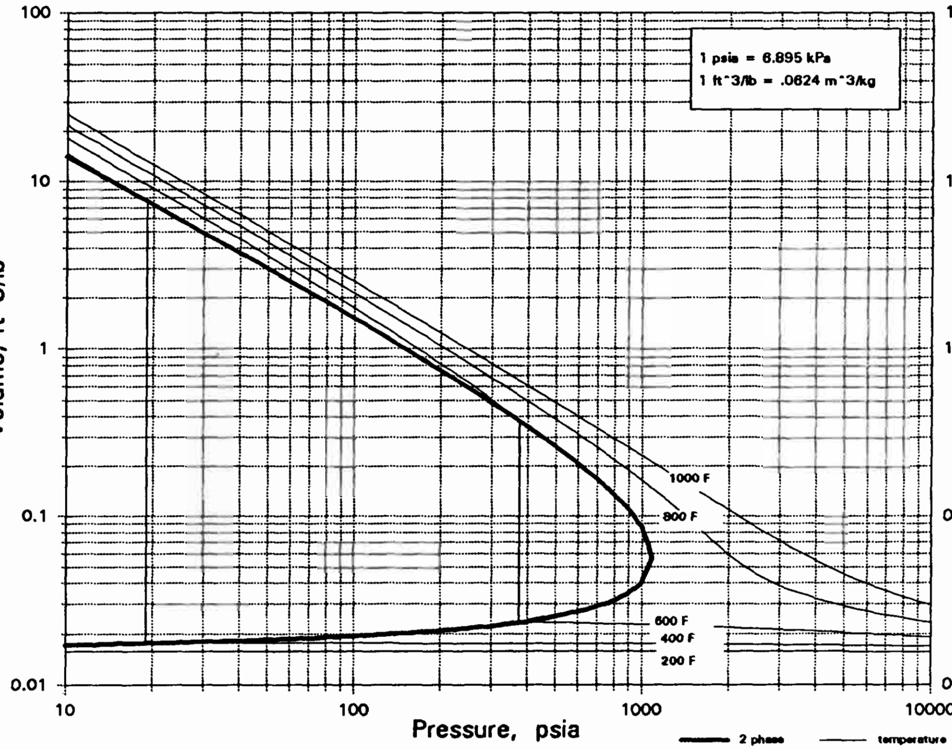


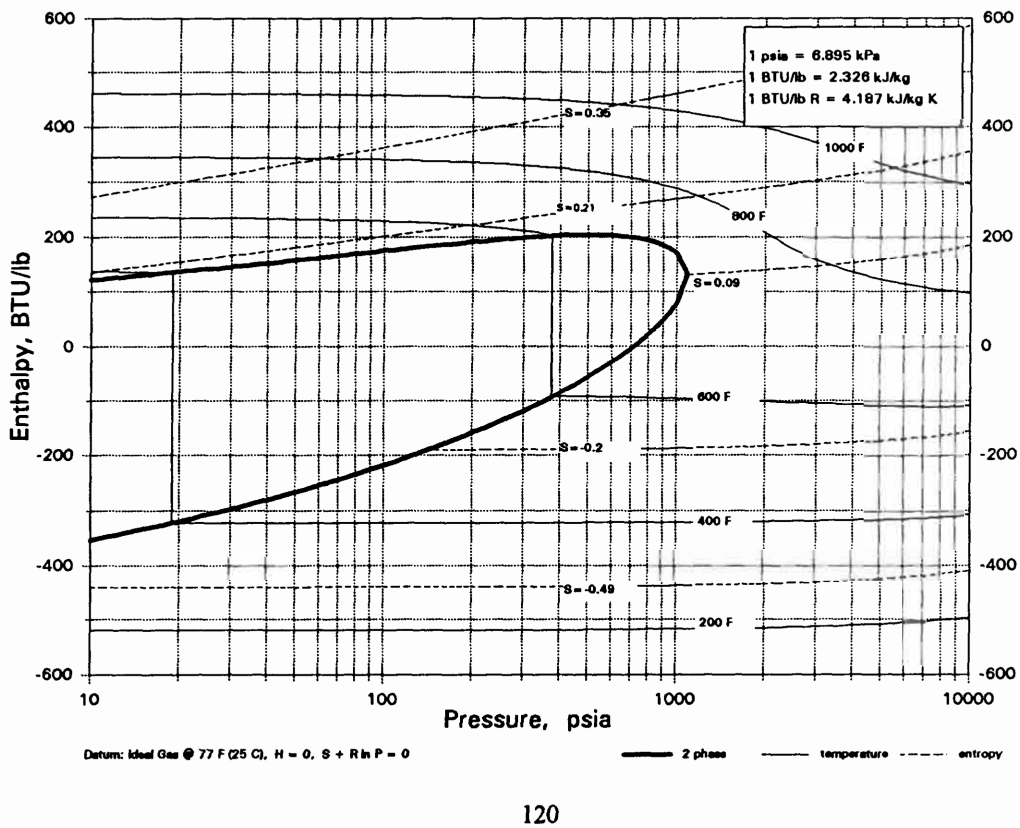
C2H6OS DIMETHYL SULFOXIDE



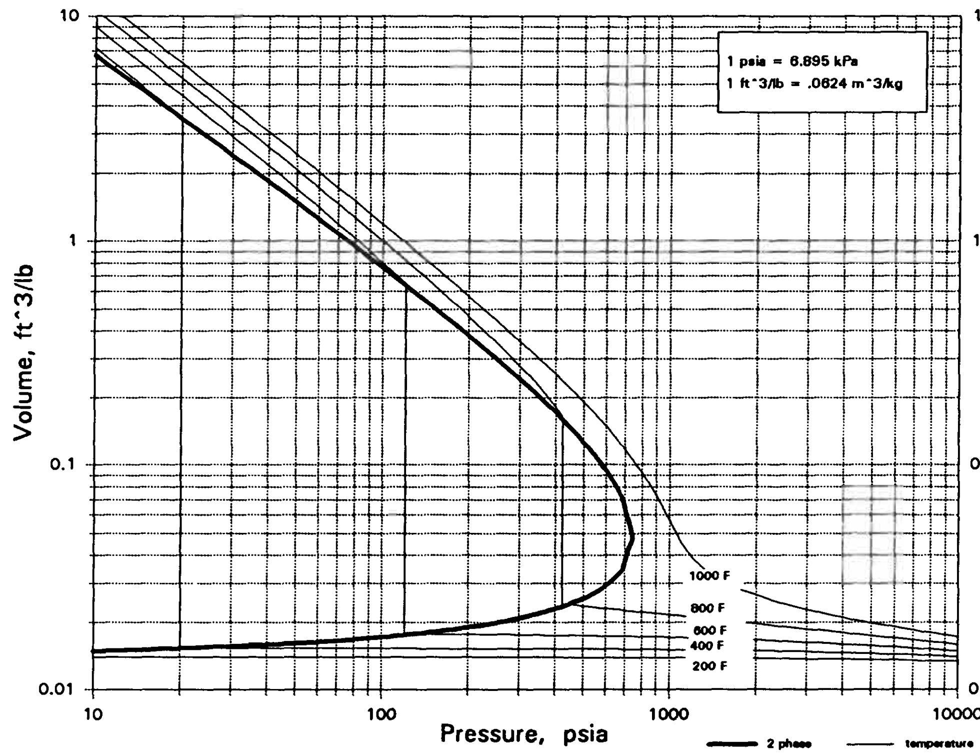


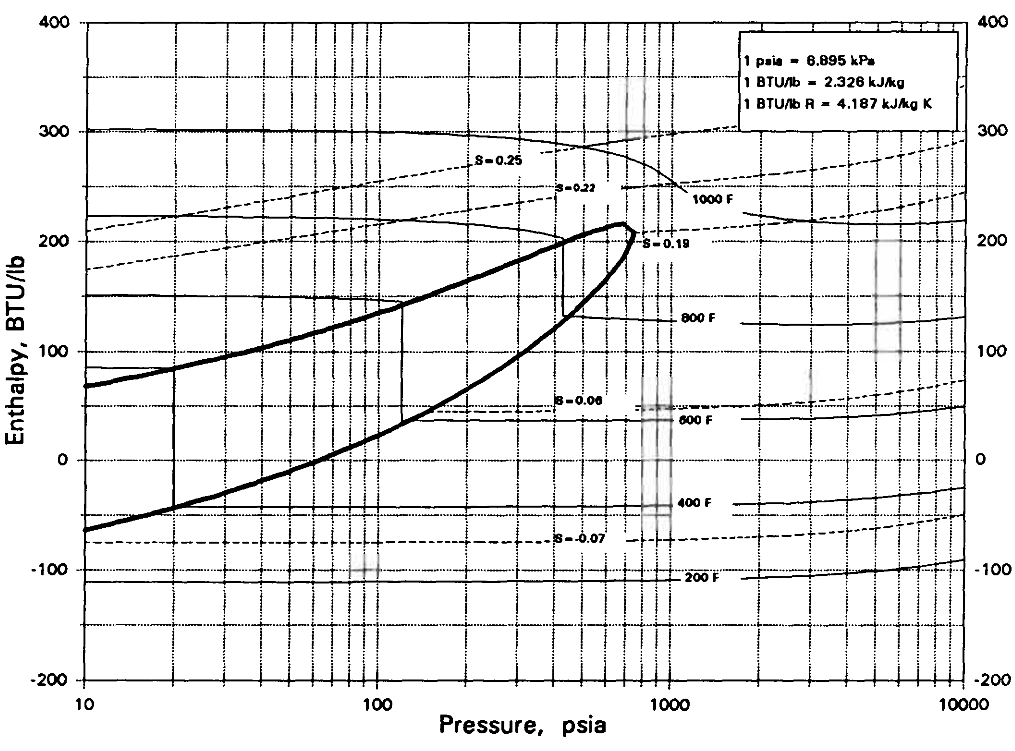
C2H6O2 ETHYLENE GLYCOL



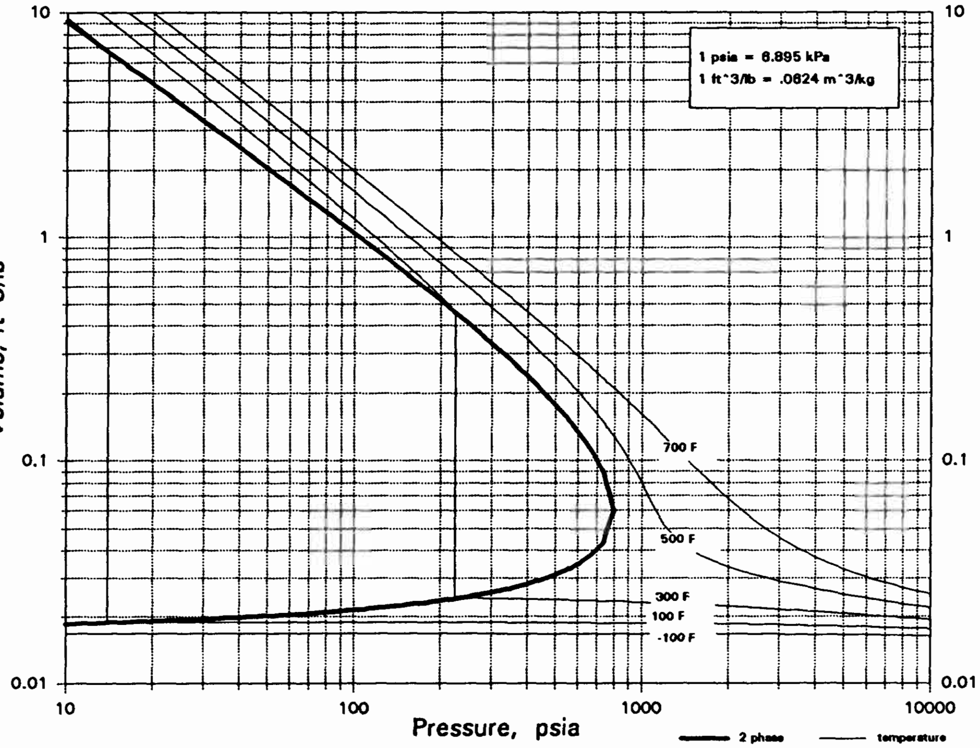


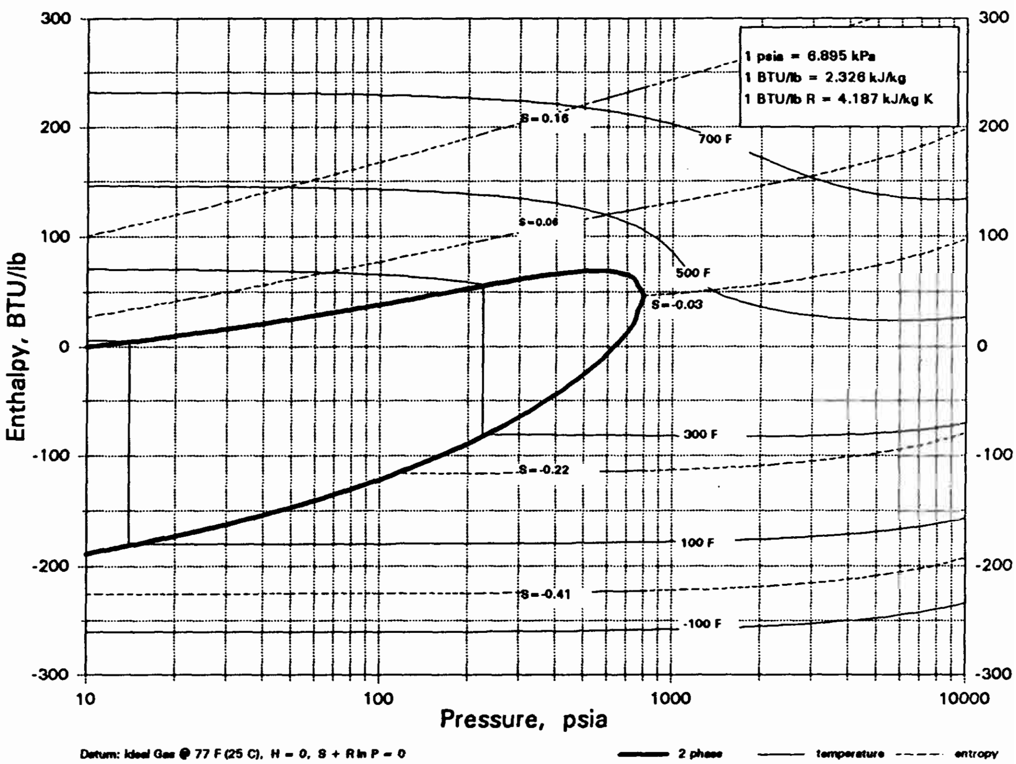
C2H6O4S DIMETHYL SULFATE



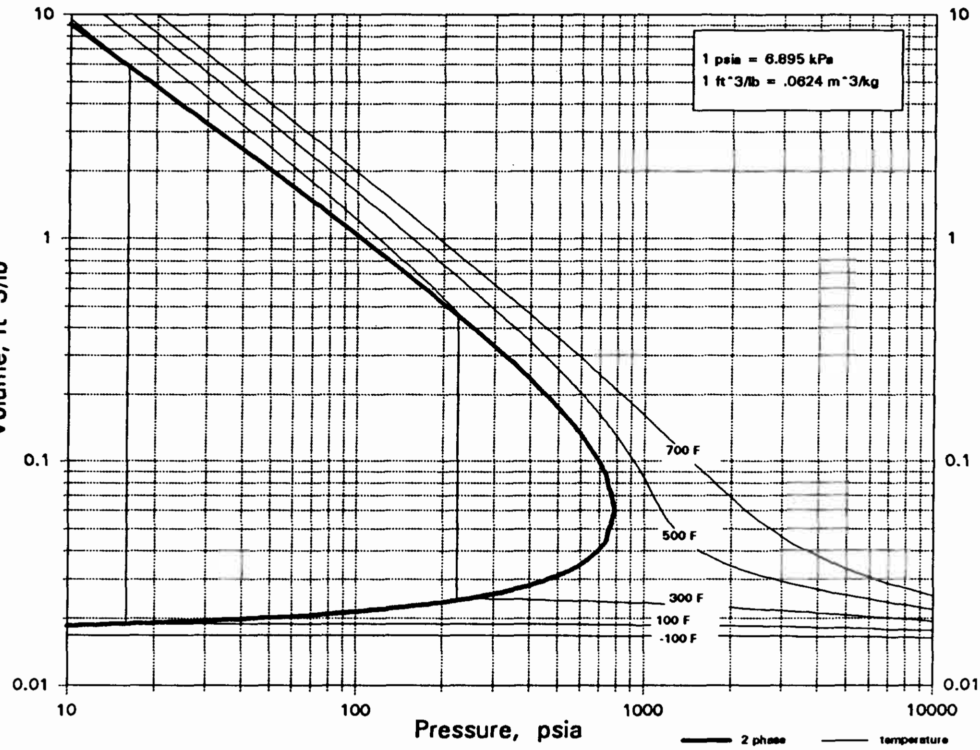


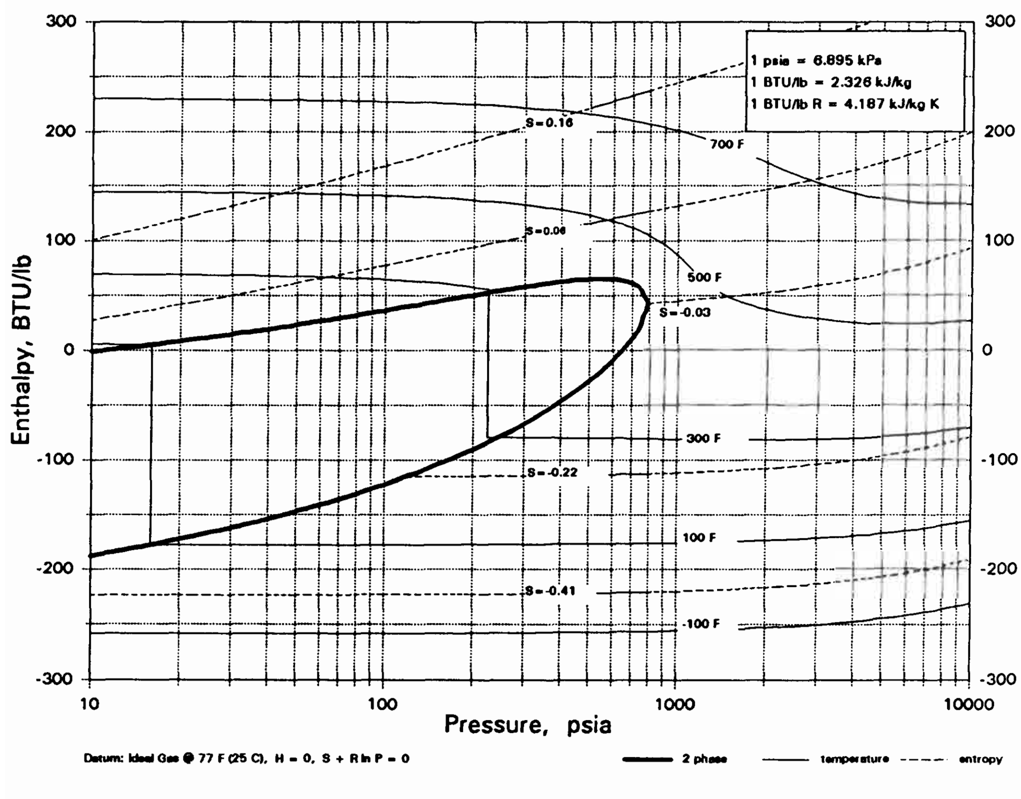
C2H6S DIMETHYL SULFIDE



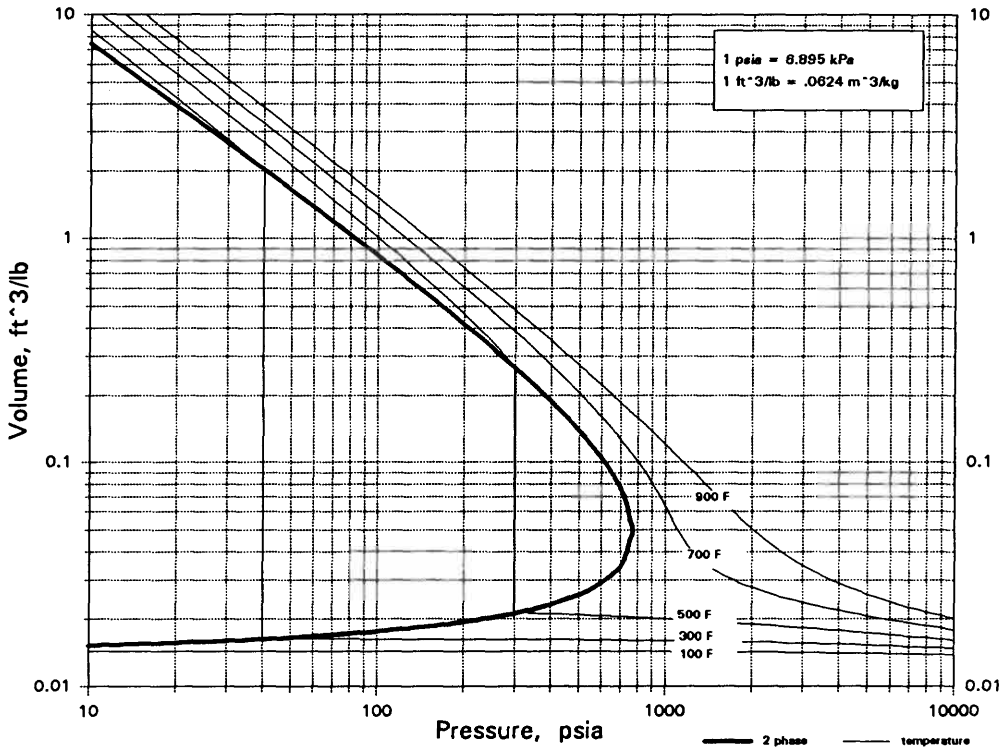


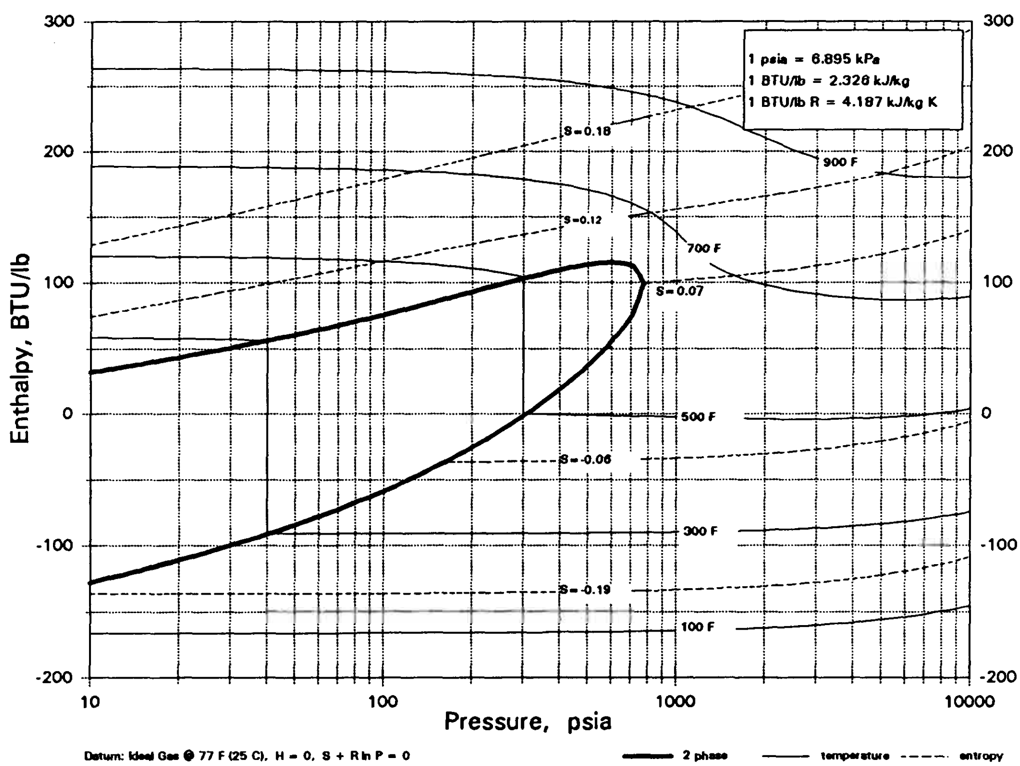
C2H6S ETHYL MERCAPTAN



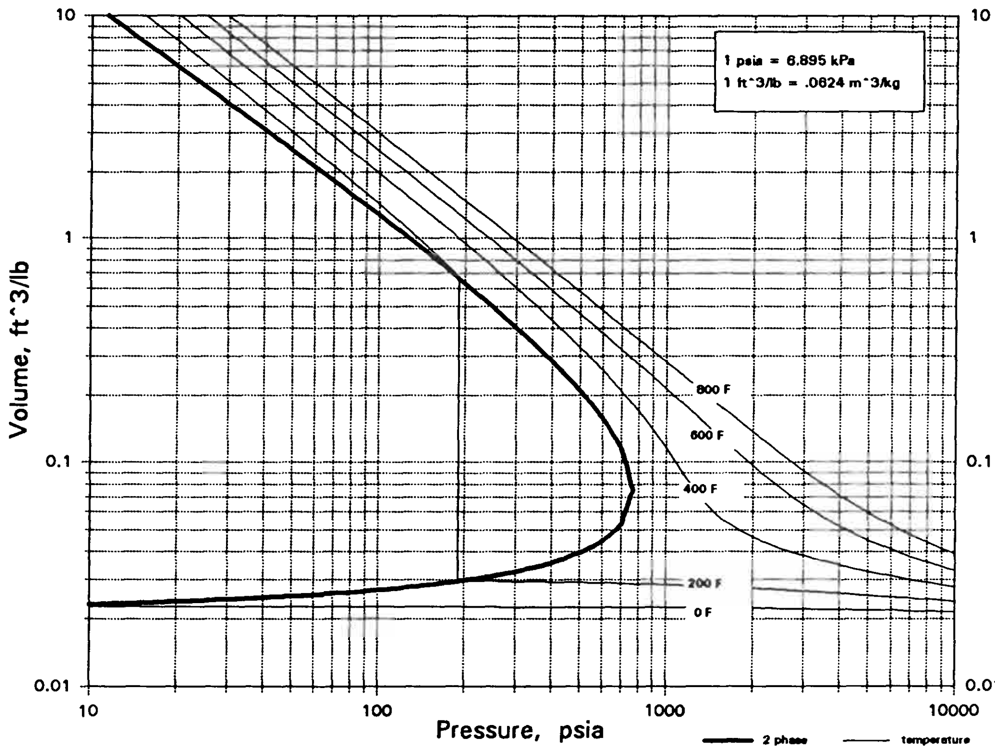


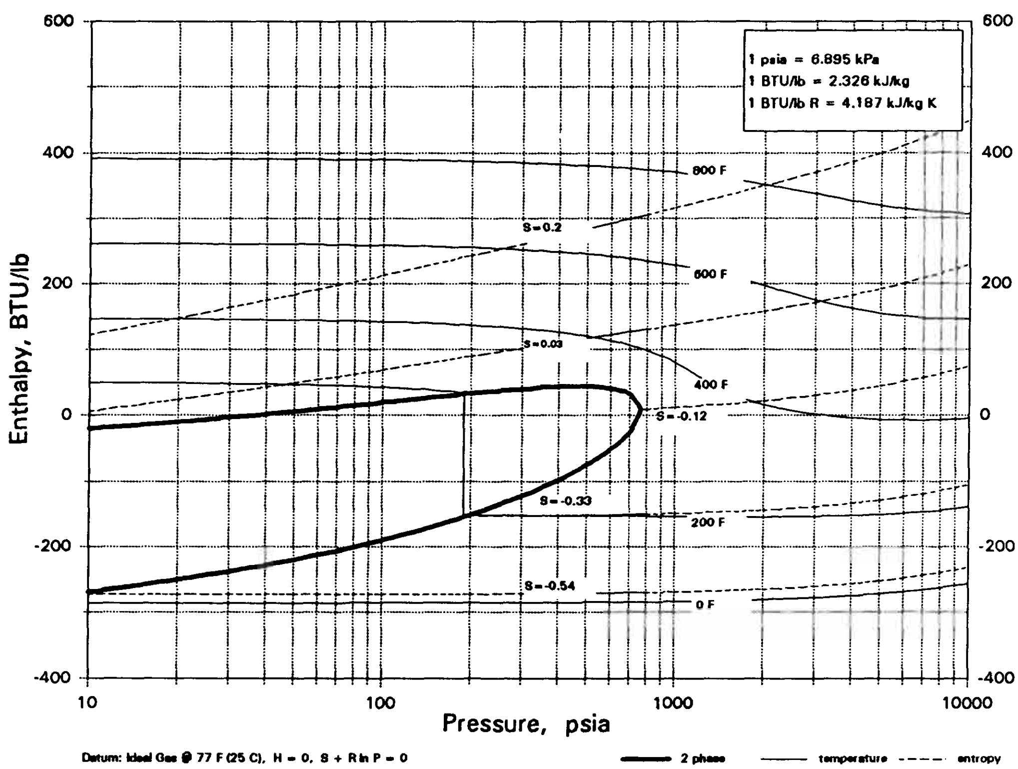
$C_2H_6S_2$ DIMETHYL DISULFIDE



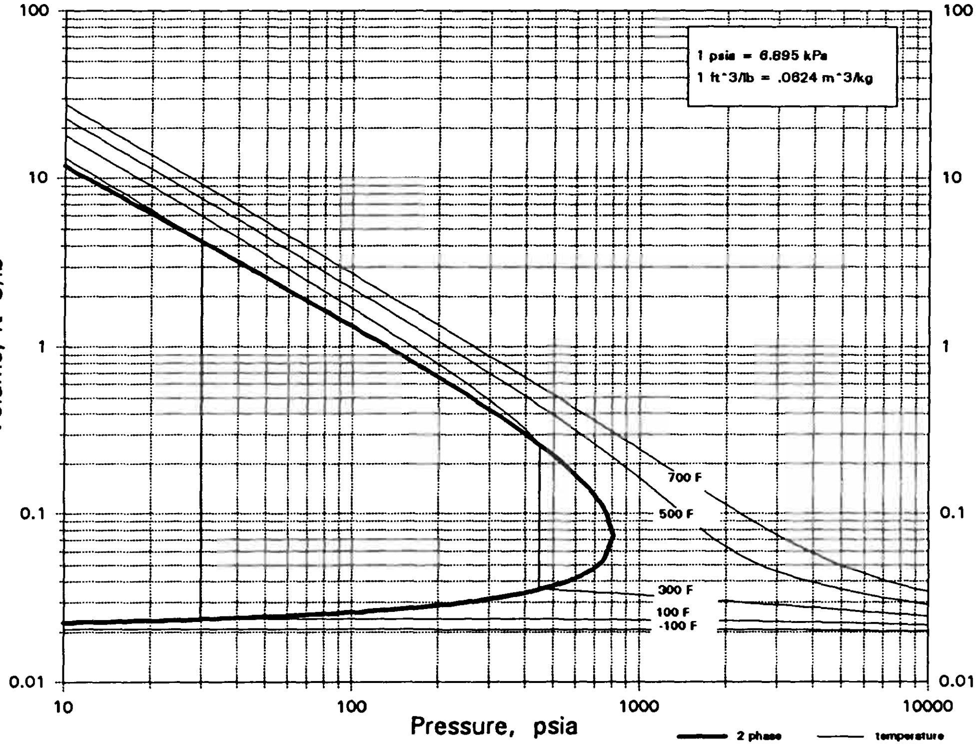


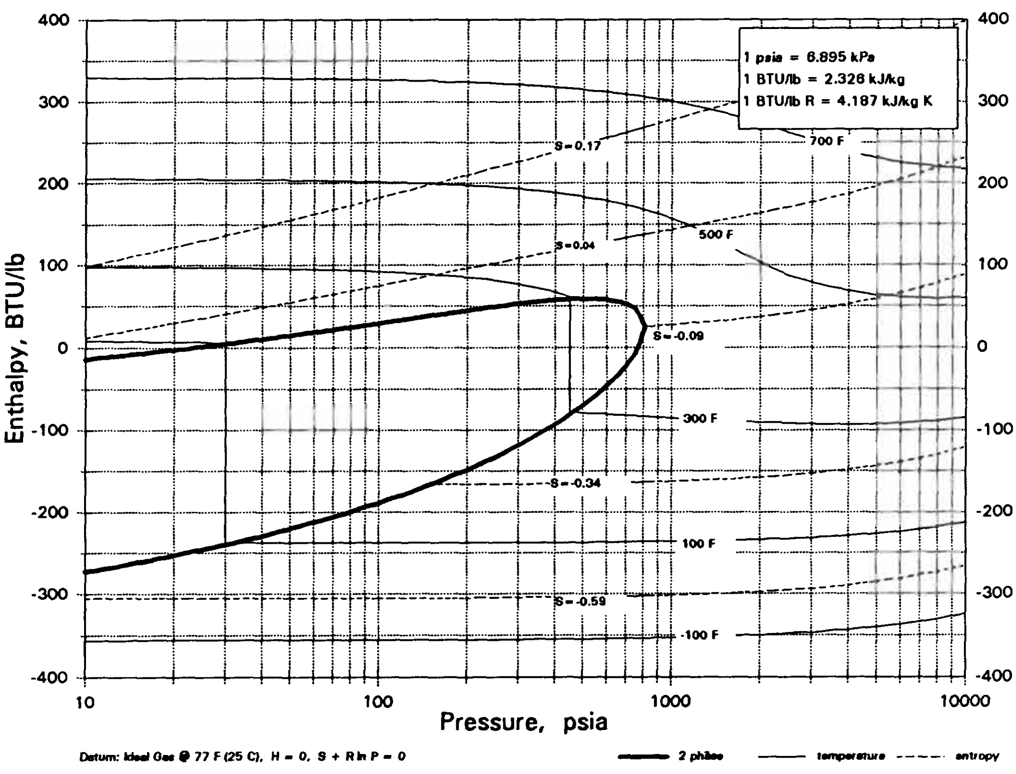
C2H7N DIMETHYLAMINE



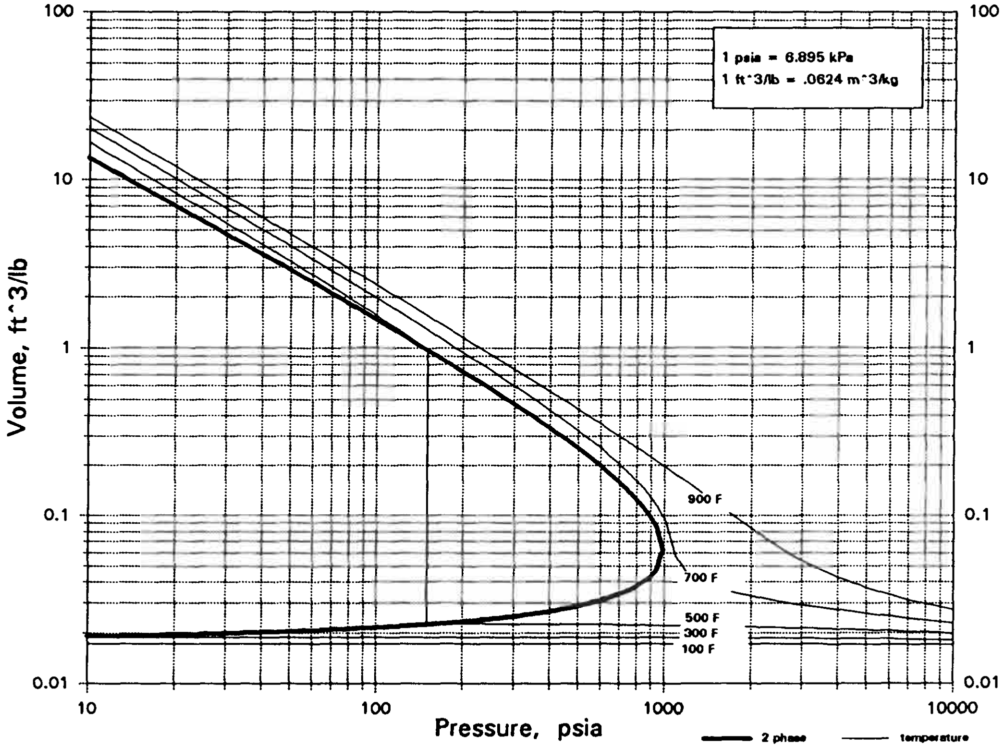


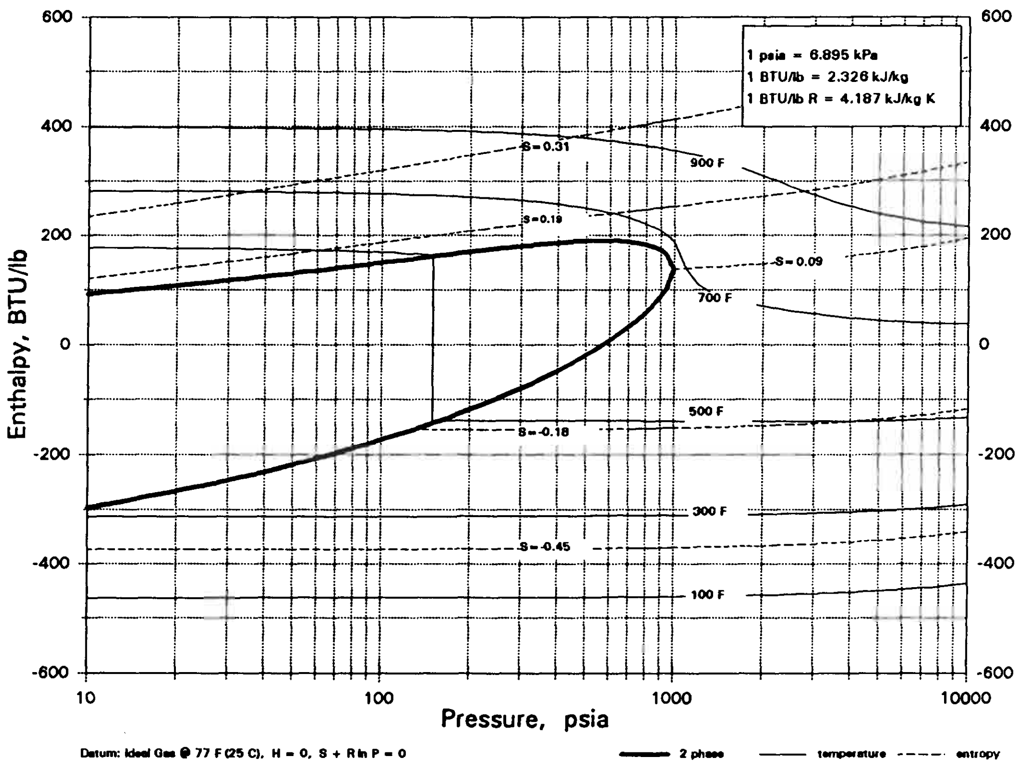
C2H7N ETHYLAMINE



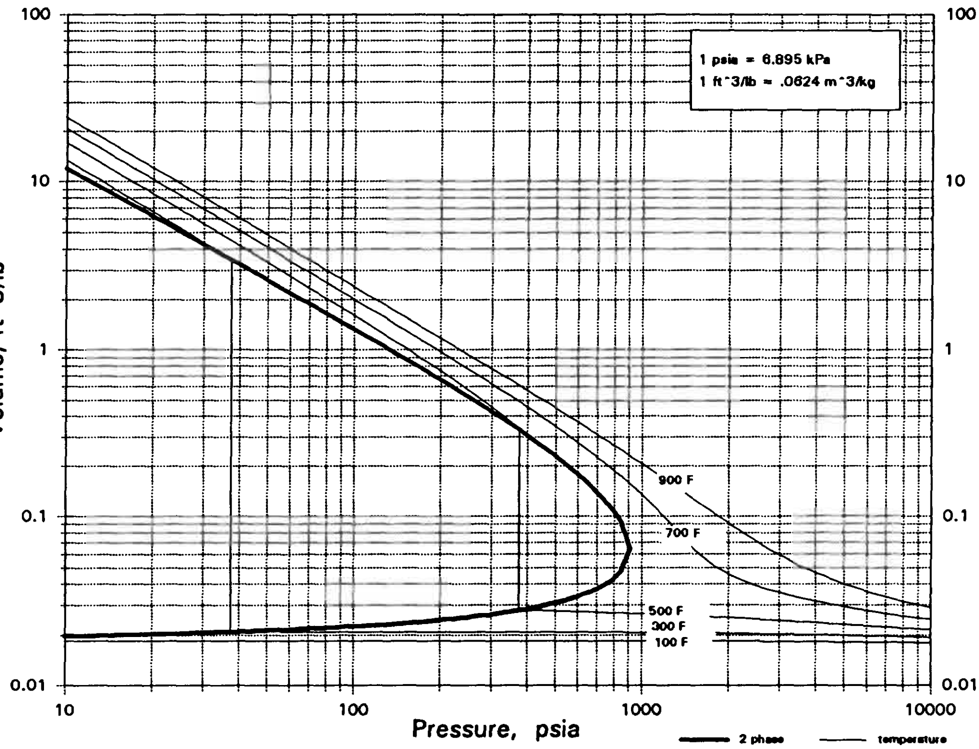


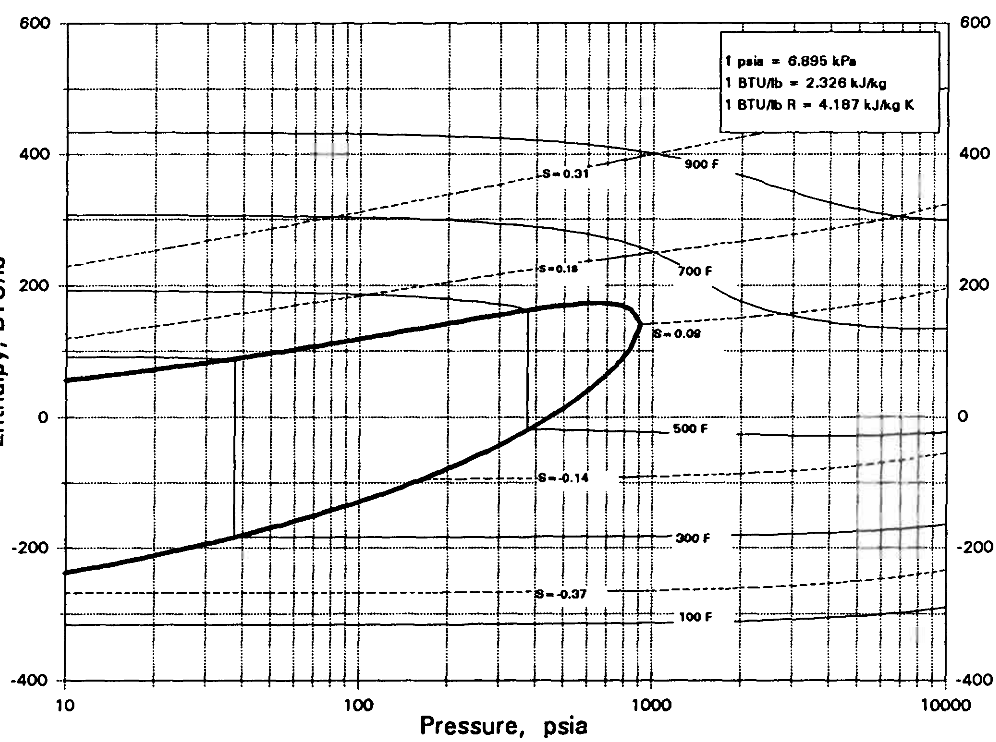
C2H7NO MONOETHANOLAMINE





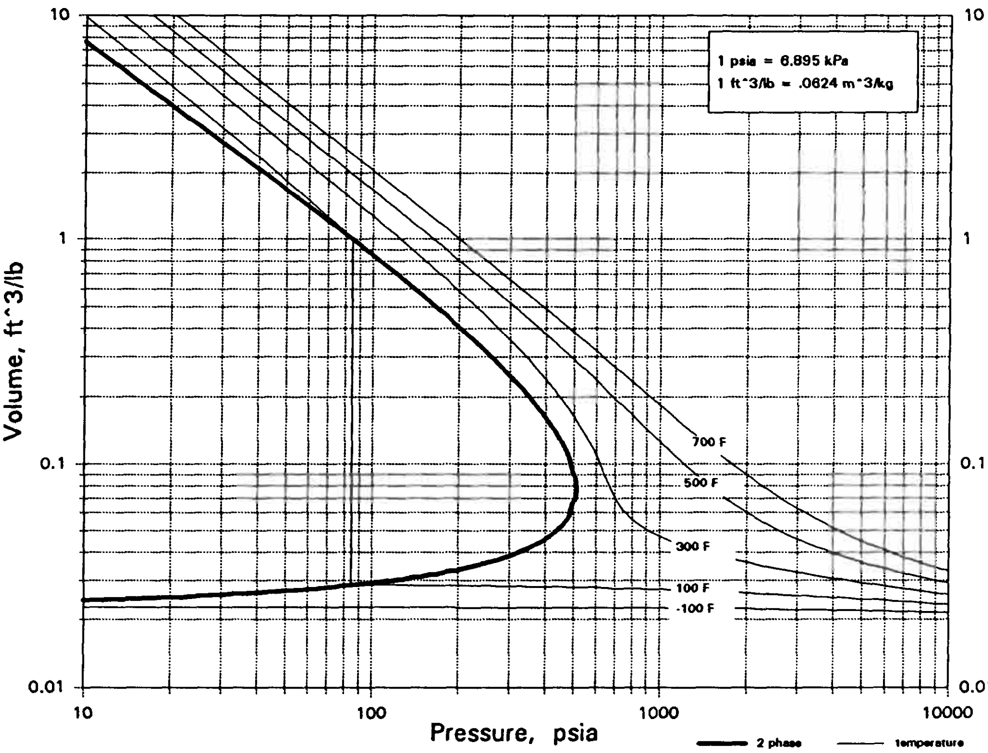
C2H8N2 ETHYLENEDIAMINE

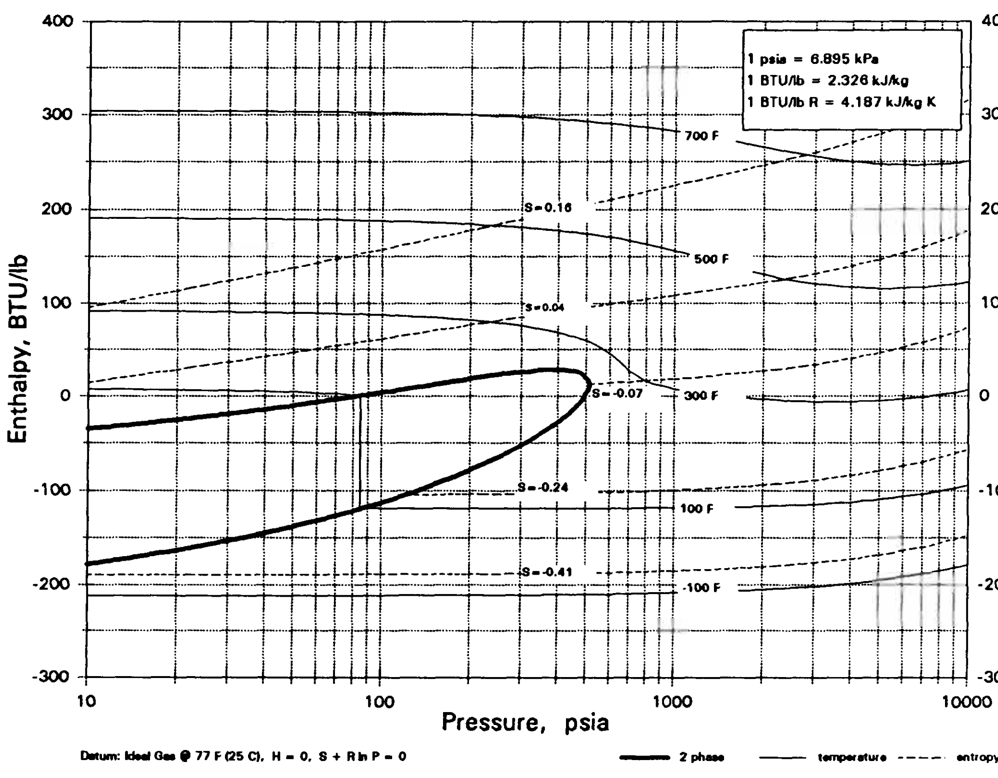




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

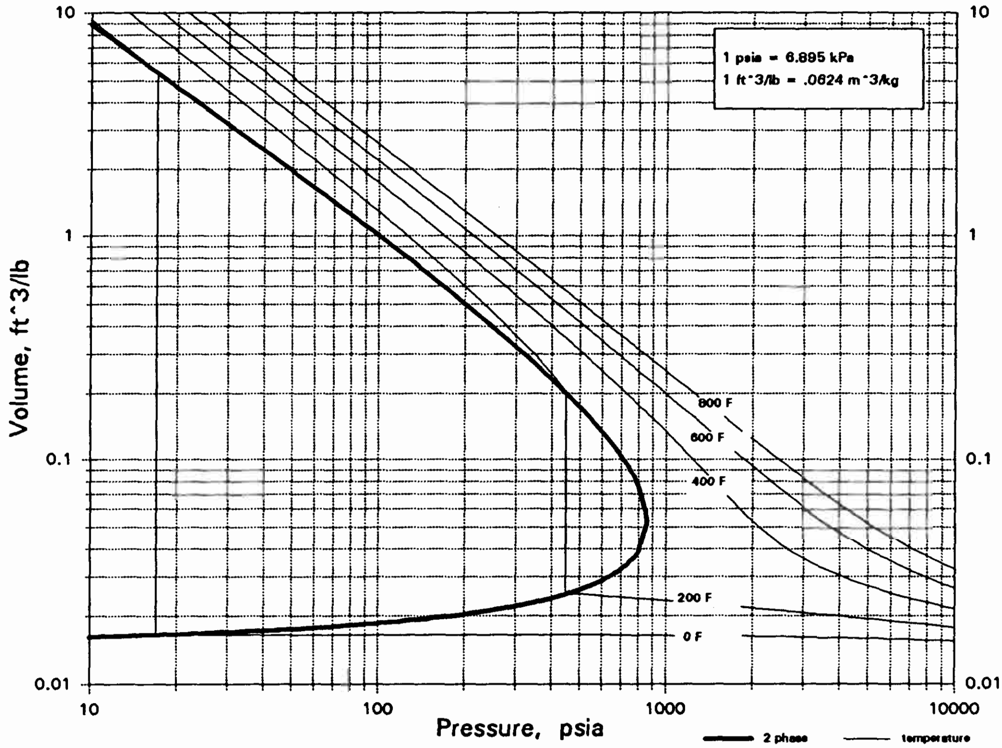
C2H8Si	DIMETHYL SILANE

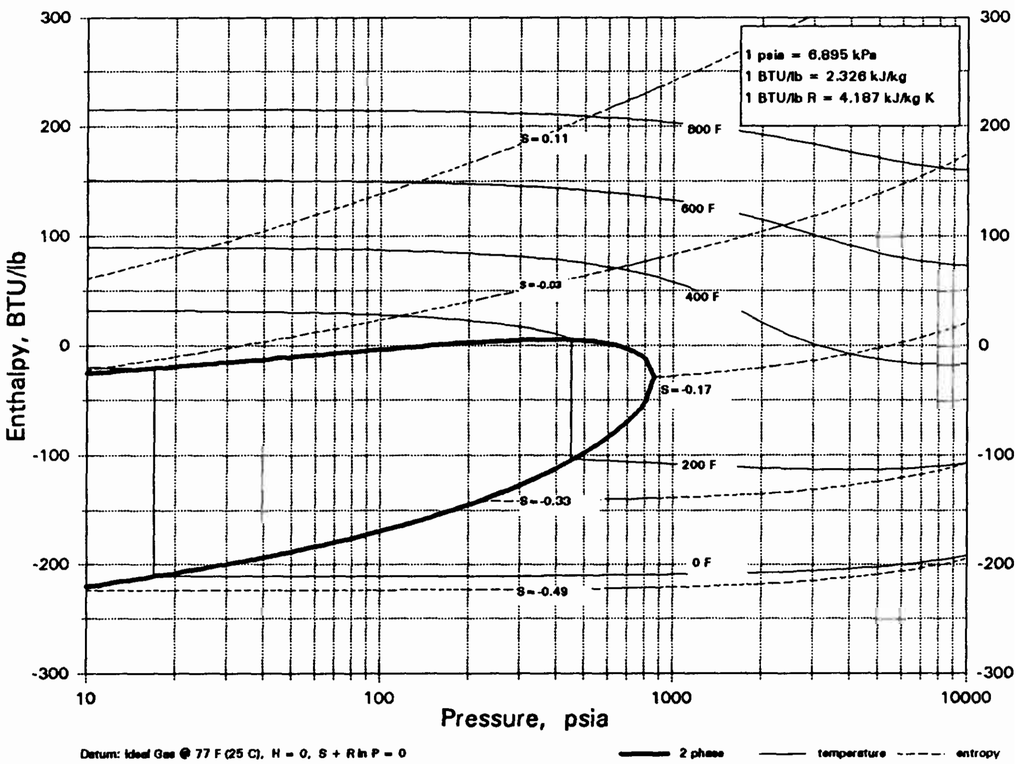




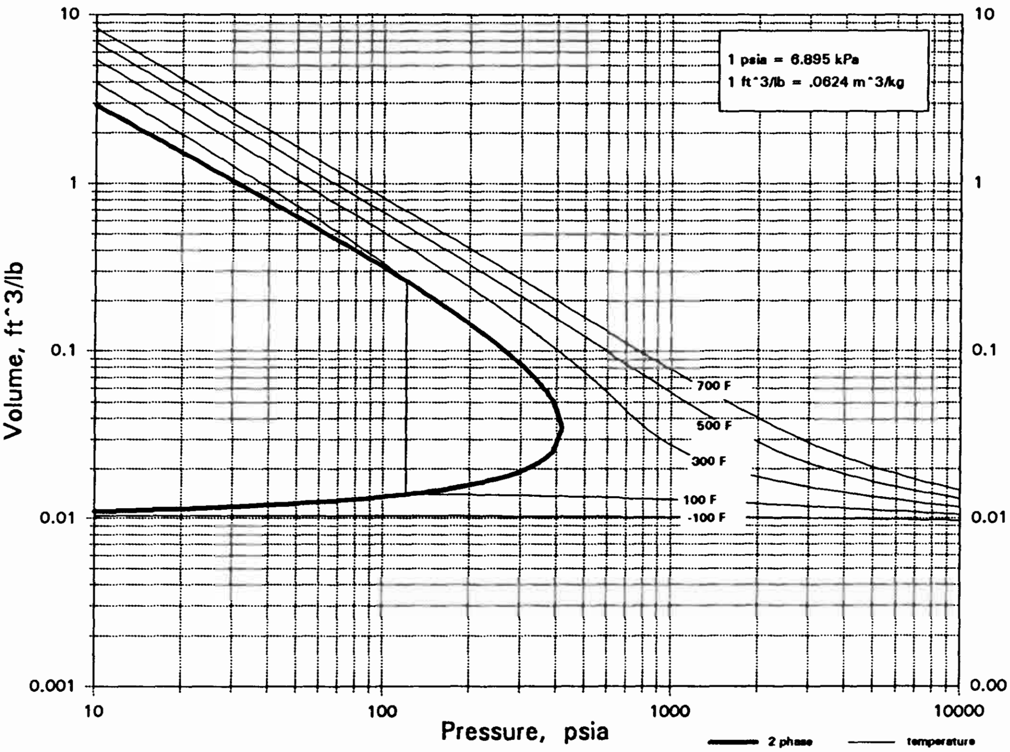
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

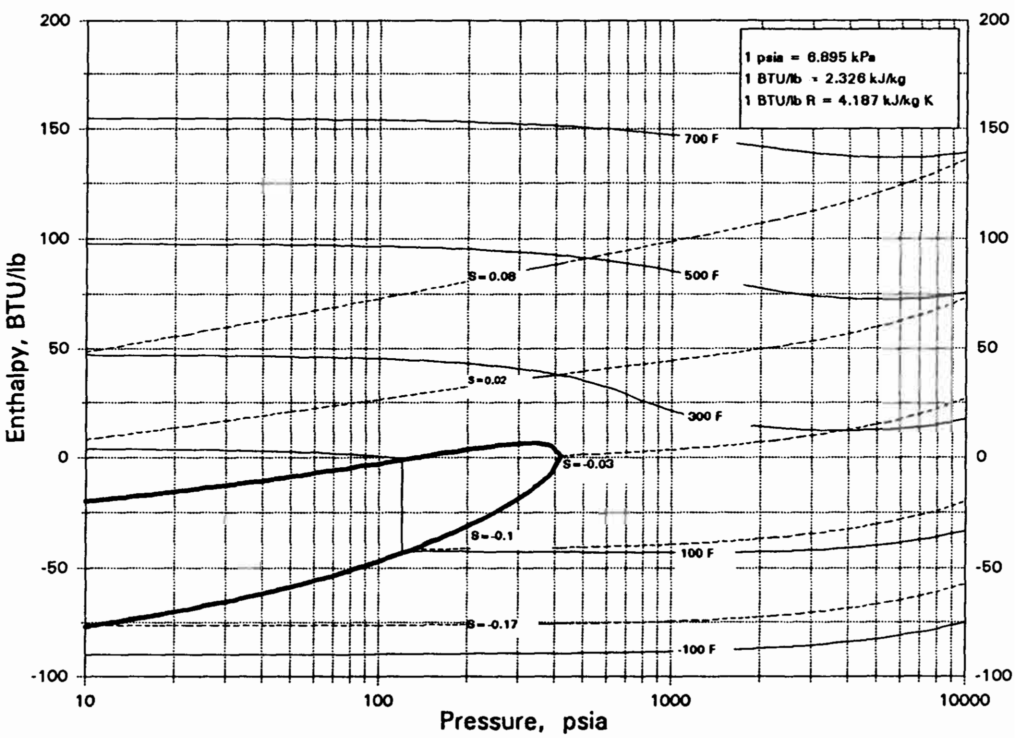
C2N2 CYANOGEN





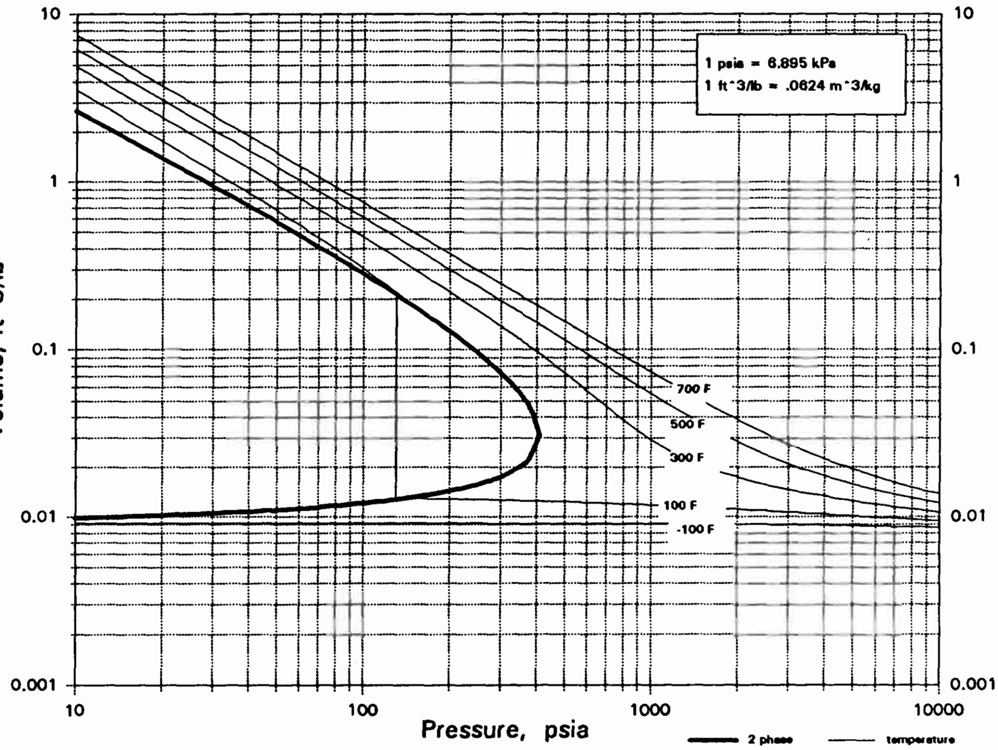
C3F6 HEXAFLUOROPROPYLENE

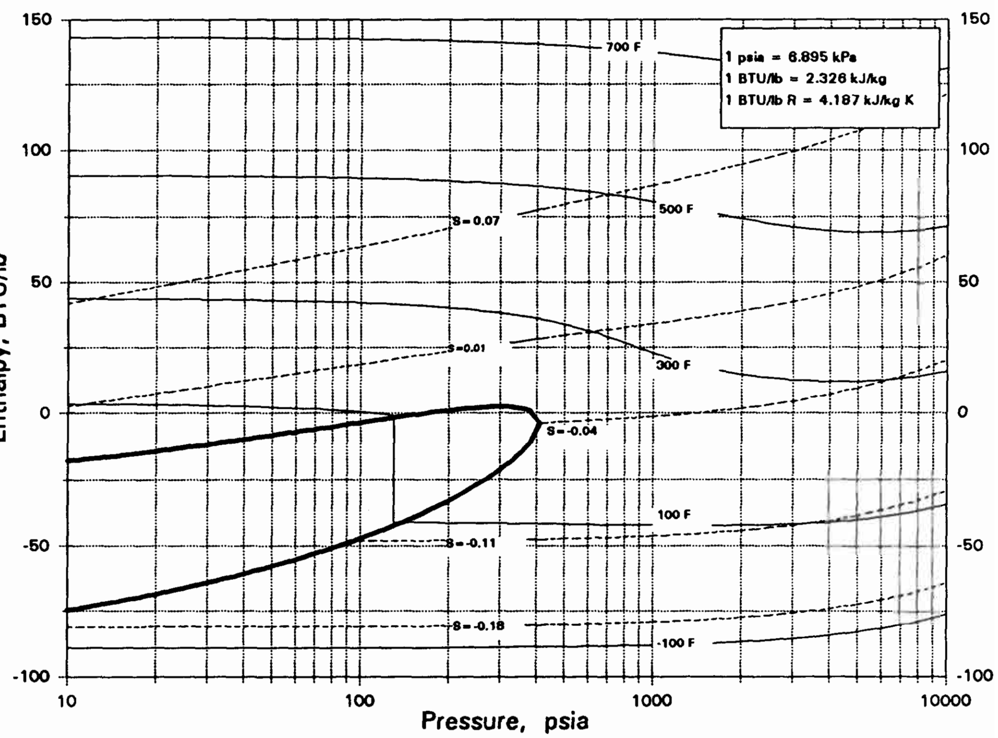




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

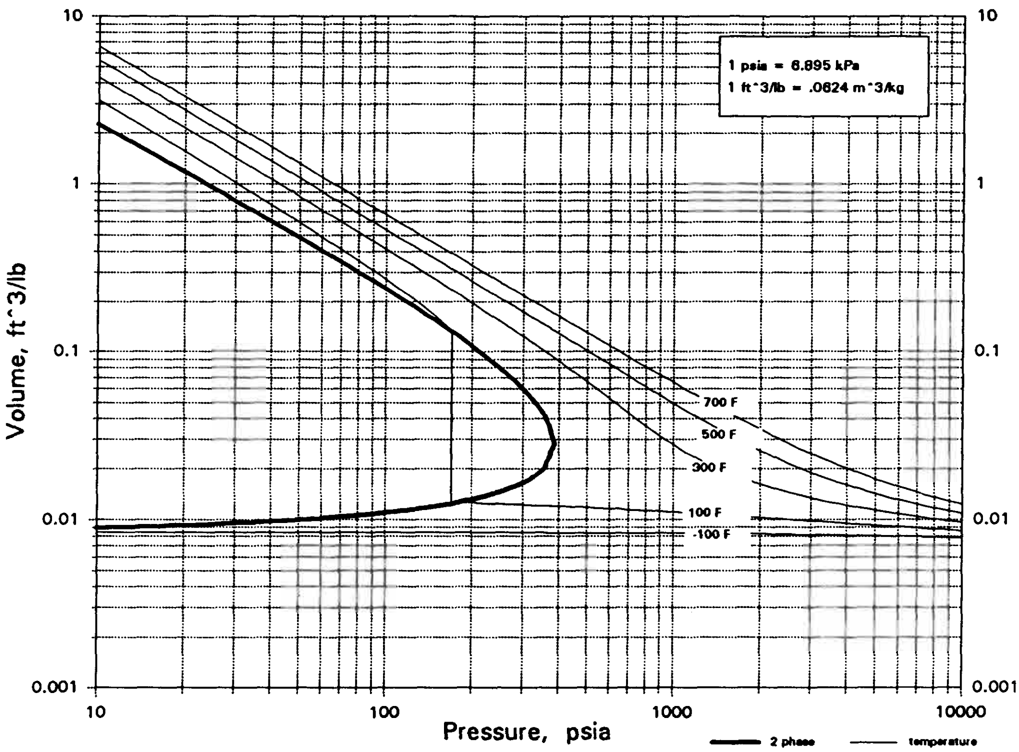
C3F6O HEXAFLUOROACETONE

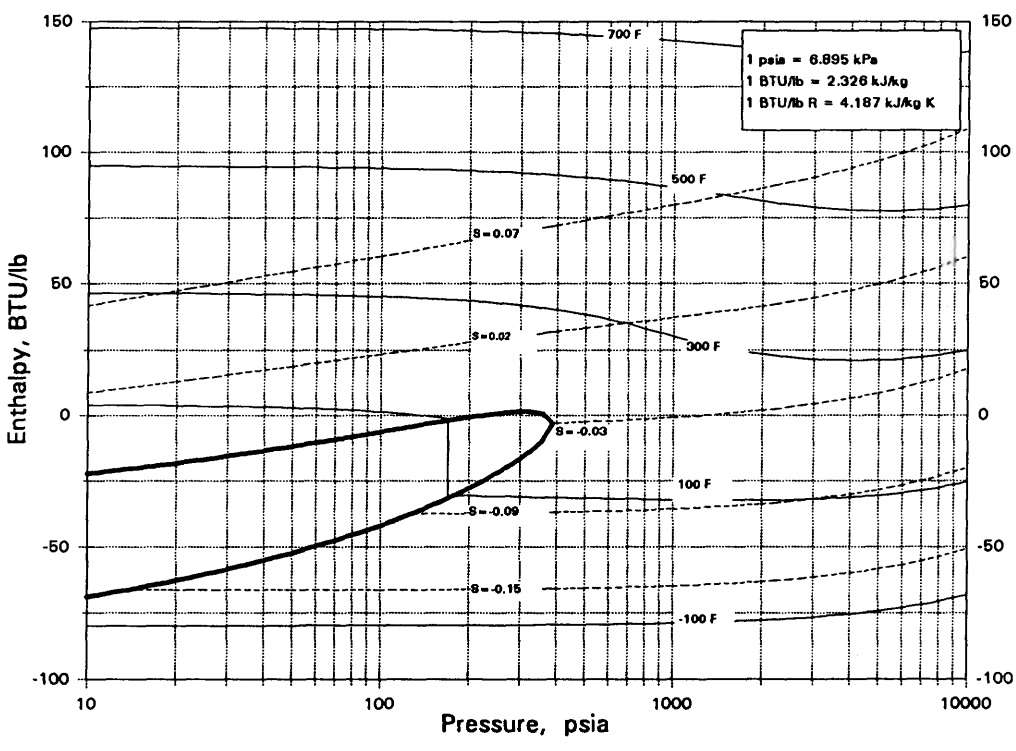




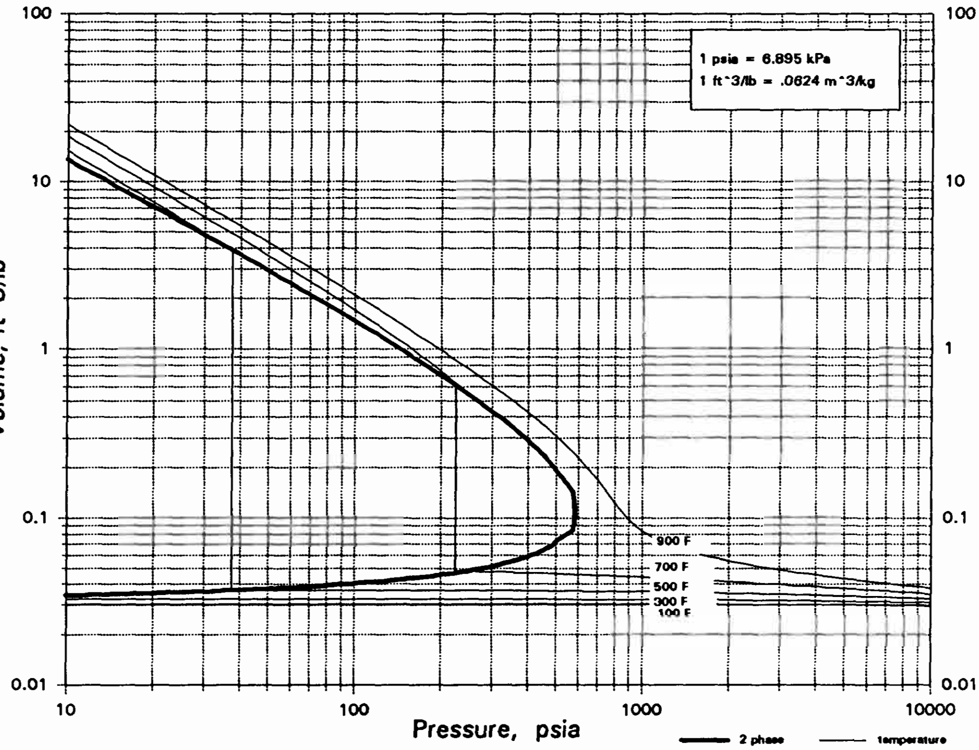
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

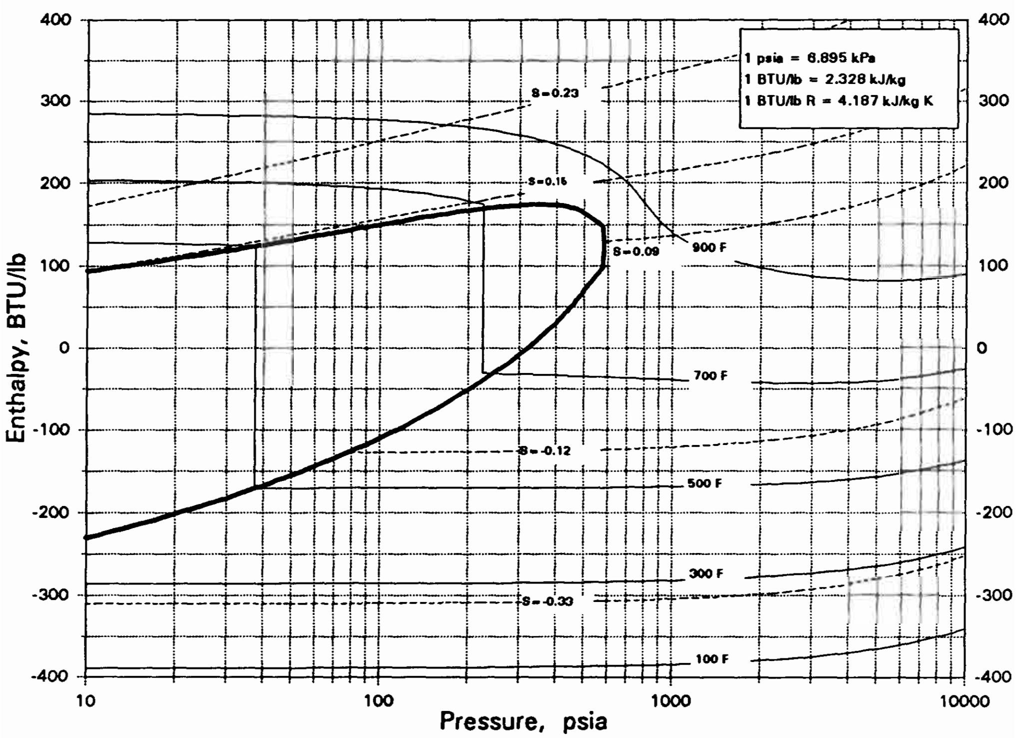
C3F8 OCTAFLUOROPROPANE





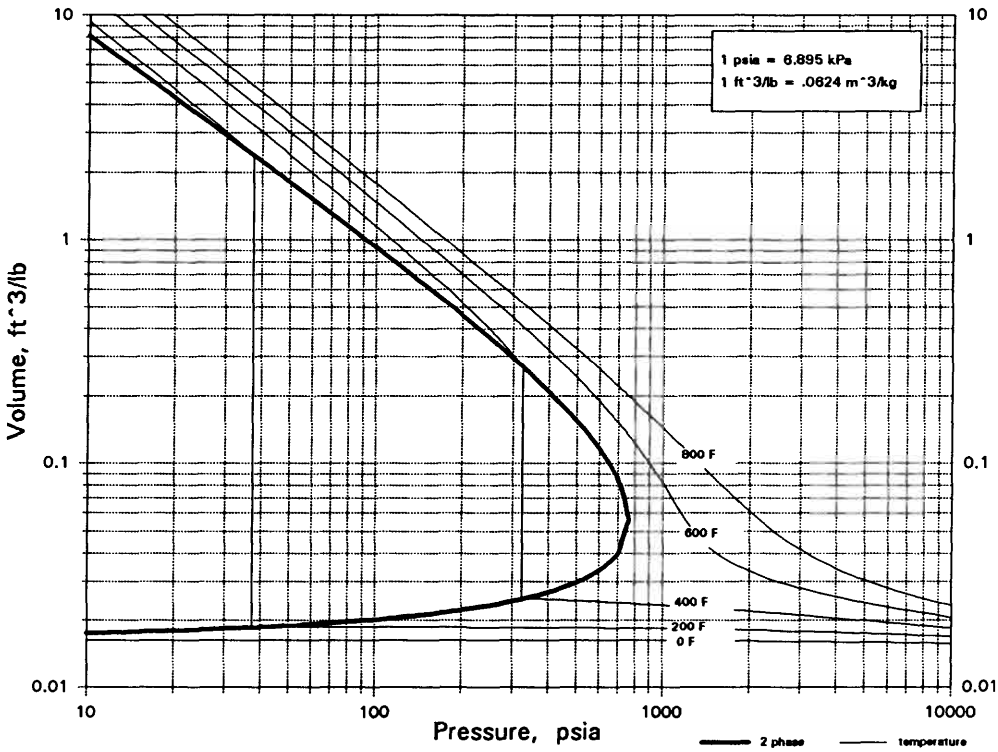
C3H2N2 MALONONITRILE

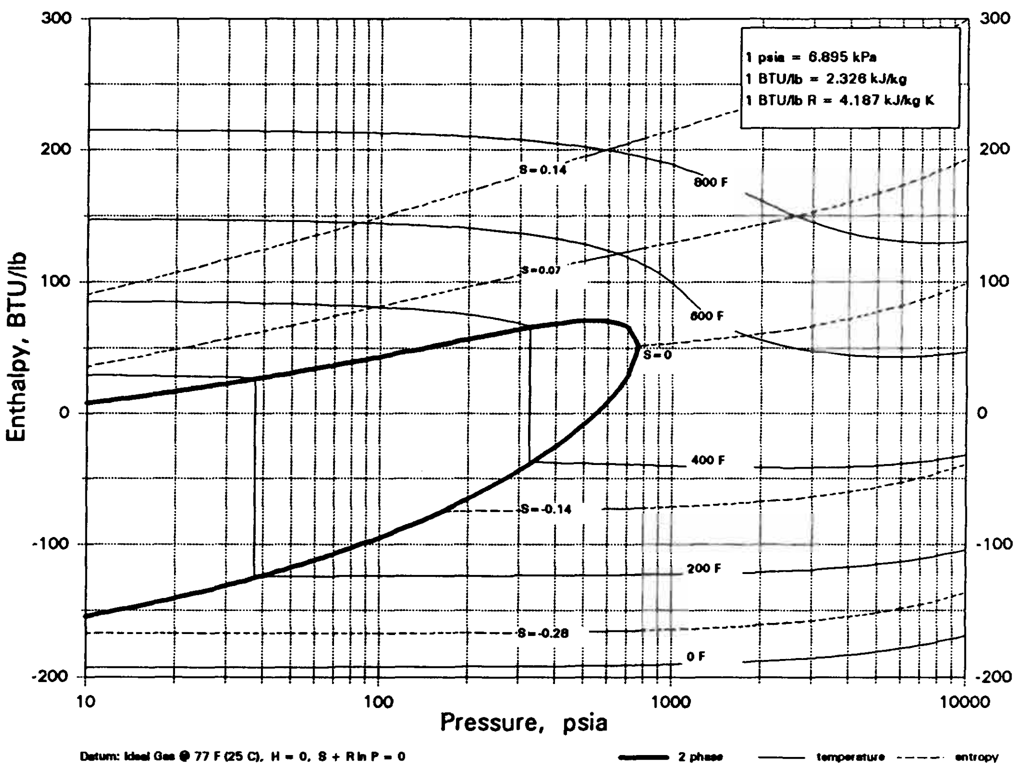




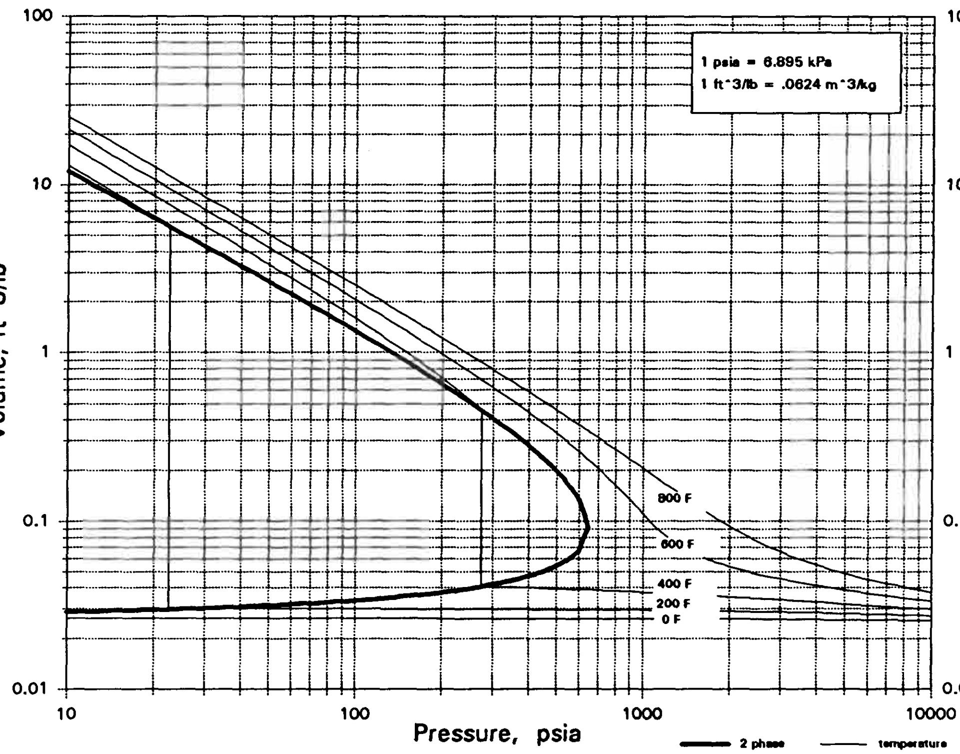
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

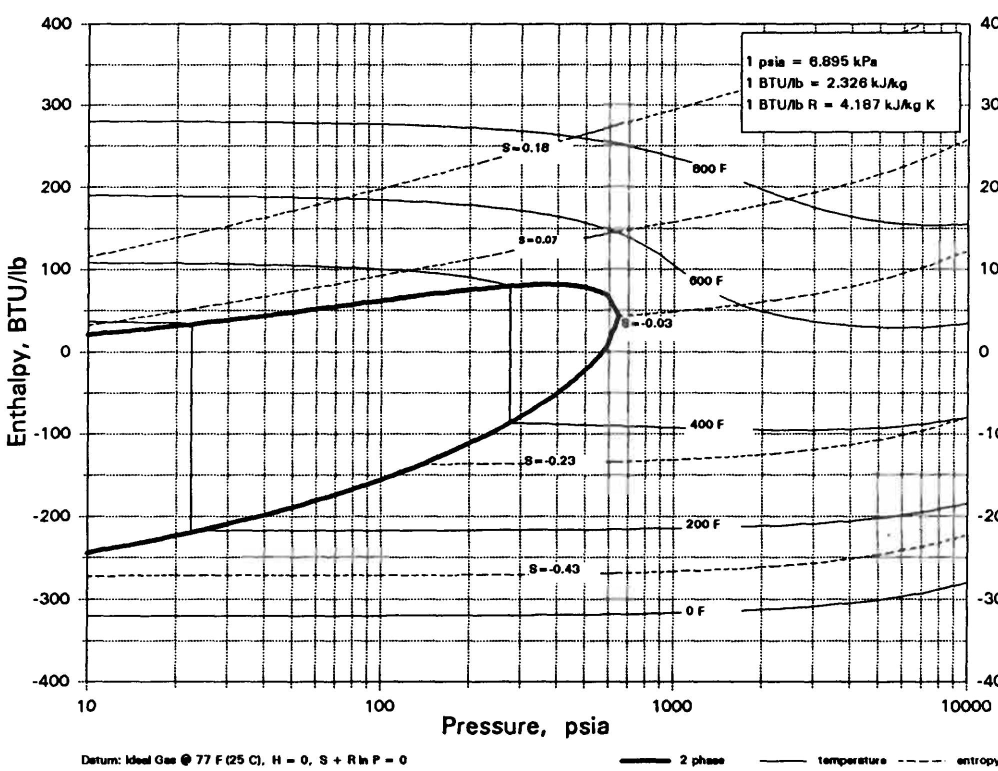
C3H3Cl PROPARGYL CHLORIDE



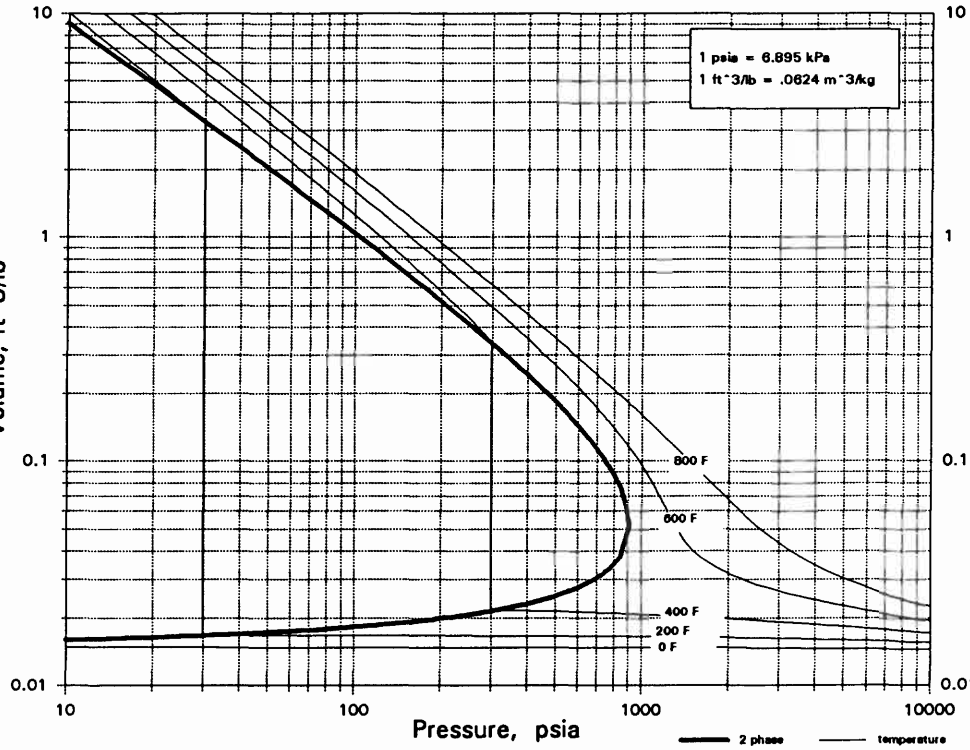


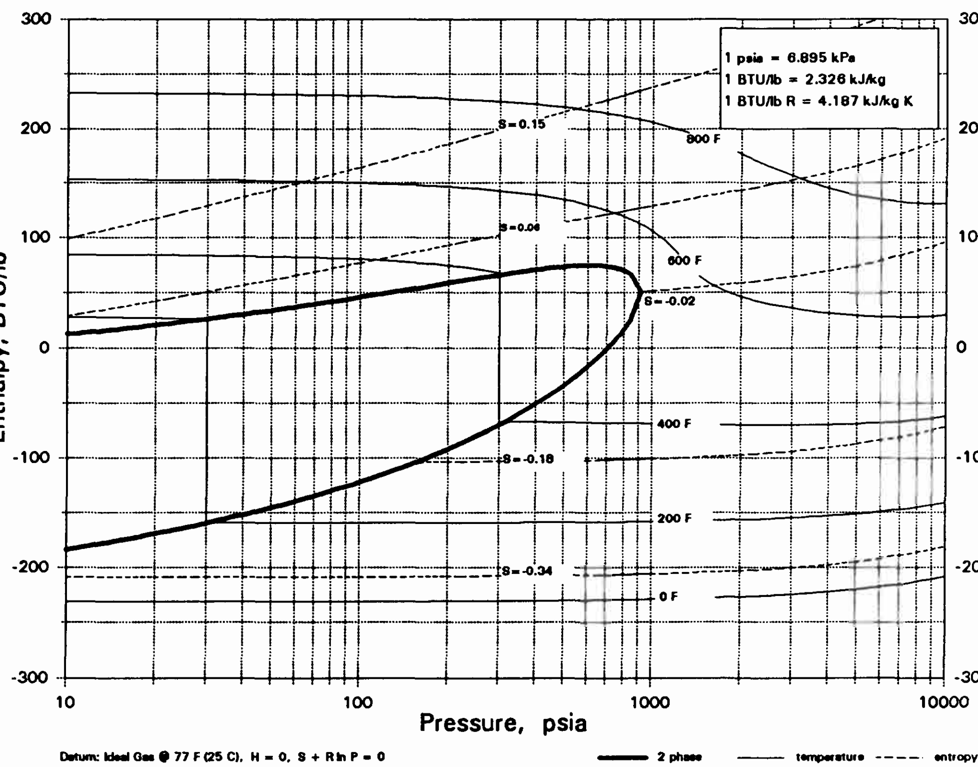
C3H3N ACRYLONITRILE



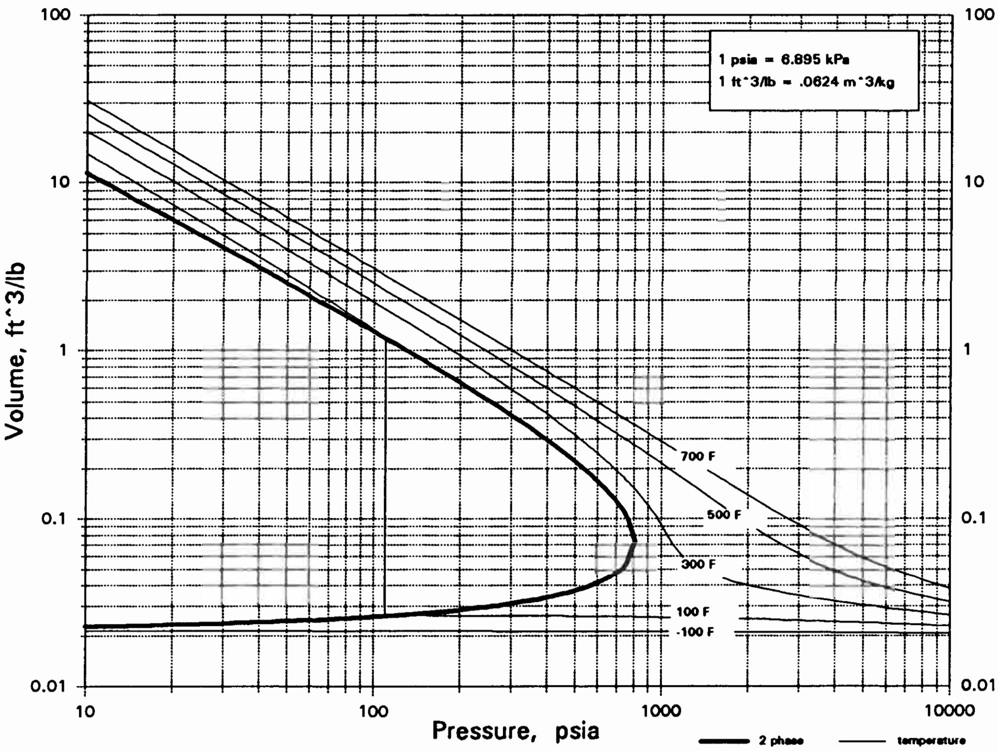


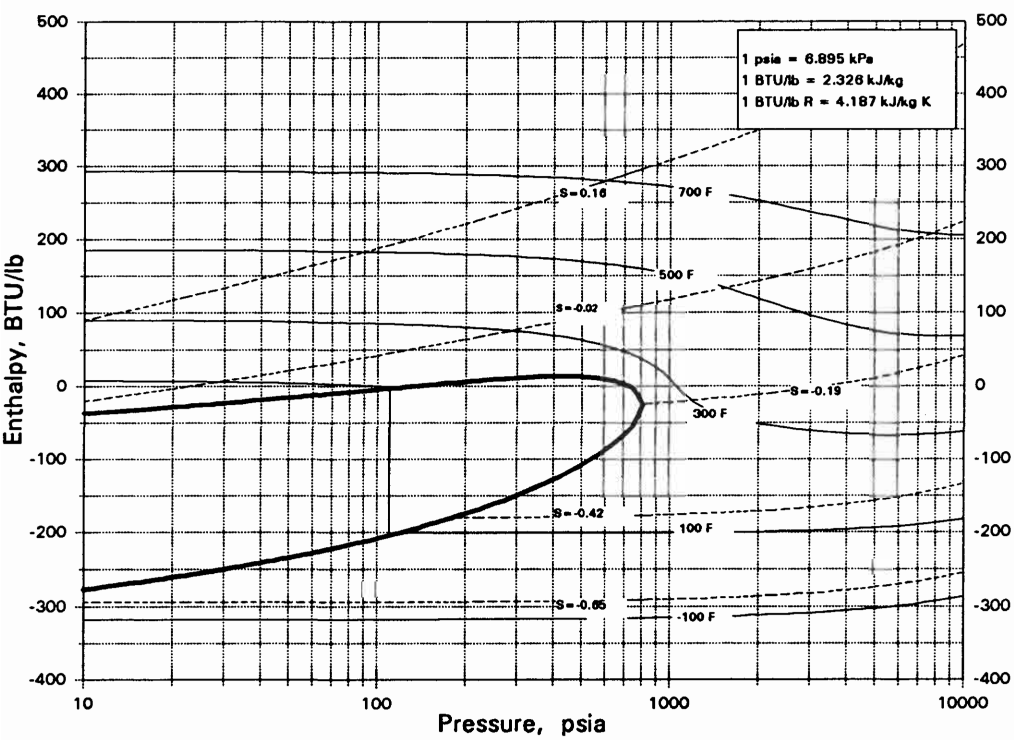
C3H3NO OXAZOLE





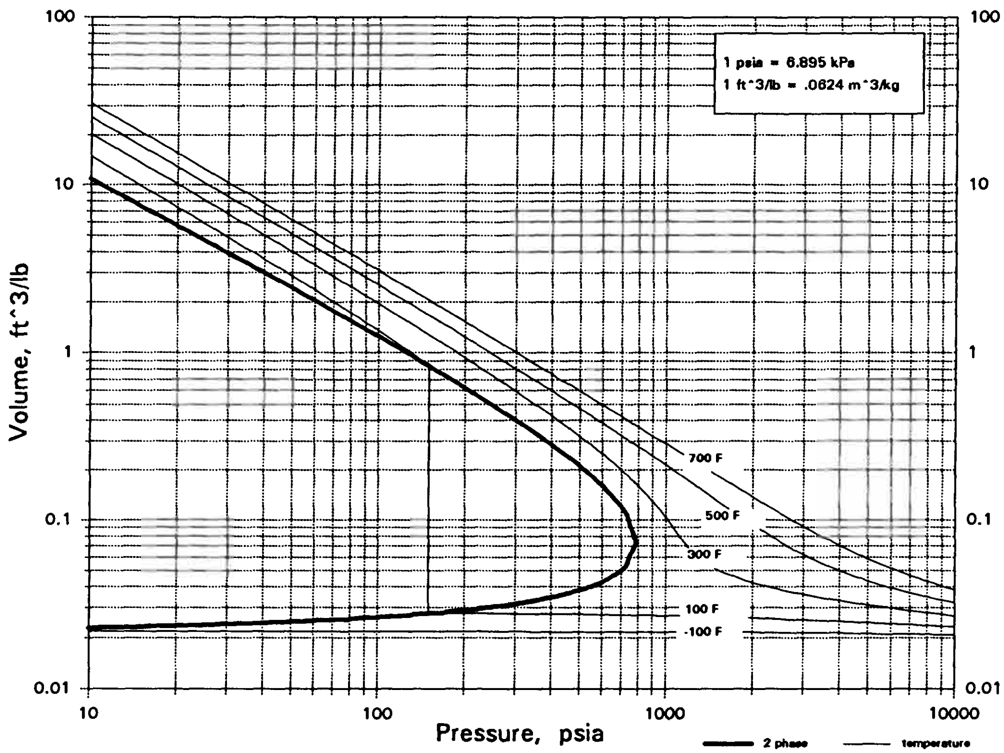
C3H4 METHYLACETYLENE

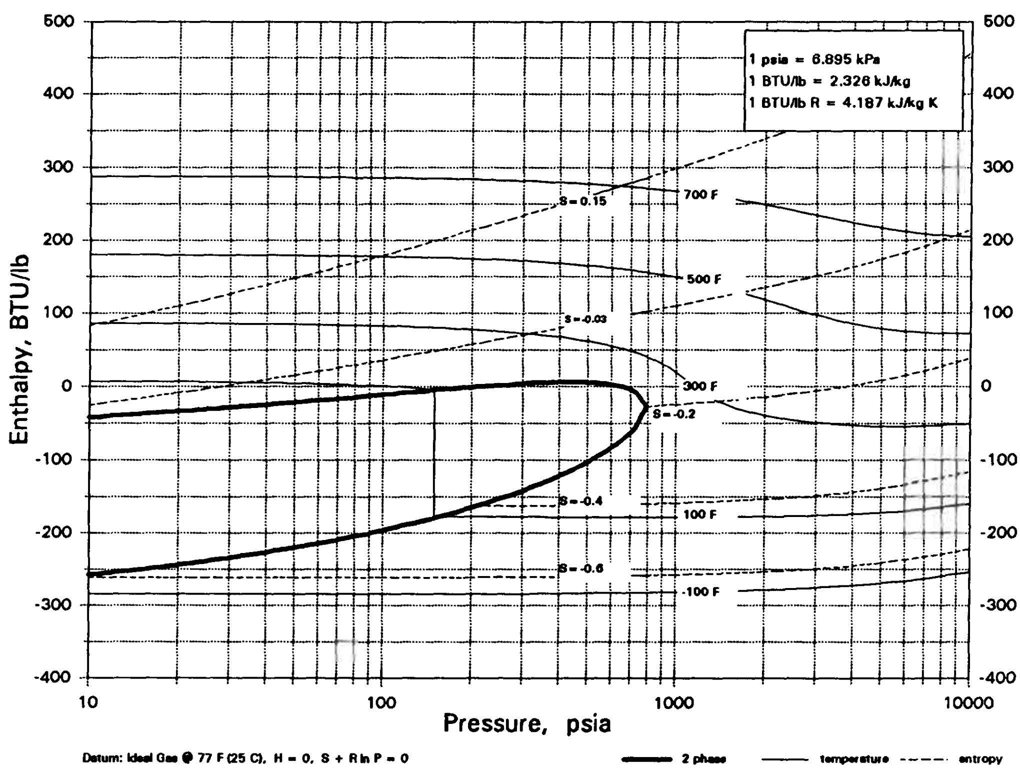




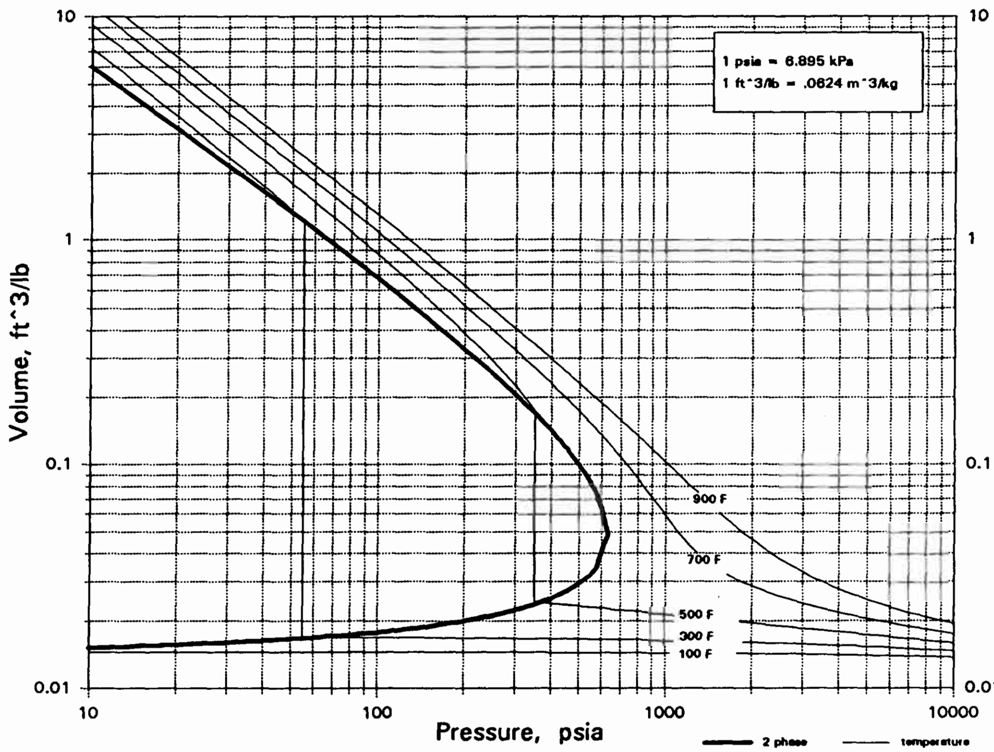
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

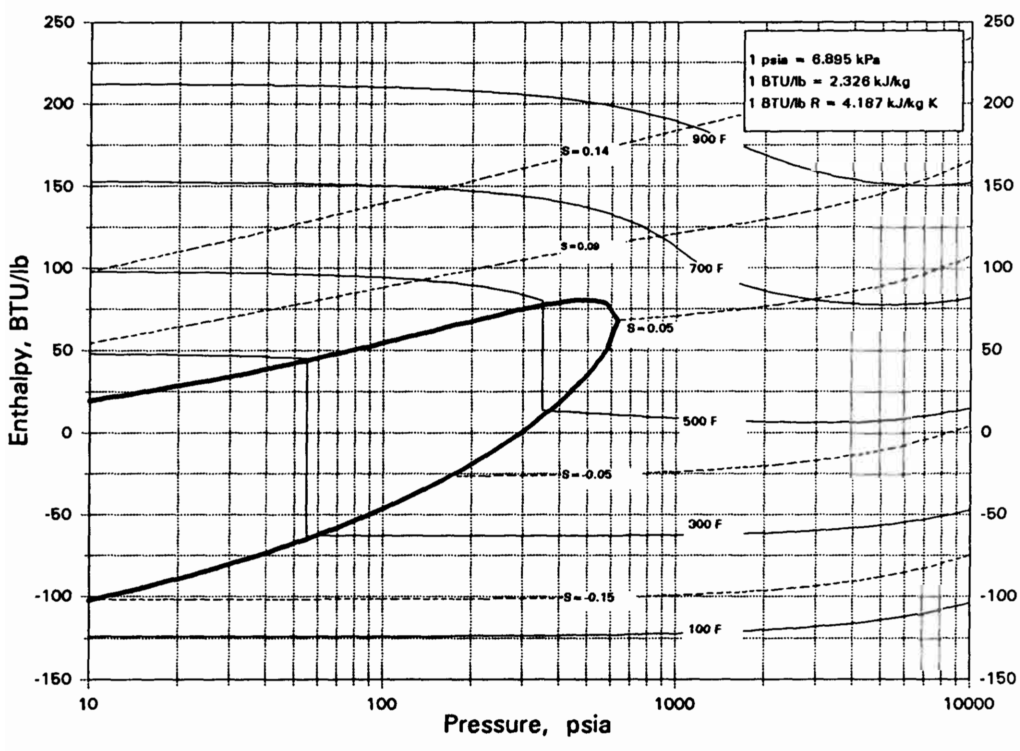
C3H4 PROPADIENE



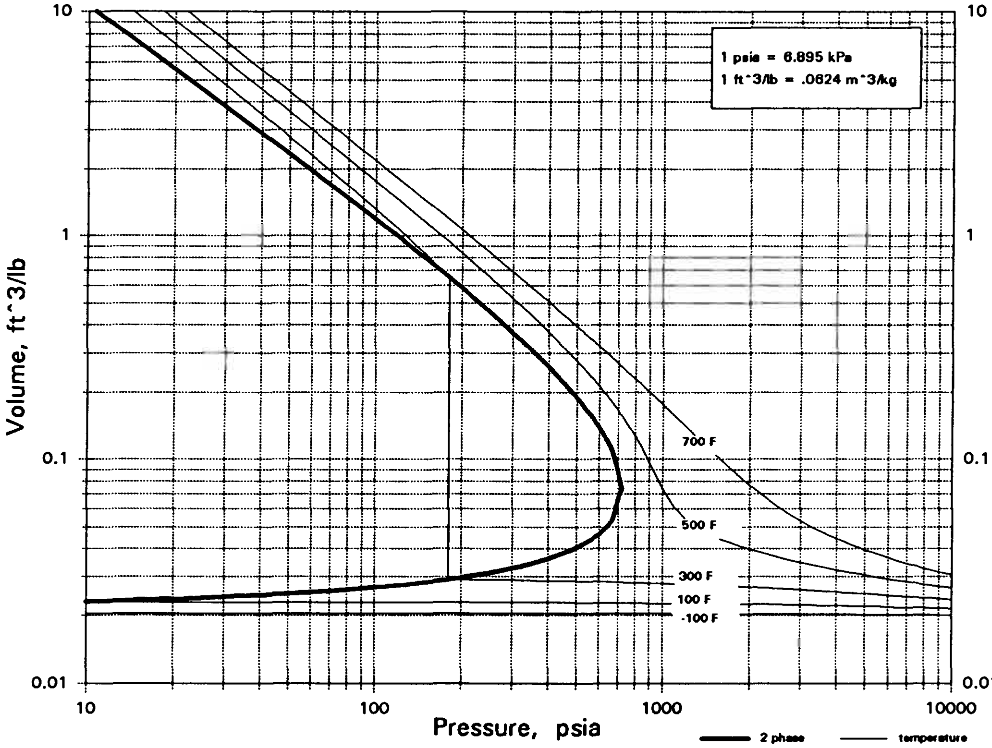


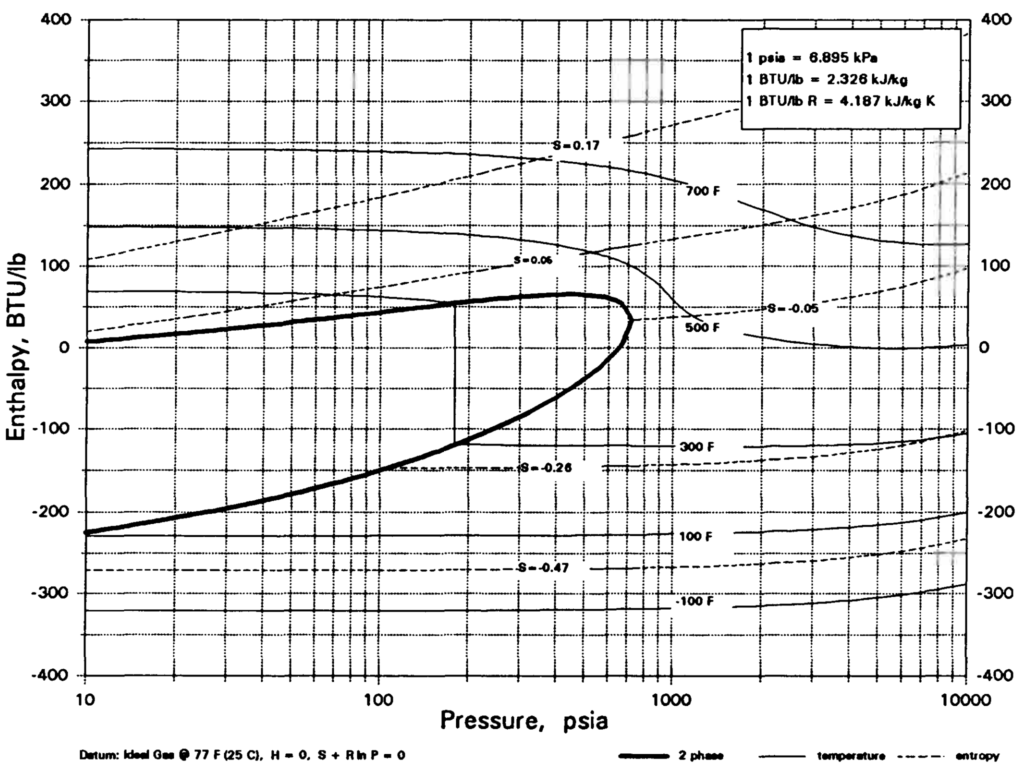
C3H4Cl2 2-3-DICHLOROPROPENE



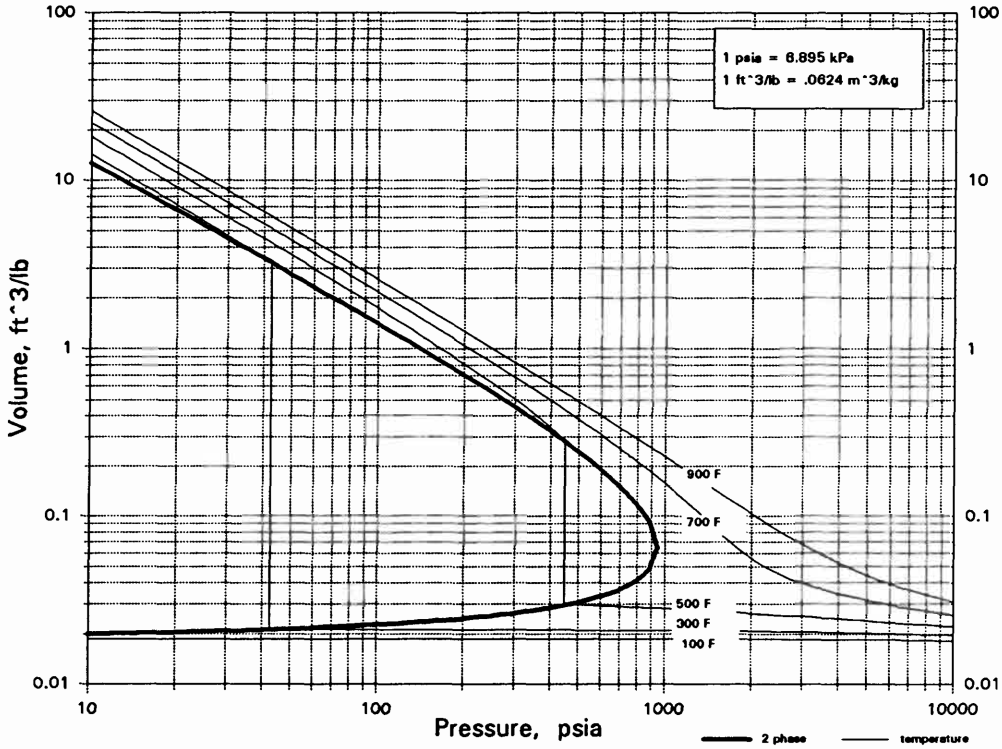


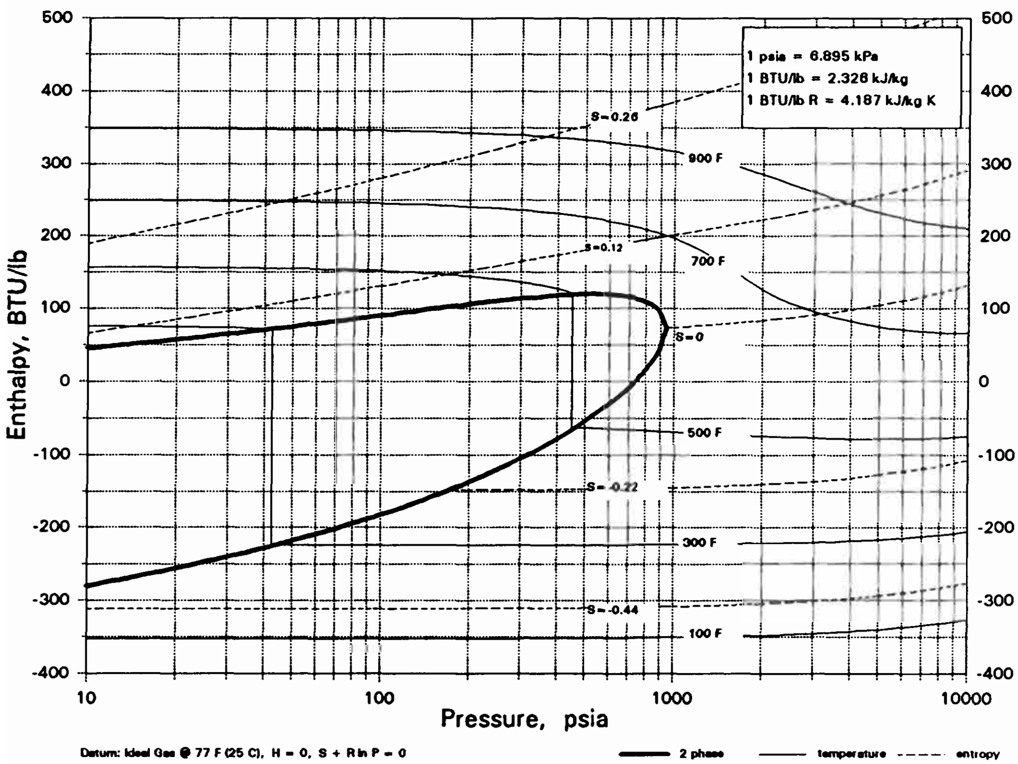
C3H4O ACROLEIN



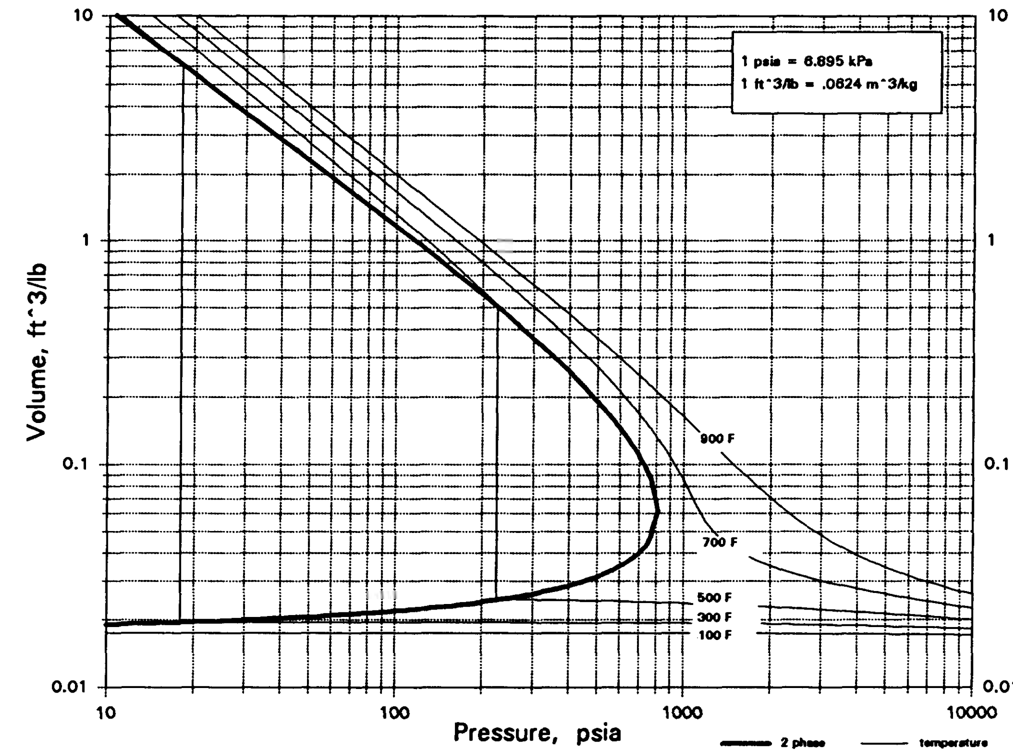


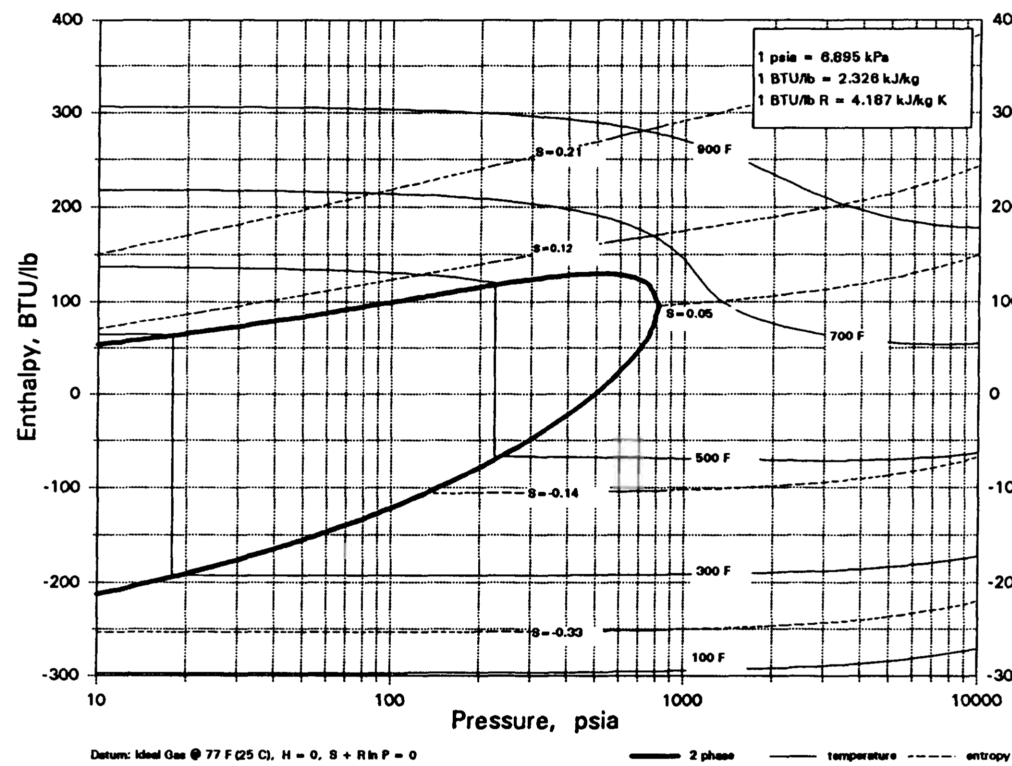
C3H4O PROPARGYL ALCOHOL



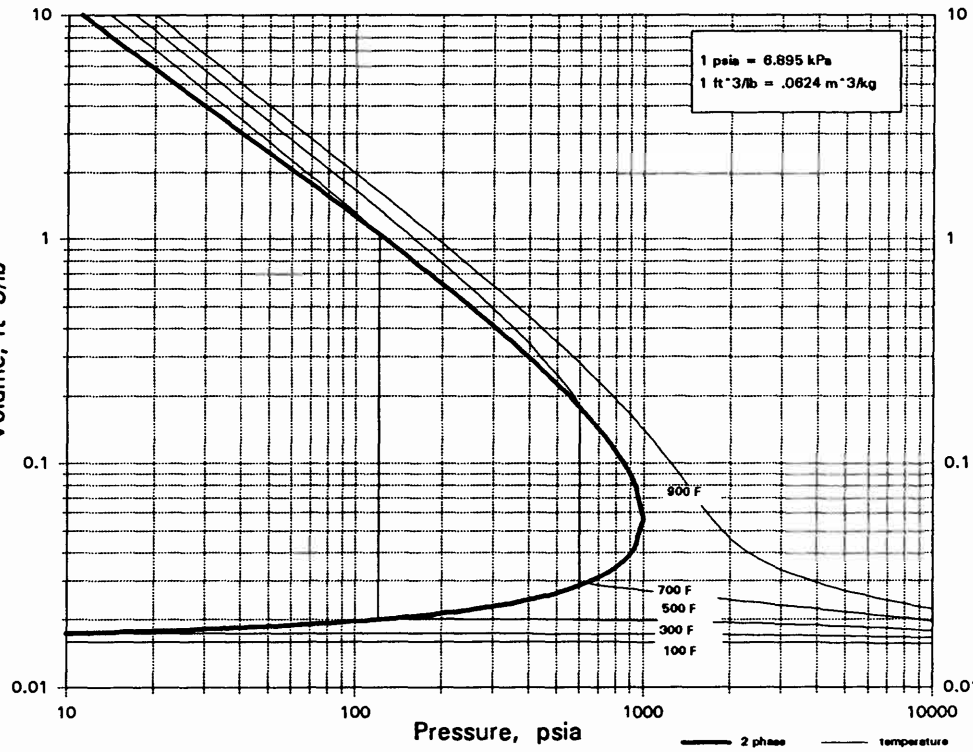


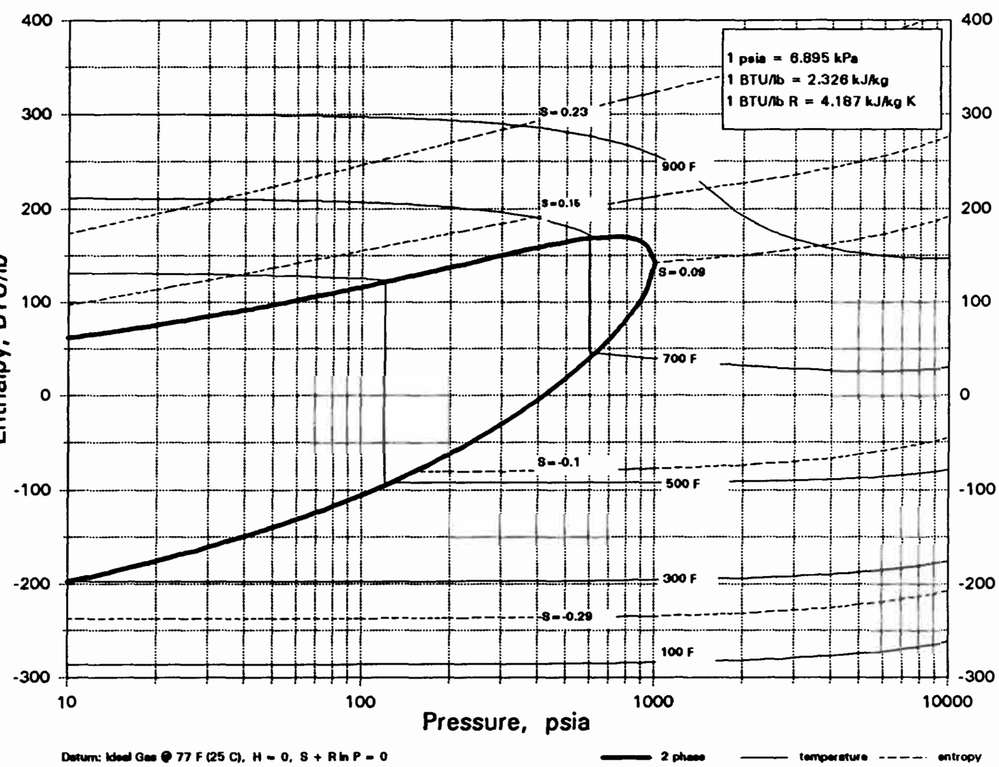
C3H4O2 ACRYLIC ACID



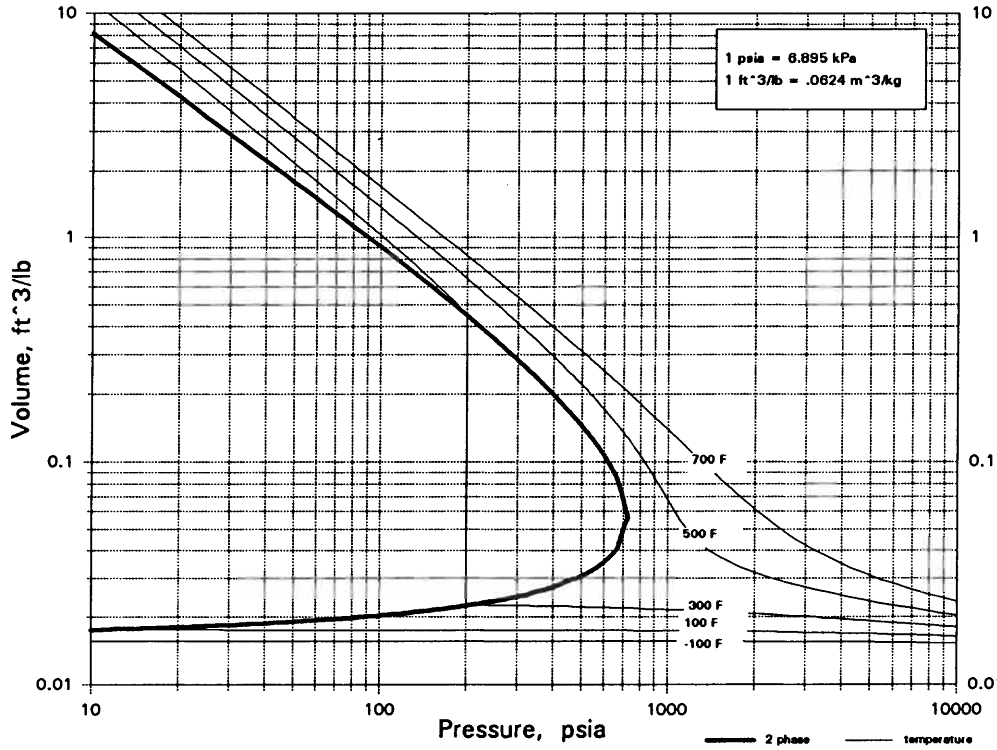


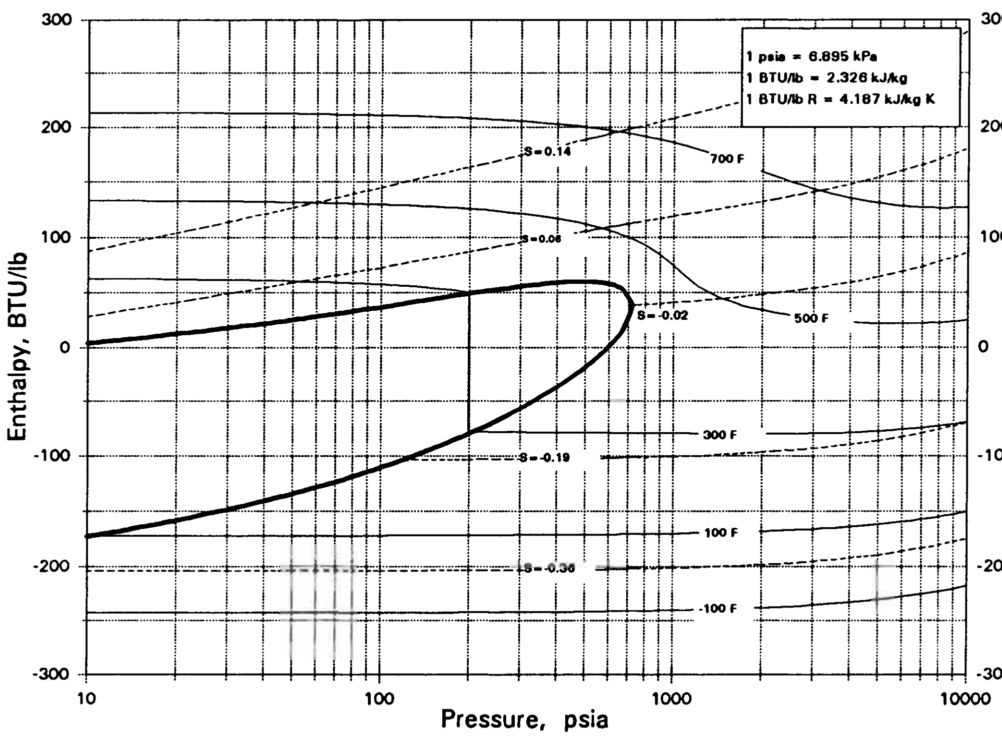
C3H4O2 beta-PROPIOLACTONE





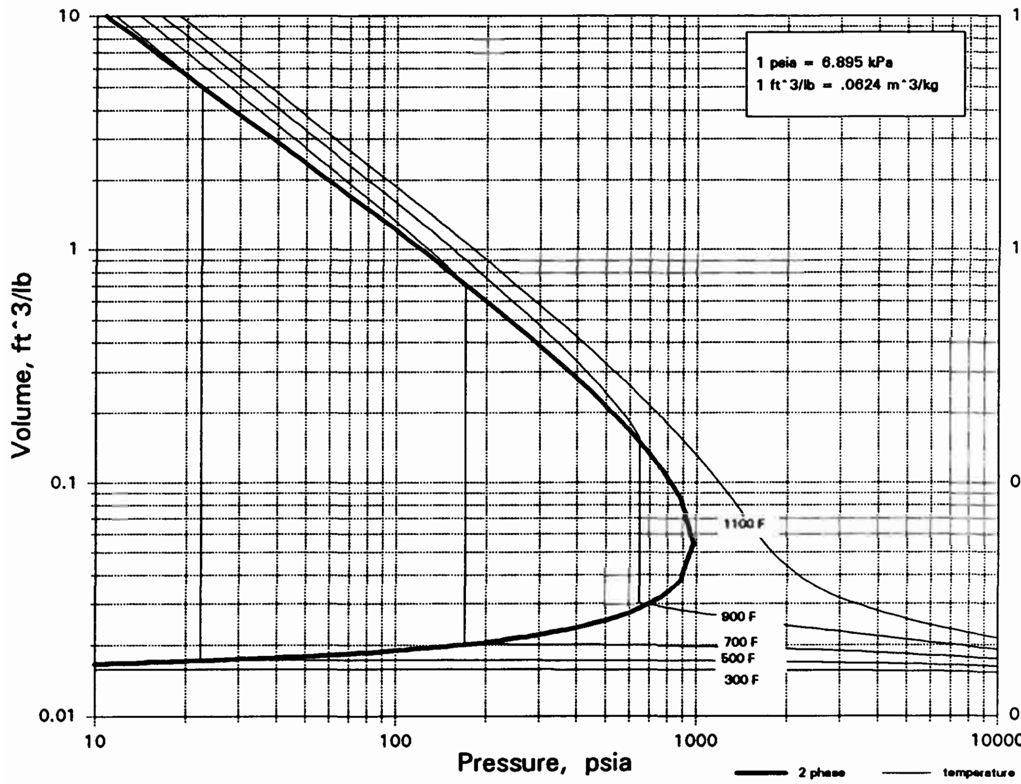
C3H4O2 VINYL FORMATE





Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

C3H4O3 ETHYLENE CARBONATE



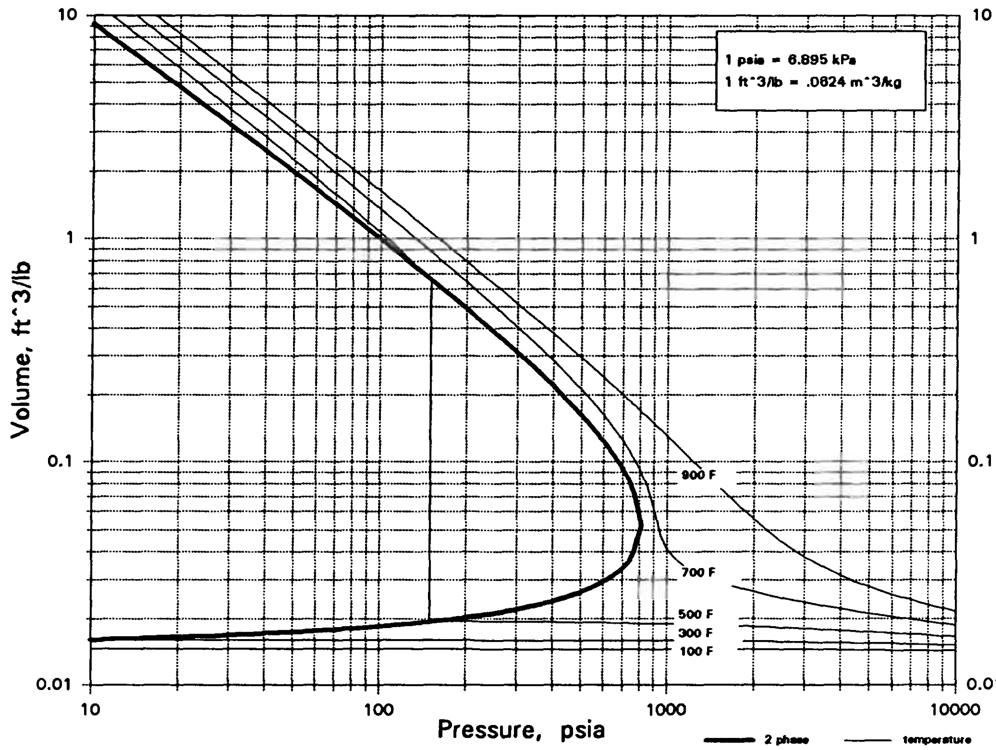
1. Boiling Point, K................ 511.15

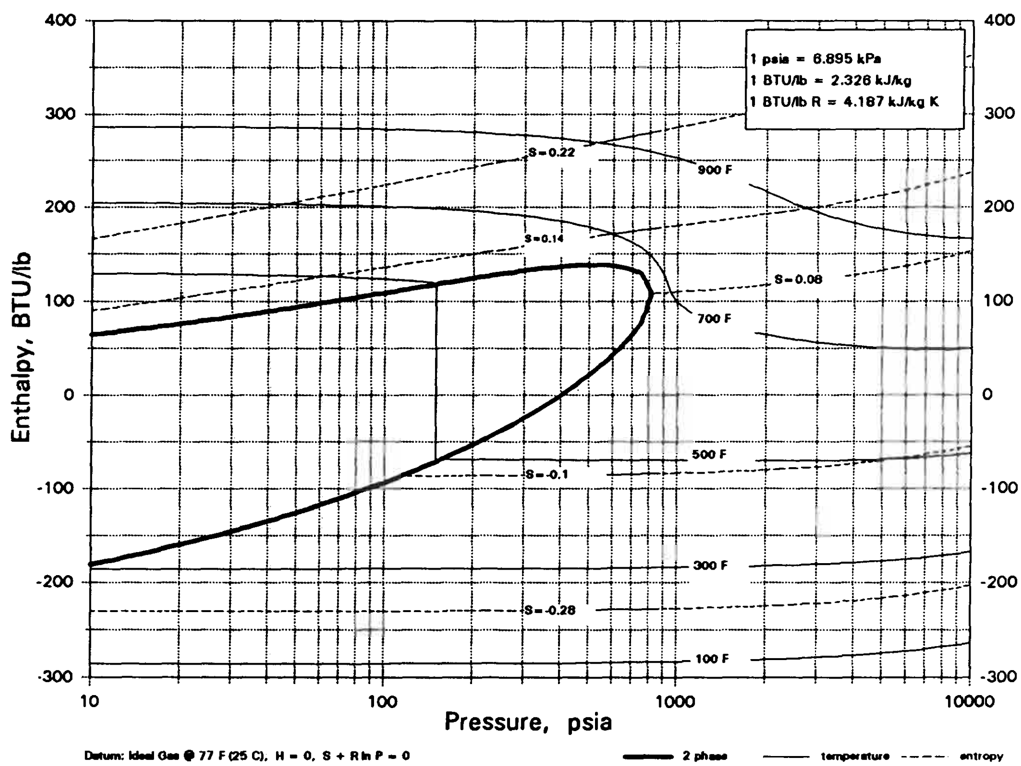
2. Critical Temperature, K.... 790.00

3. Critical Pressure, atm....... 66.81

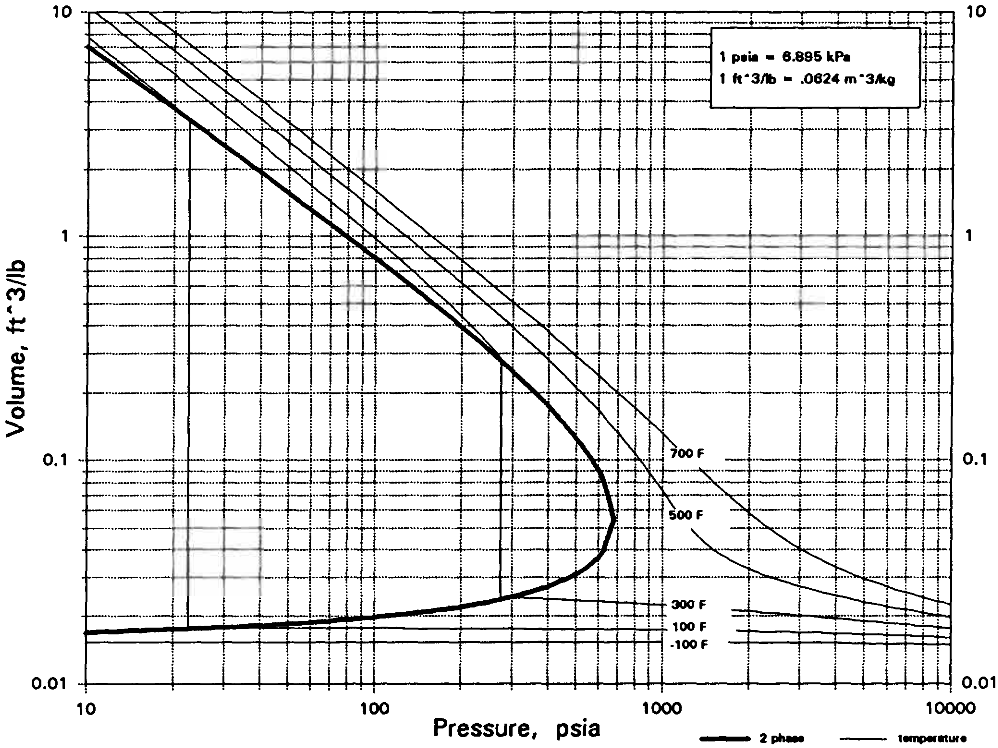
Heat capacity data are not available.

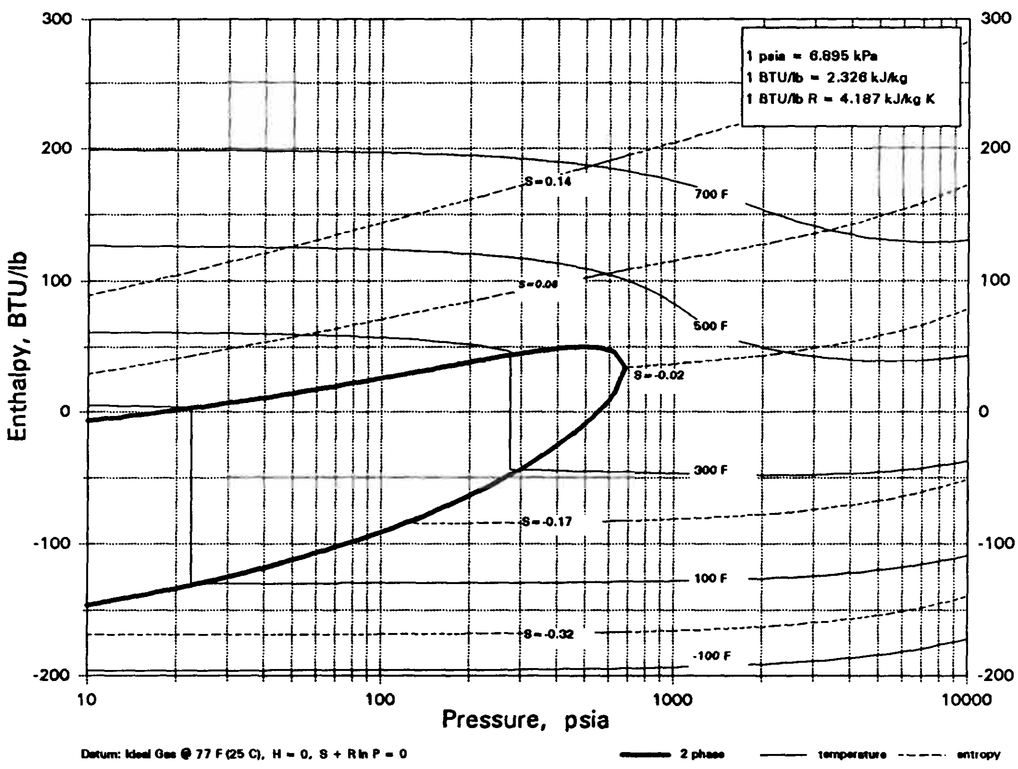
$C_3H_4O_3$ PYRUVIC ACID



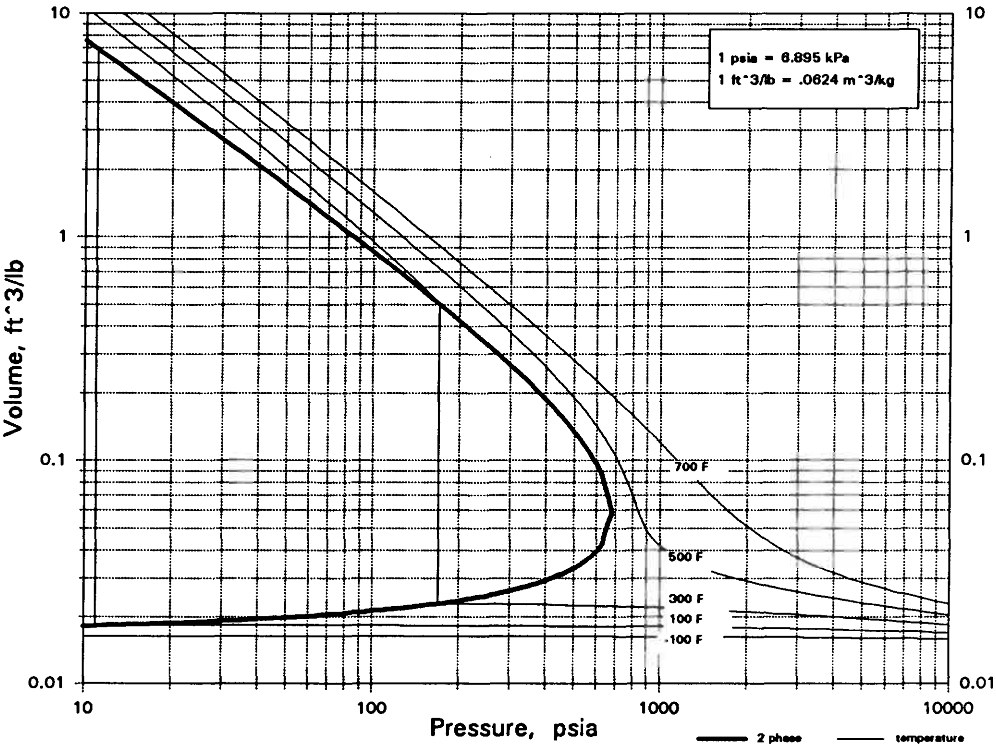


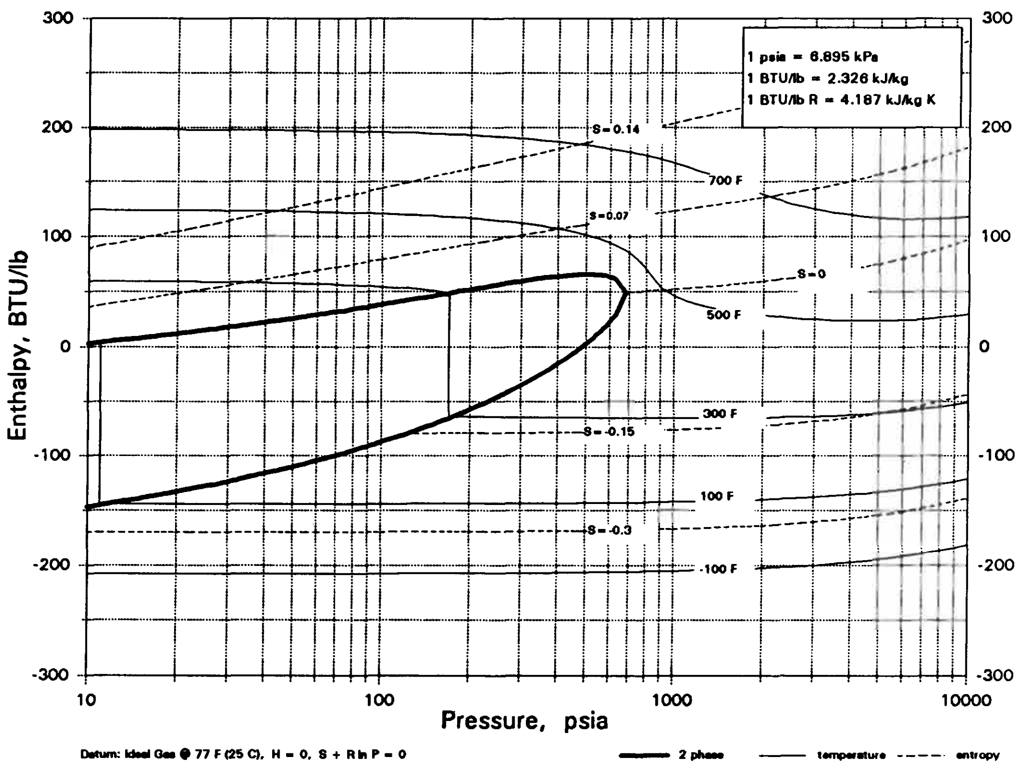
C3H5Cl 2-CHLOROPROPENE



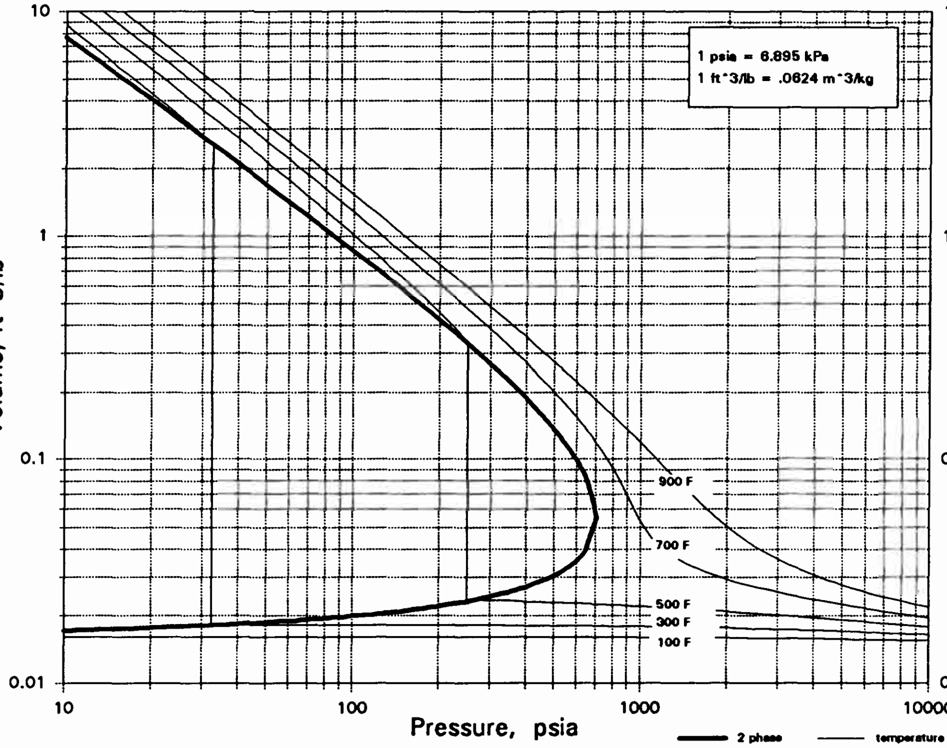


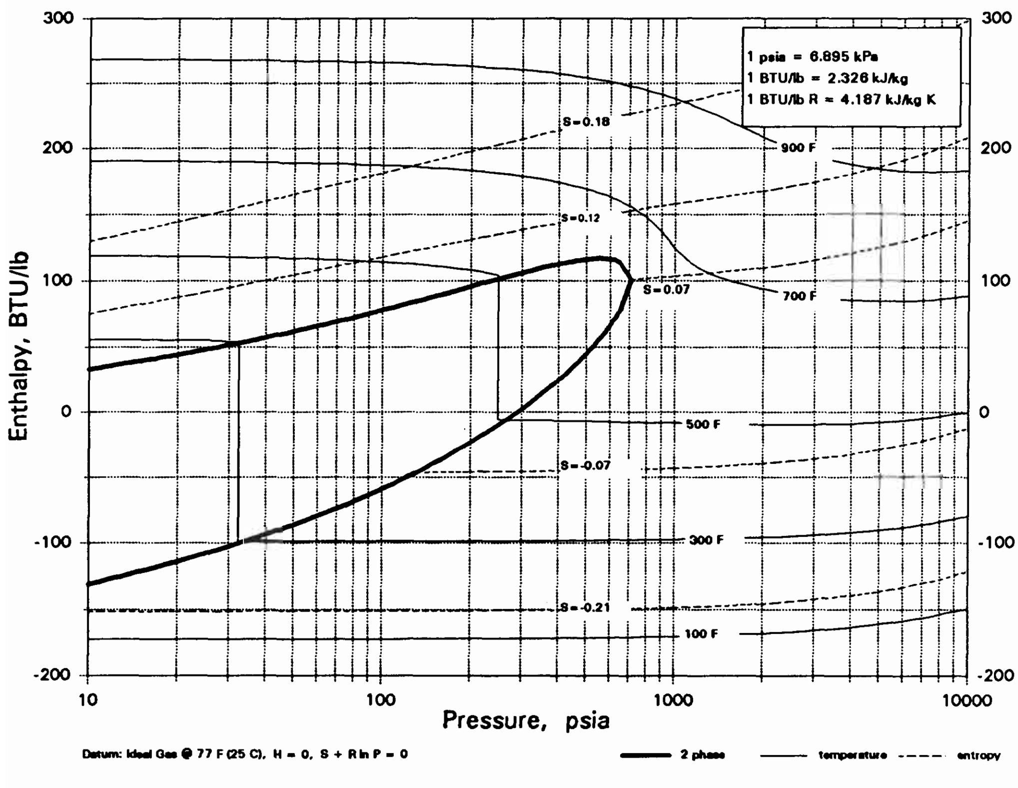
C3H5Cl	3-CHLOROPROPENE



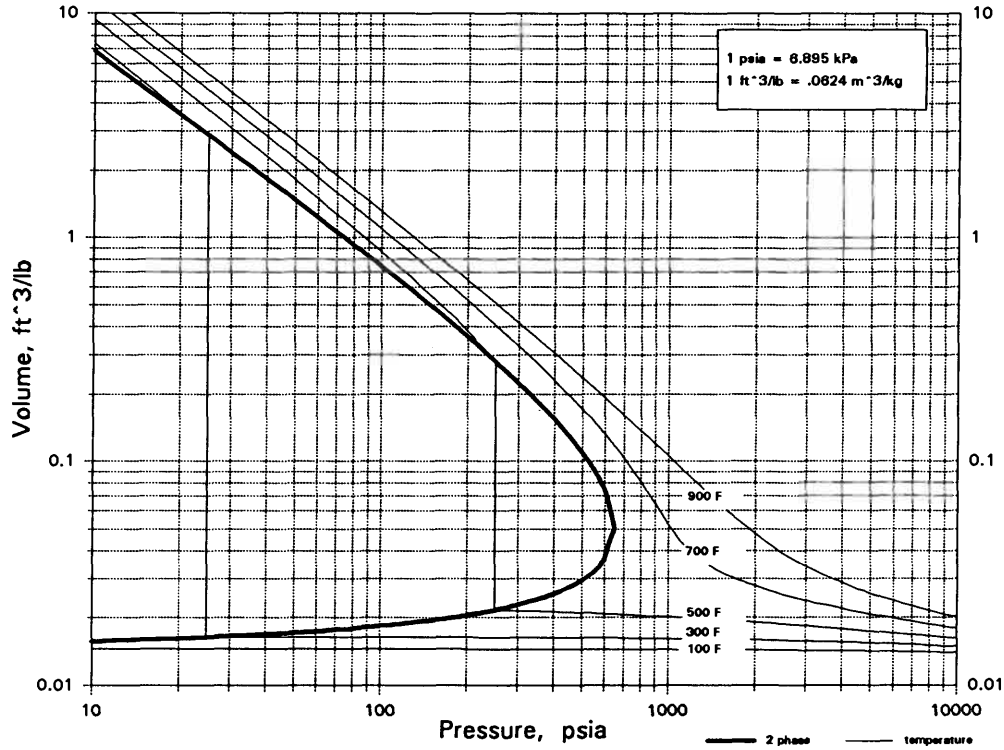


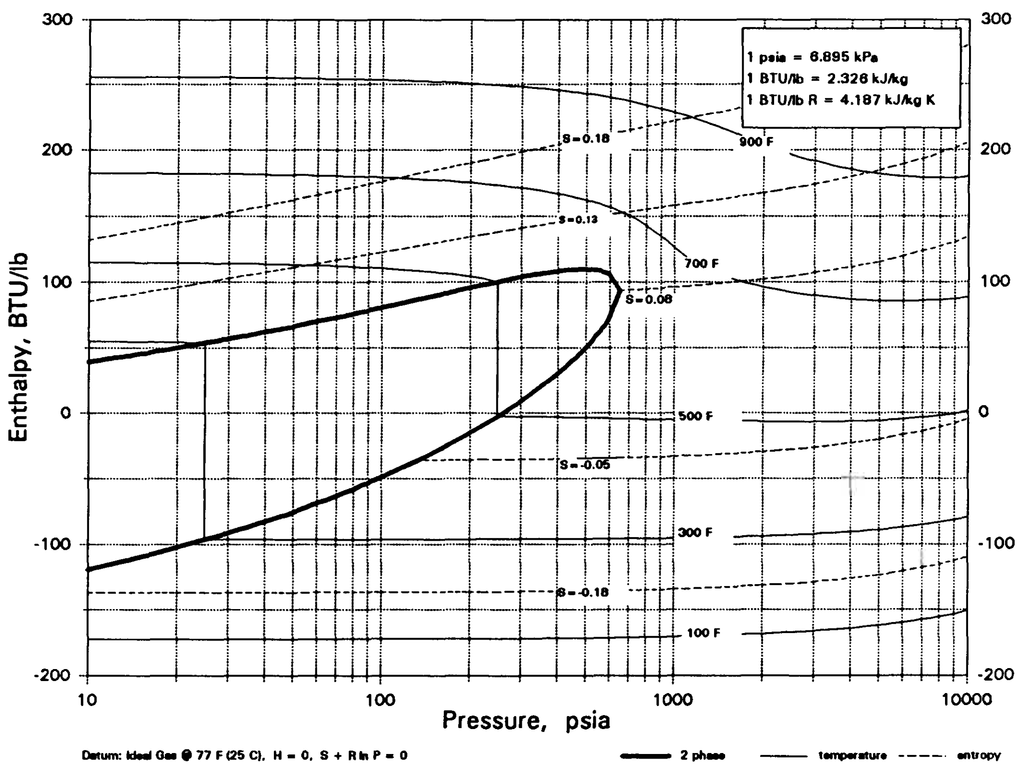
C3H5ClO alpha-EPICHLOROHYDRIN



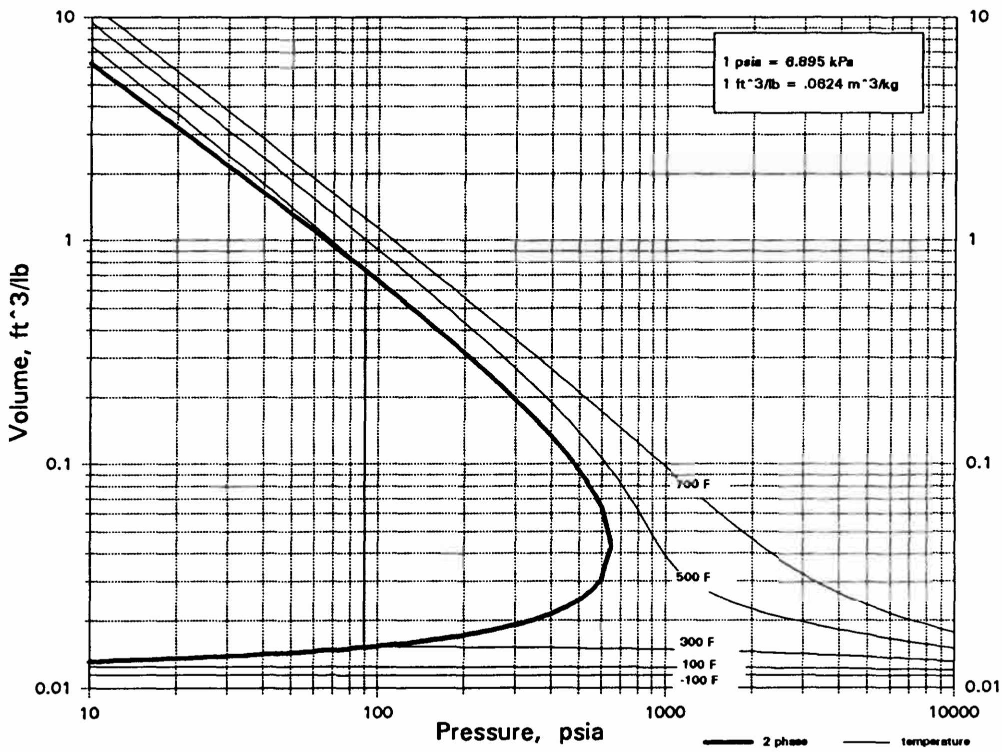


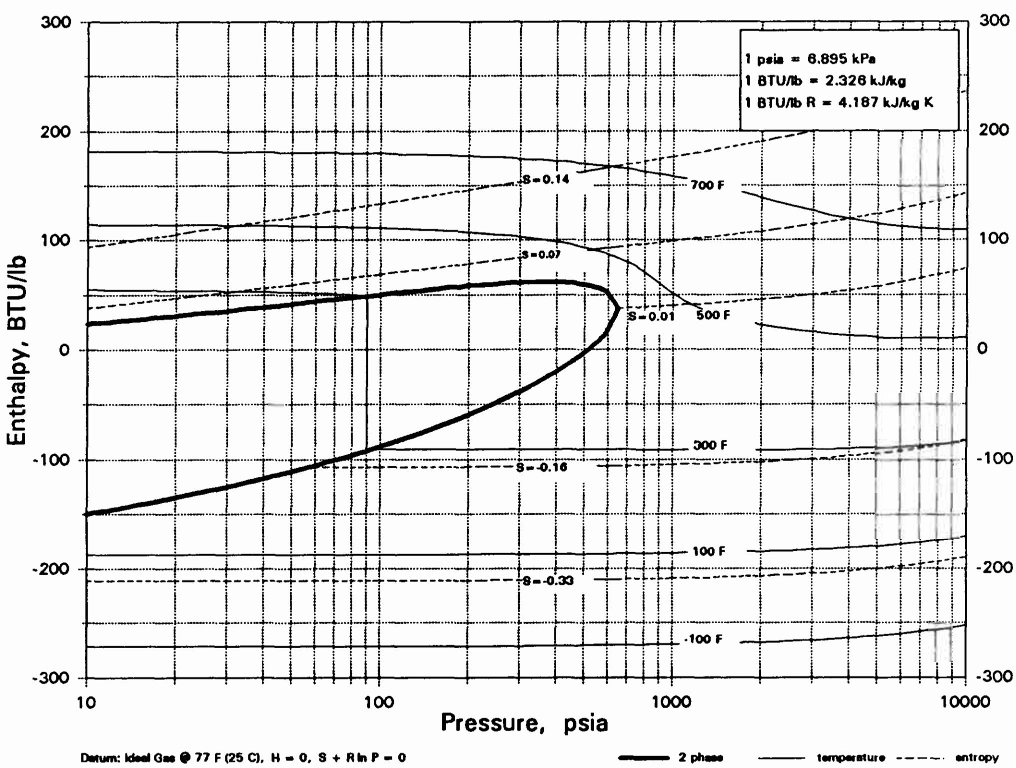
C3H5ClO2 METHYL CHLOROACETATE



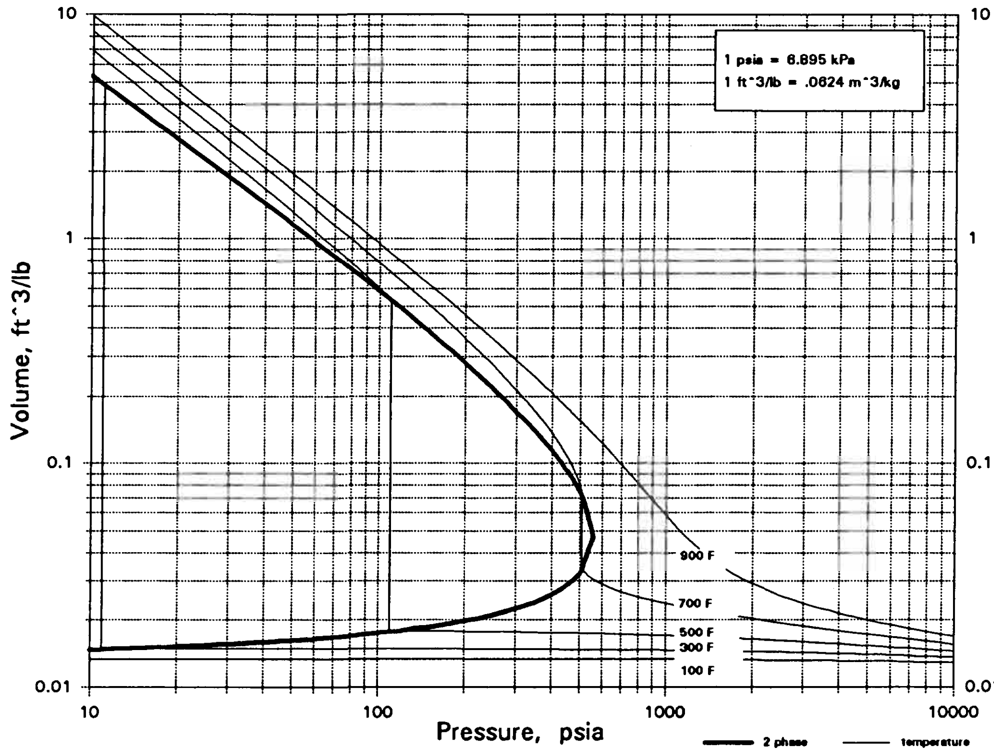


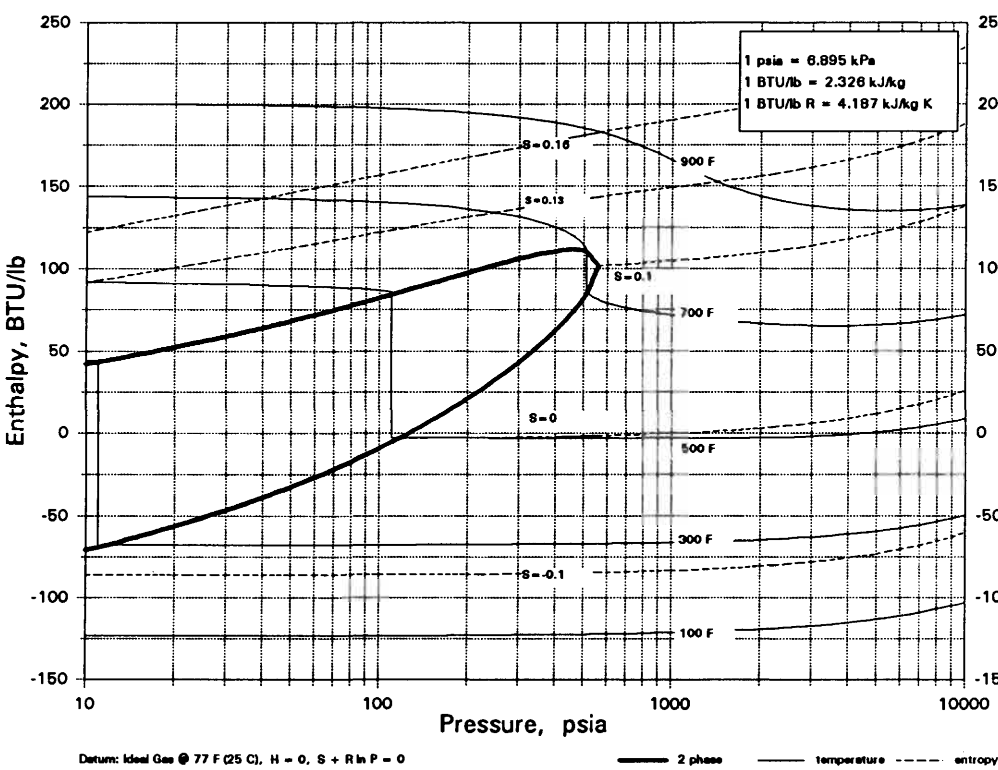
C3H5ClO2 ETHYL CHLOROFORMATE



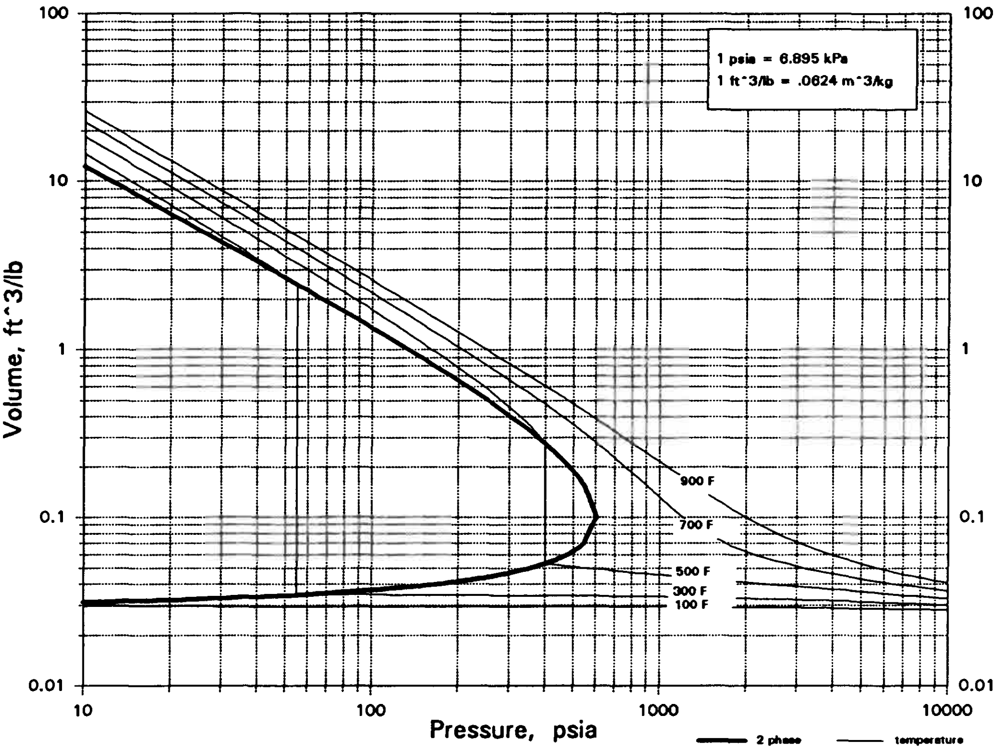


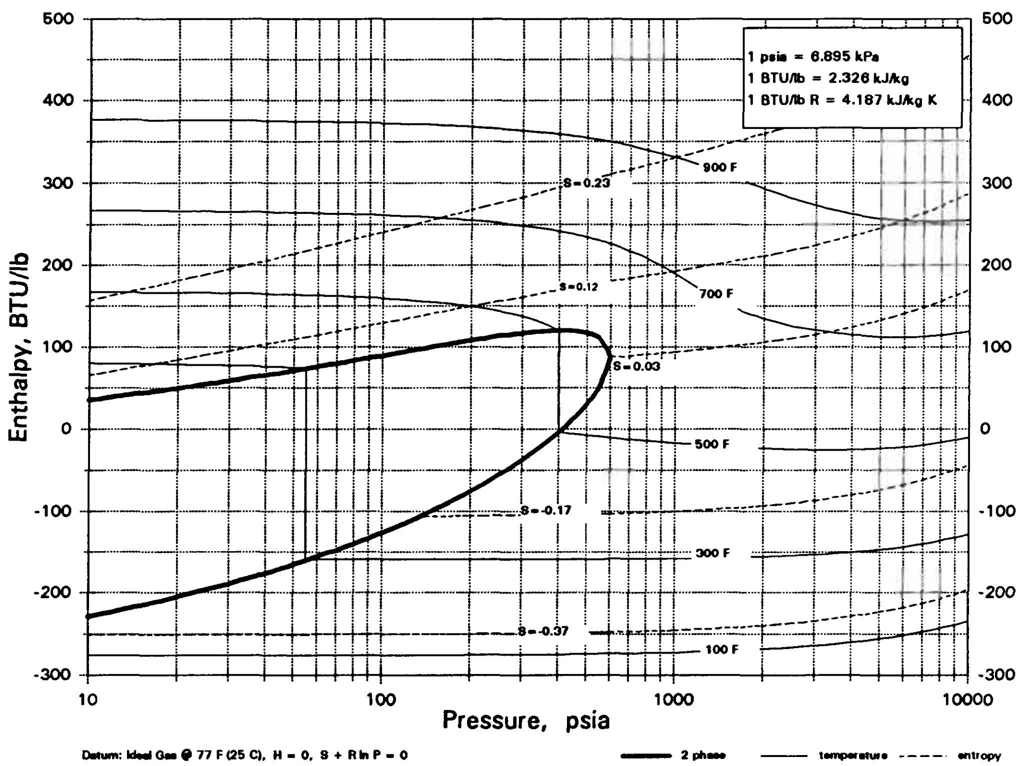
C3H5Cl3 1-2-3-TRICHLOROPROPANE



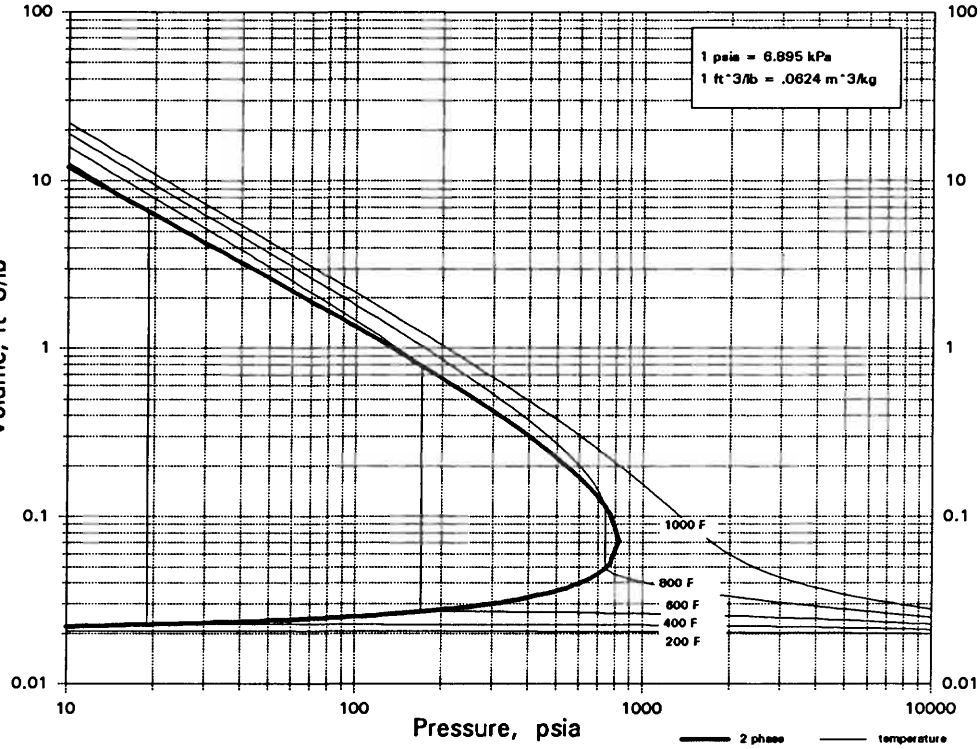


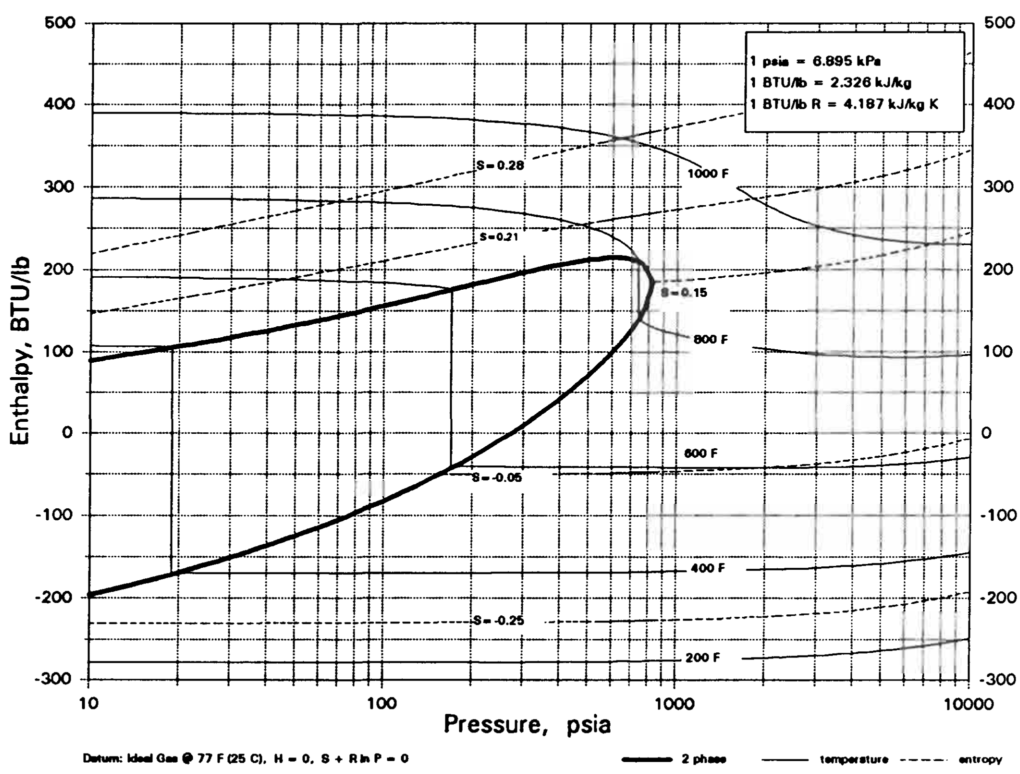
C3H5N PROPIONITRILE



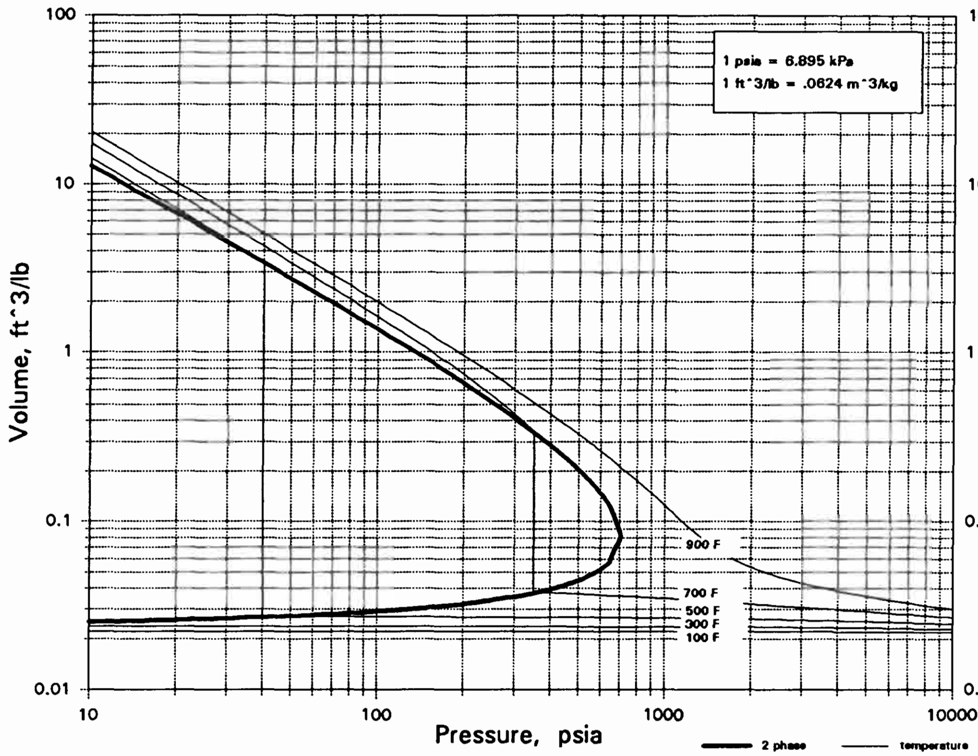


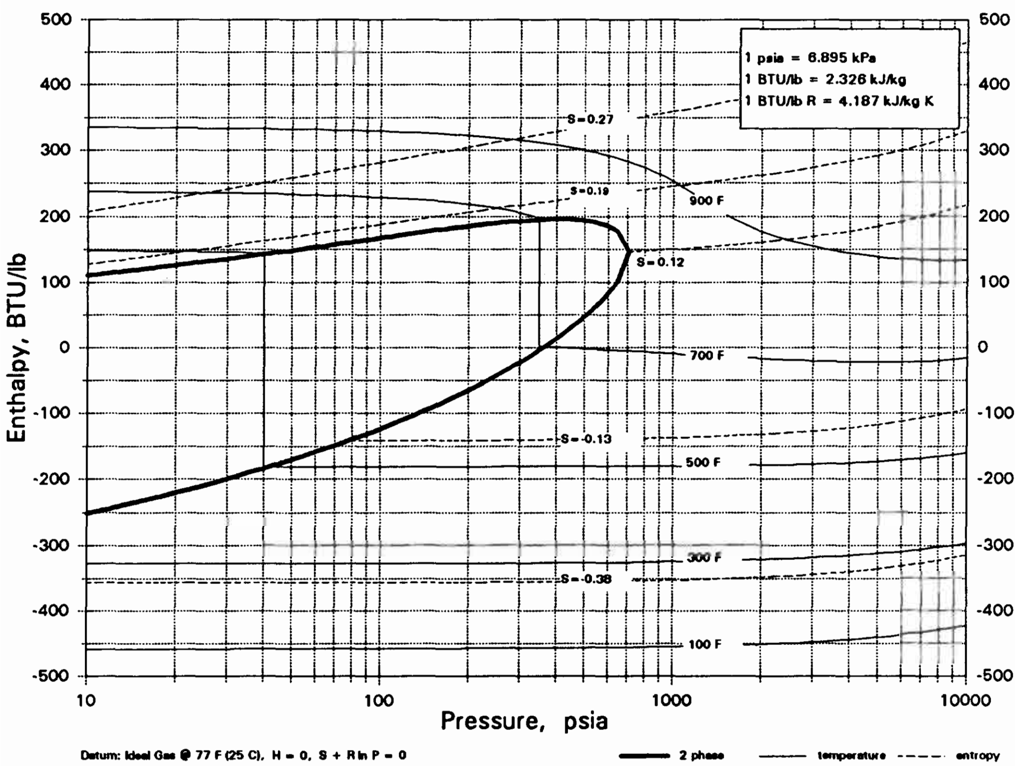
C3H5NO ACRYLAMIDE



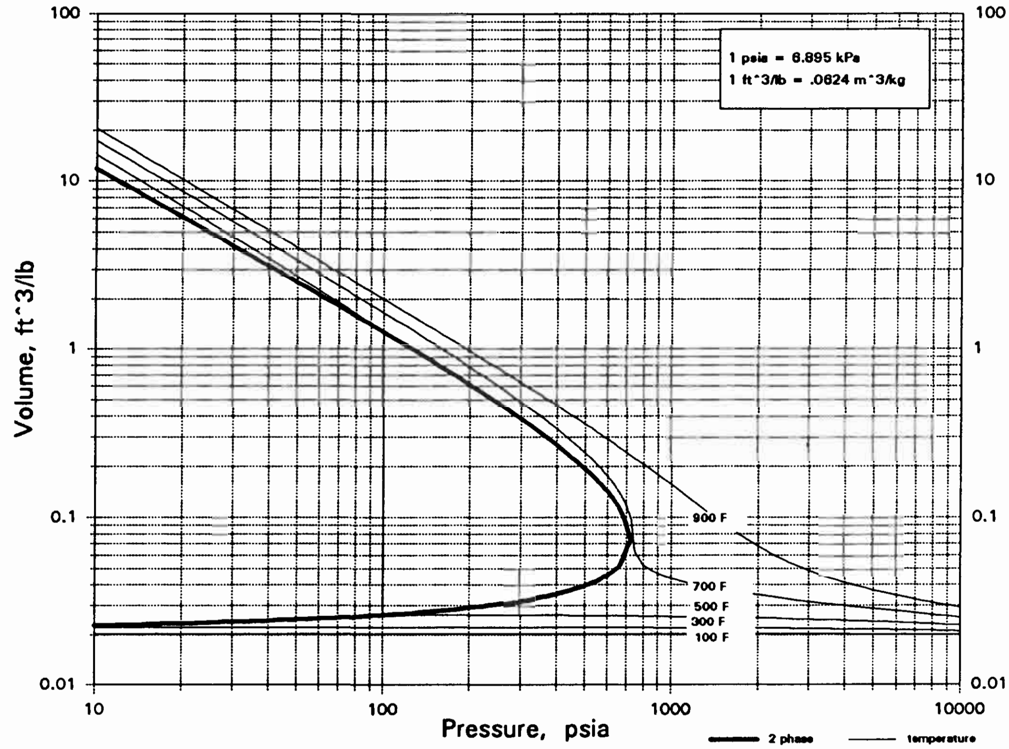


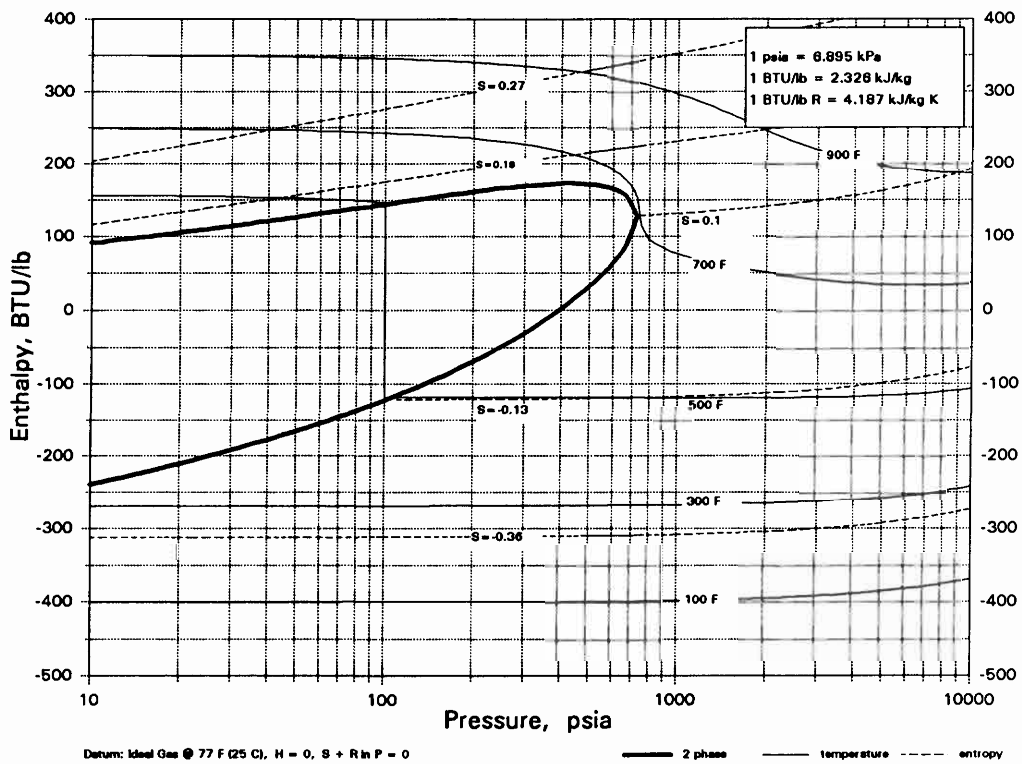
C3H5NO HYDRACRYLONITRILE



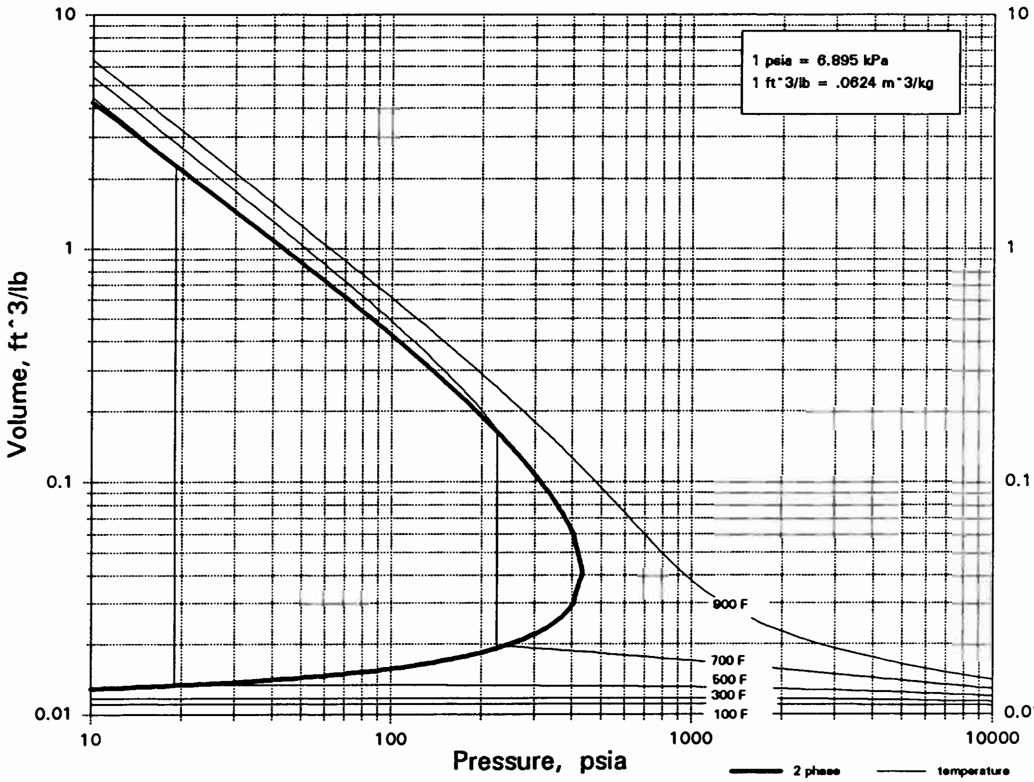


C3H5NO LACTONITRILE





C3H5N3O9 NITROGLYCERINE



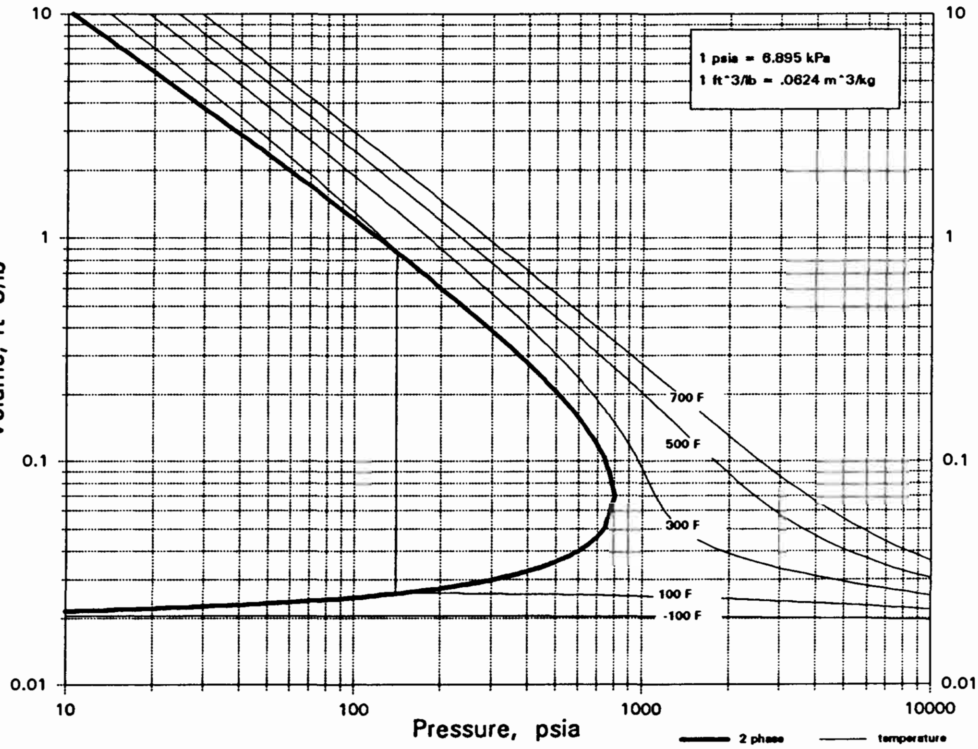
1. Boiling Point, K................ 523.00

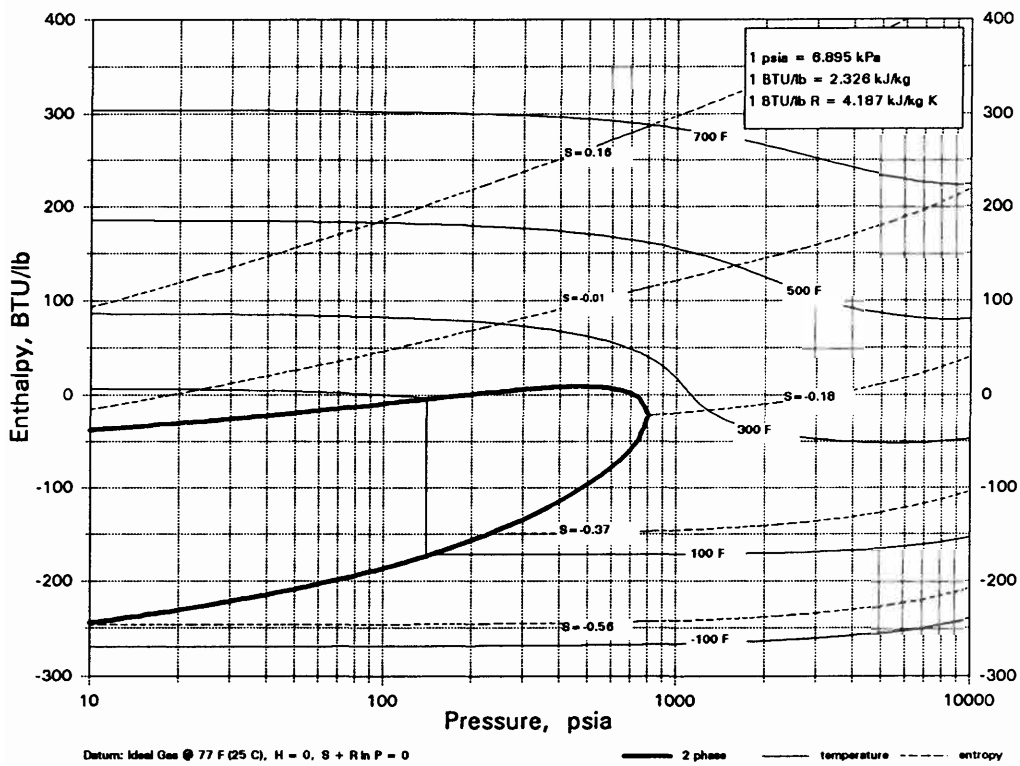
2. Critical Temperature, K.... 680.00

3. Critical Pressure, atm....... 29.61

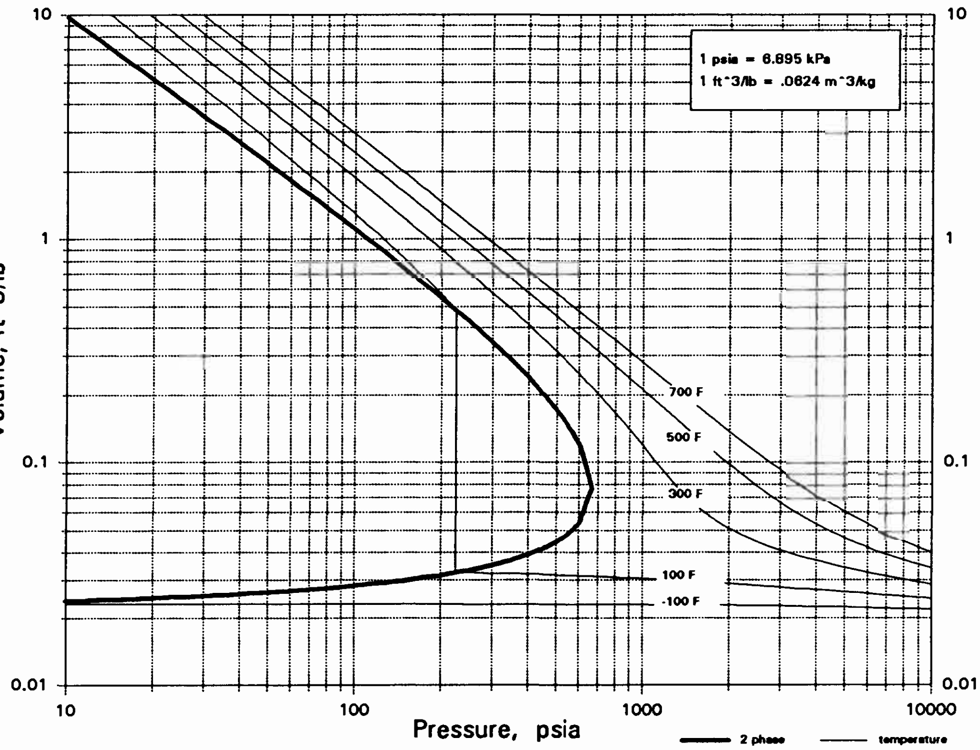
Heat capacity data are not available.

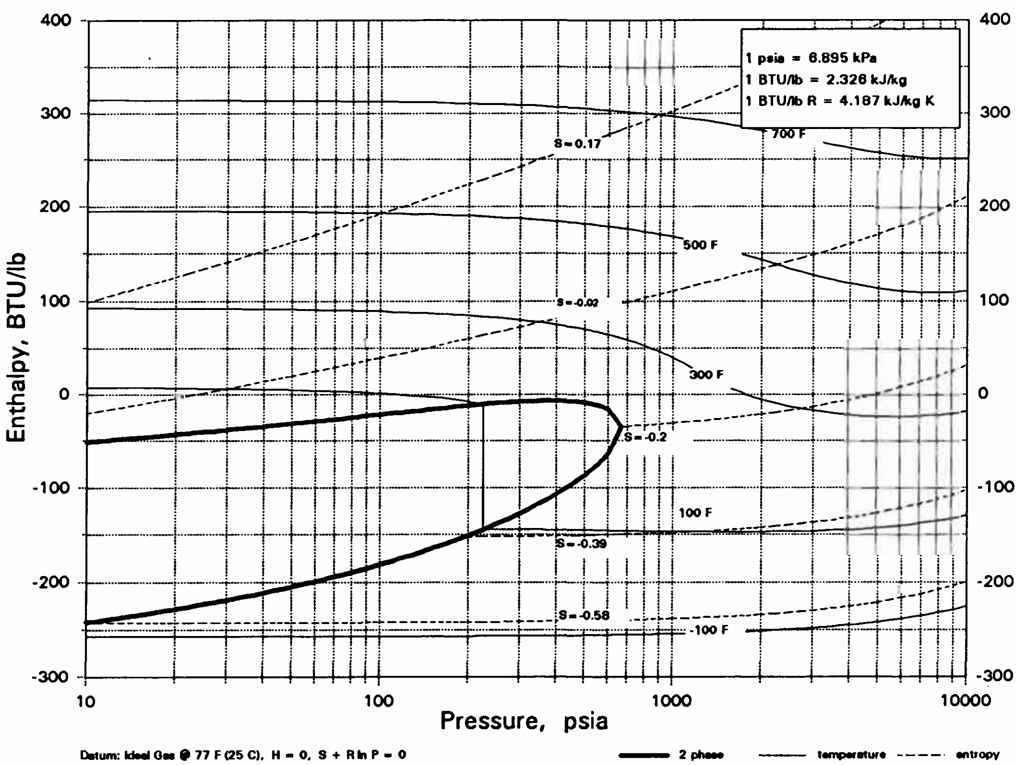
C3H6 CYCLOPROPANE



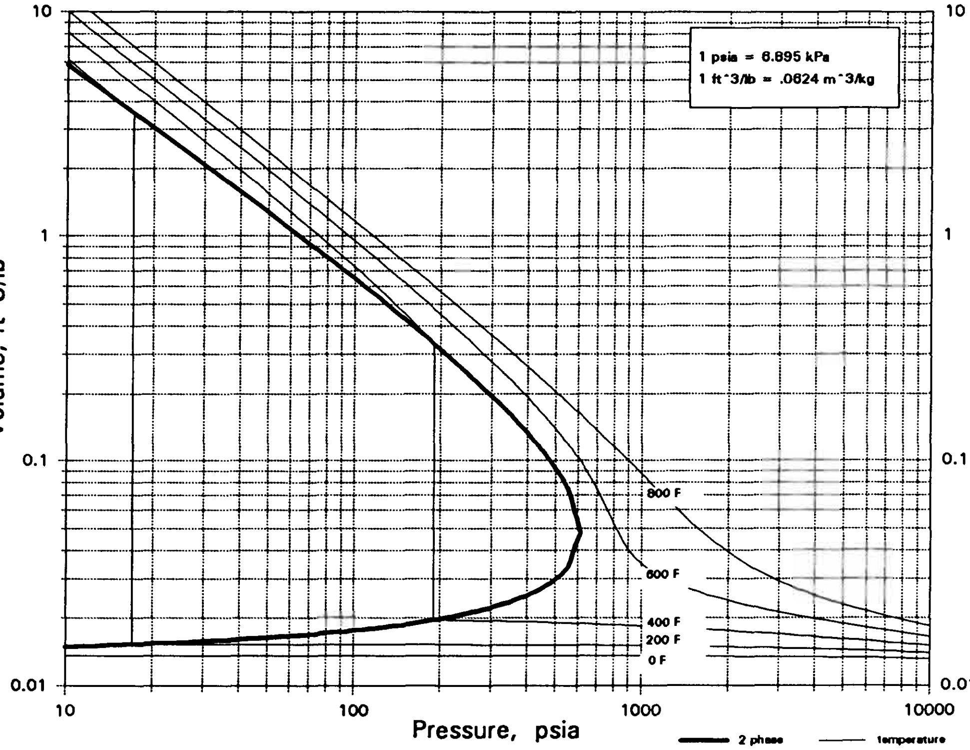


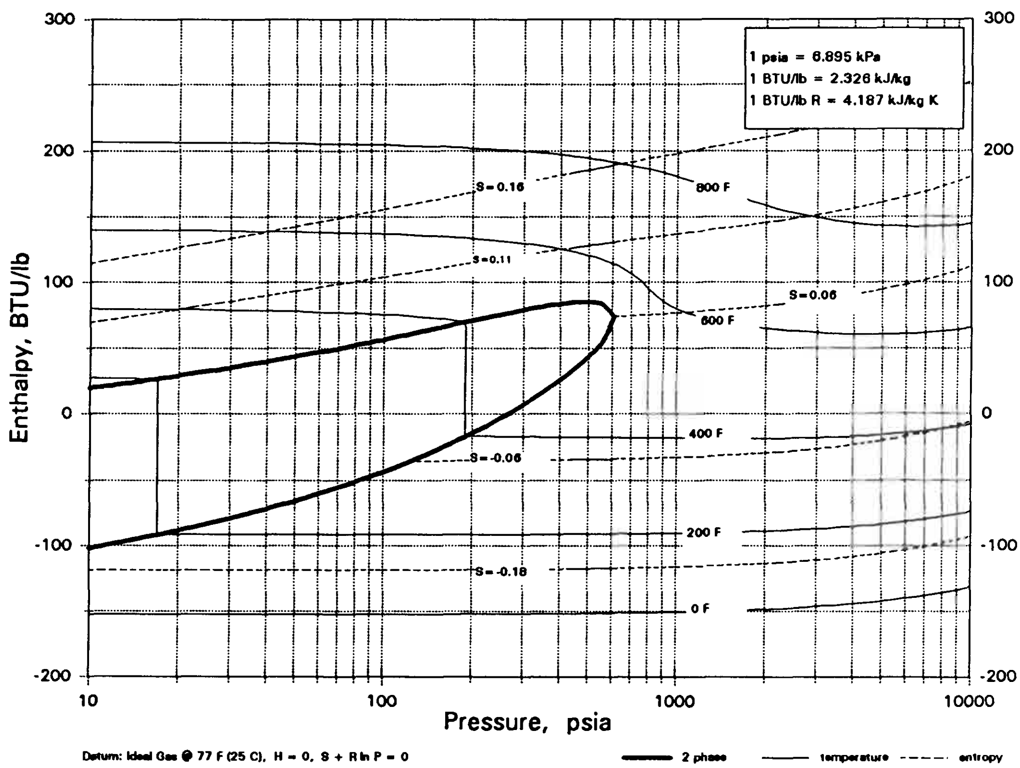
C3H6 PROPYLENE



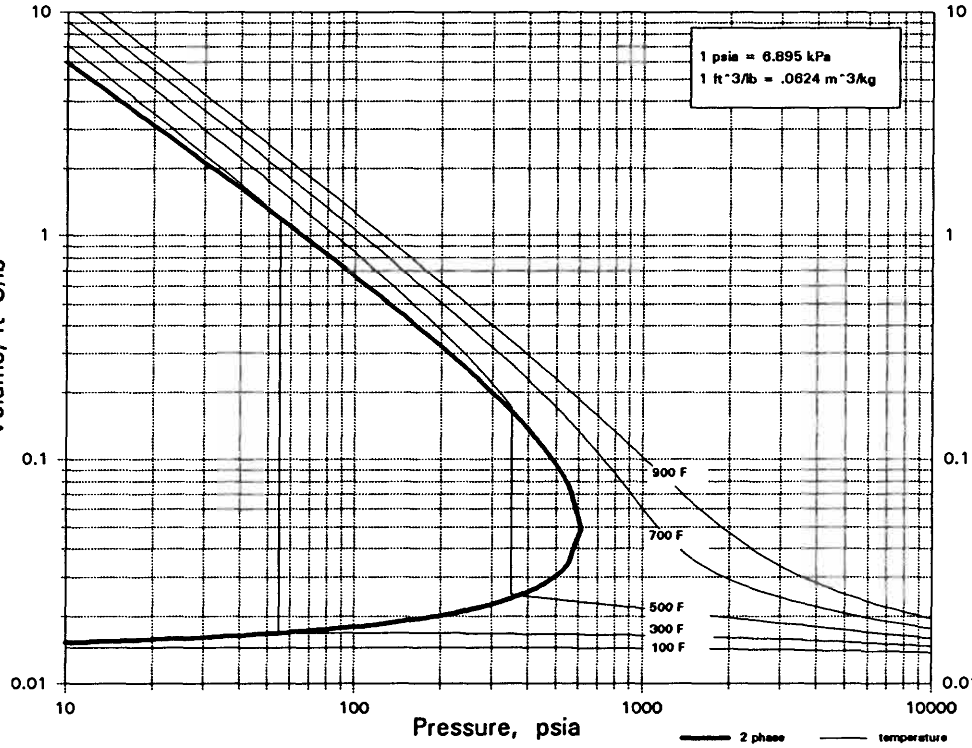


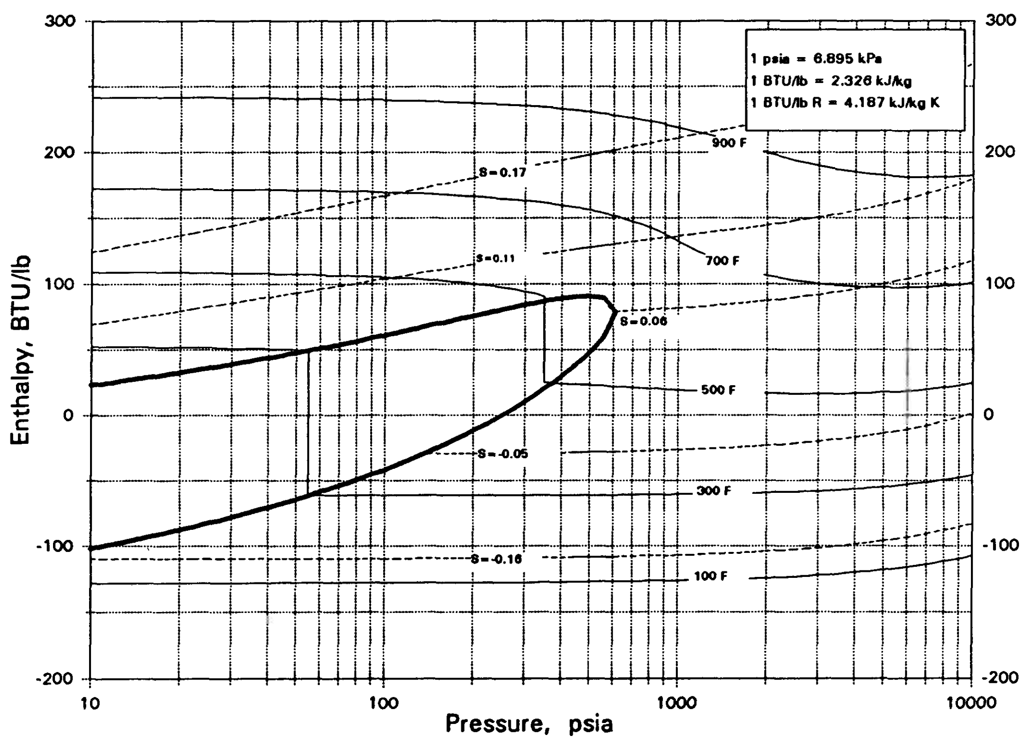
C3H6Cl2 1-1-DICHLOROPROPANE





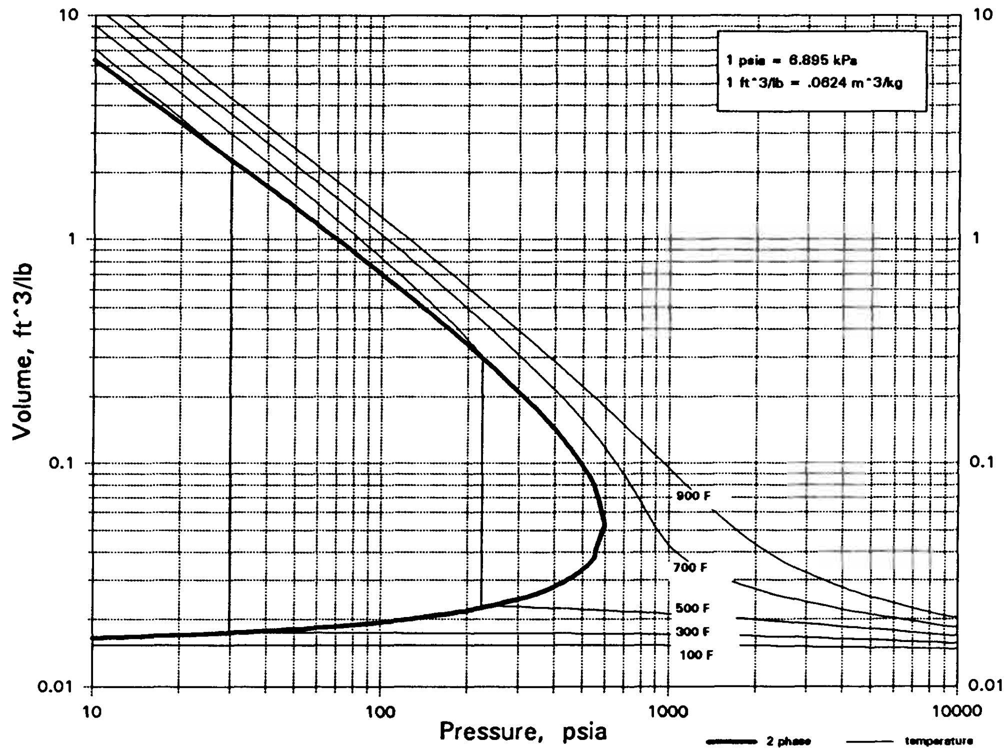
C3H6Cl2 1-2-DICHLOROPROPANE

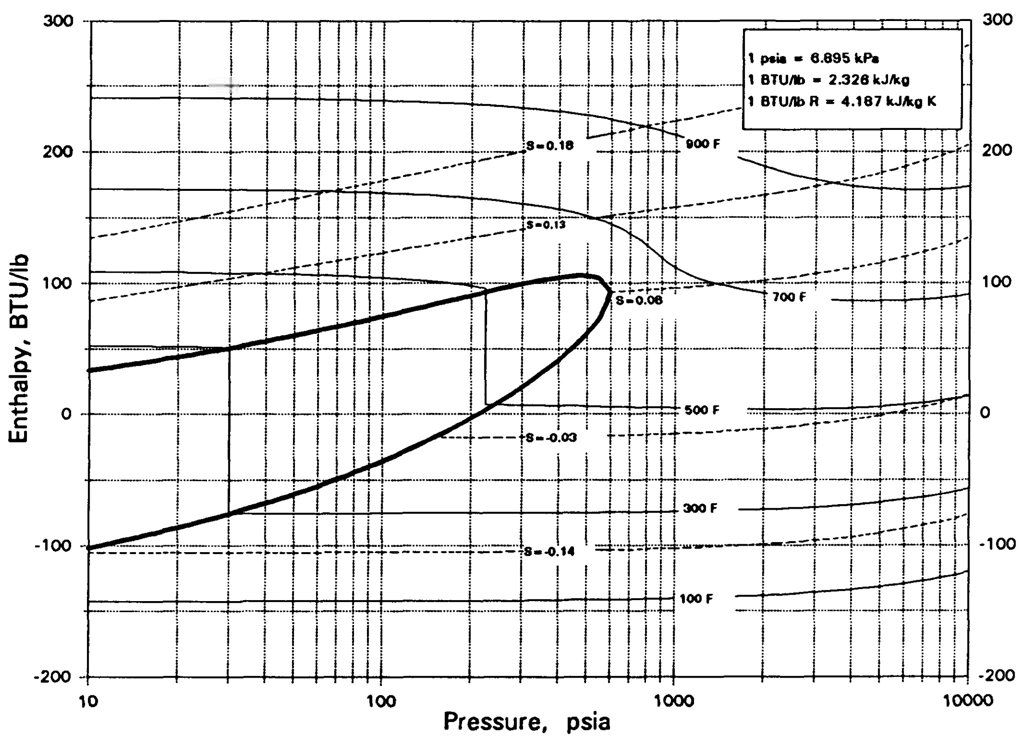




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

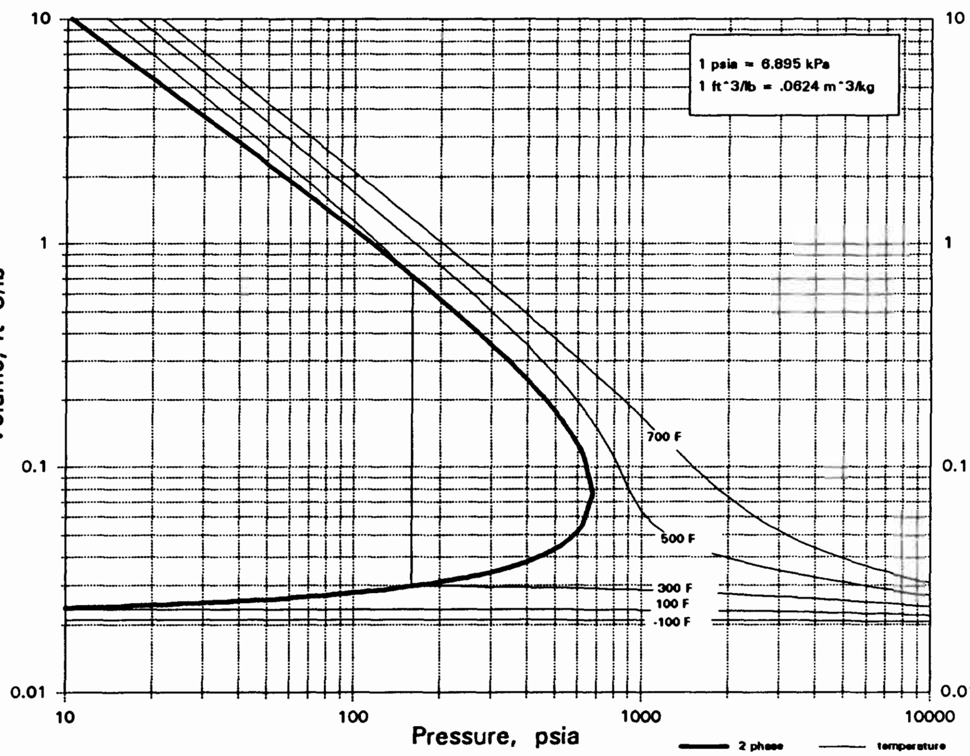
C3H6Cl2 1-3-DICHLOROPROPANE

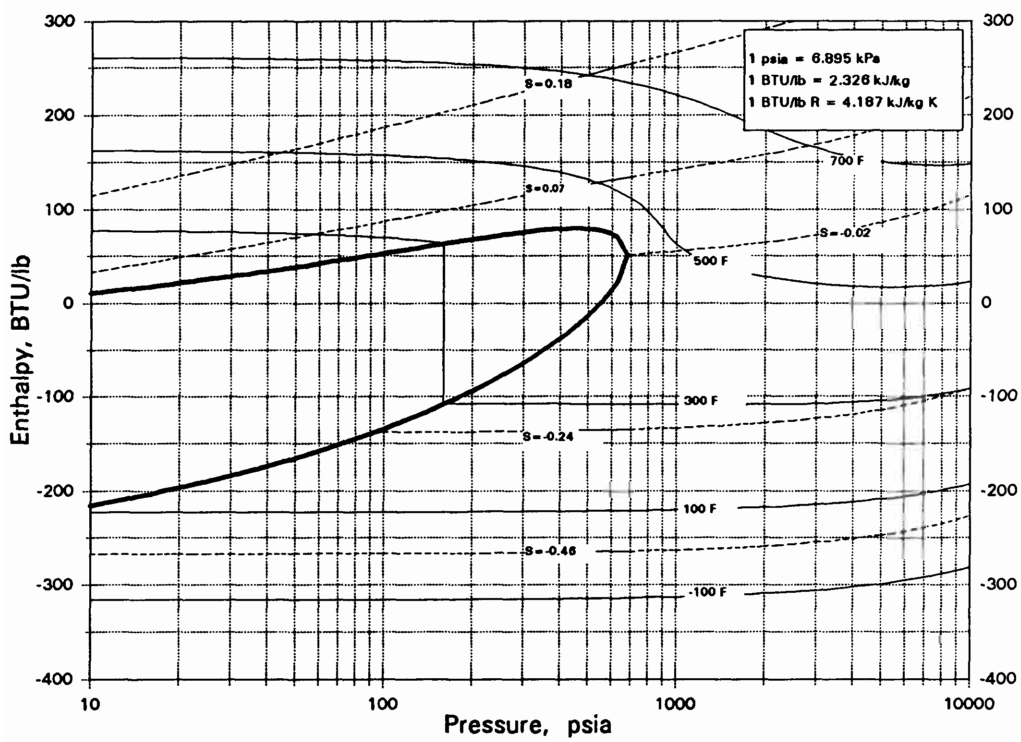




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

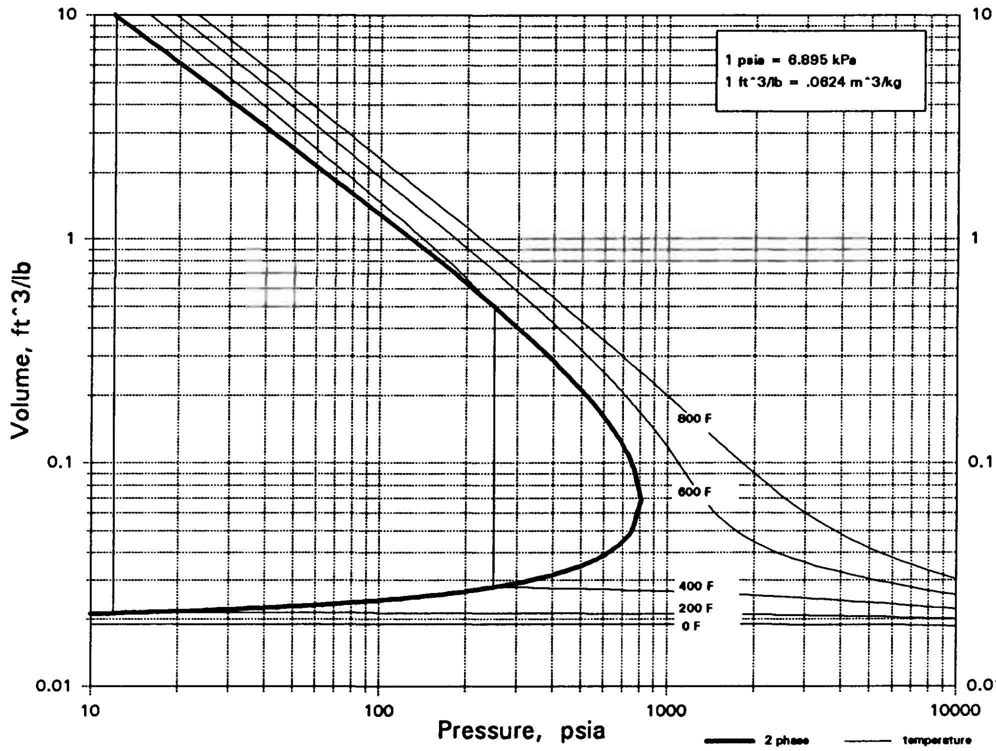
C3H6O ACETONE

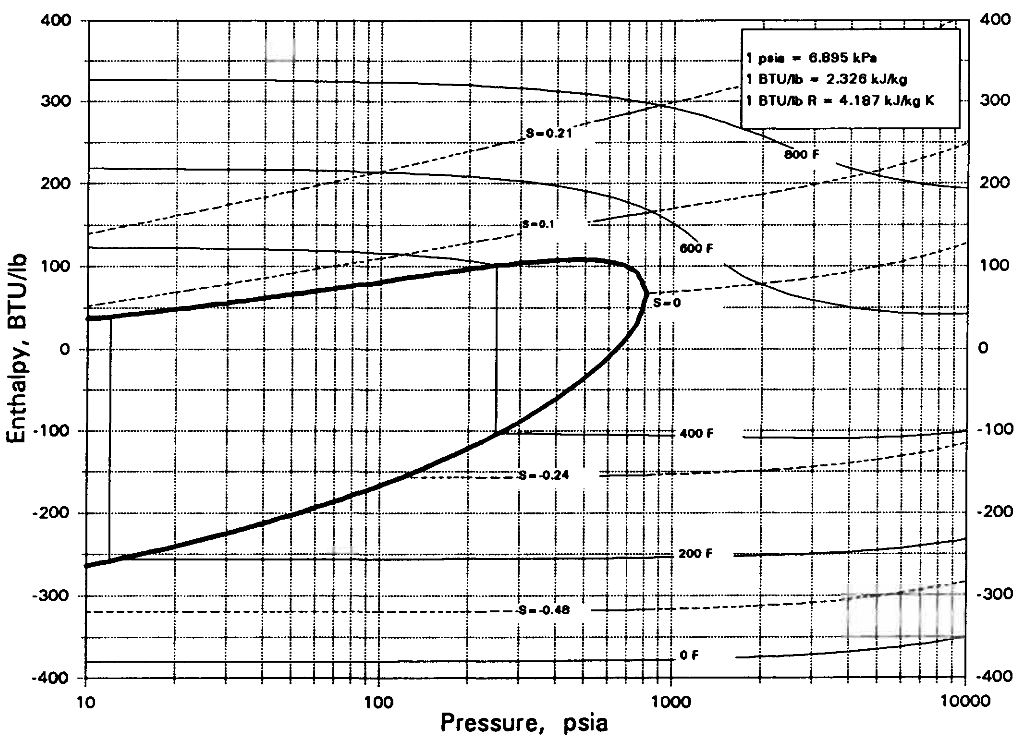




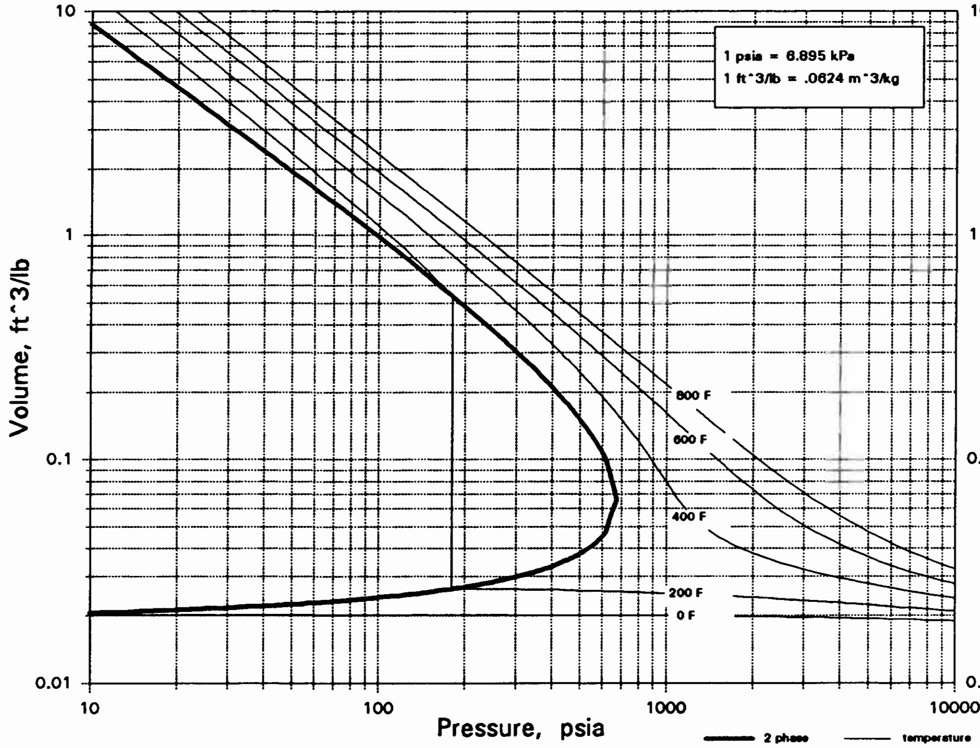
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

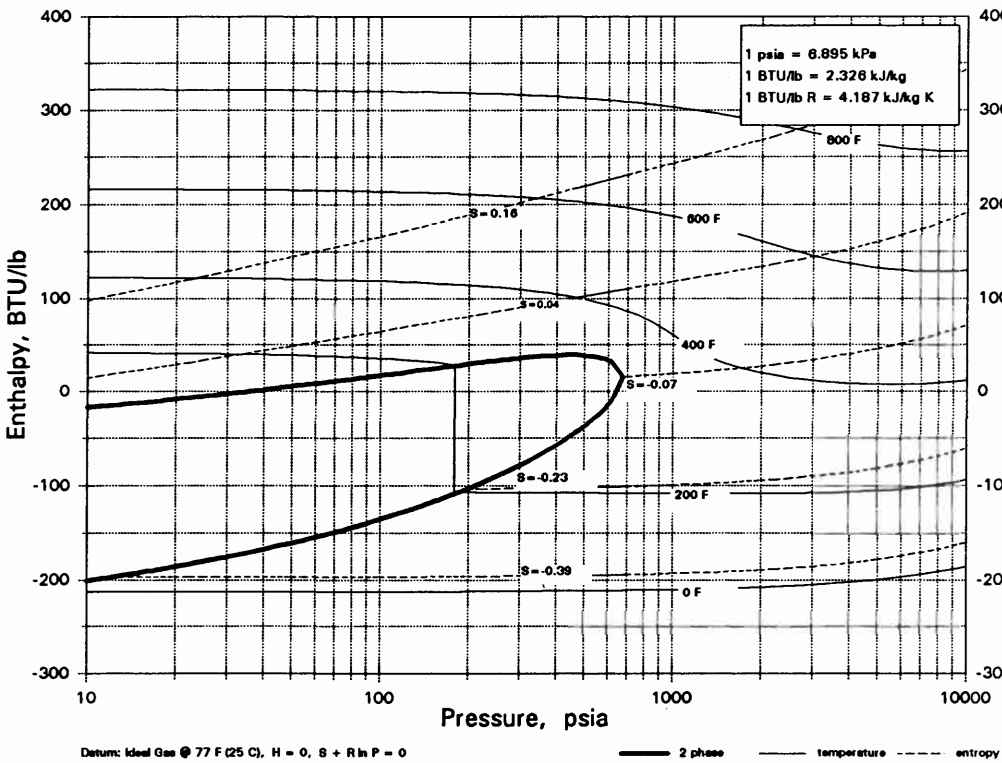
C3H6O ALLYL ALCOHOL



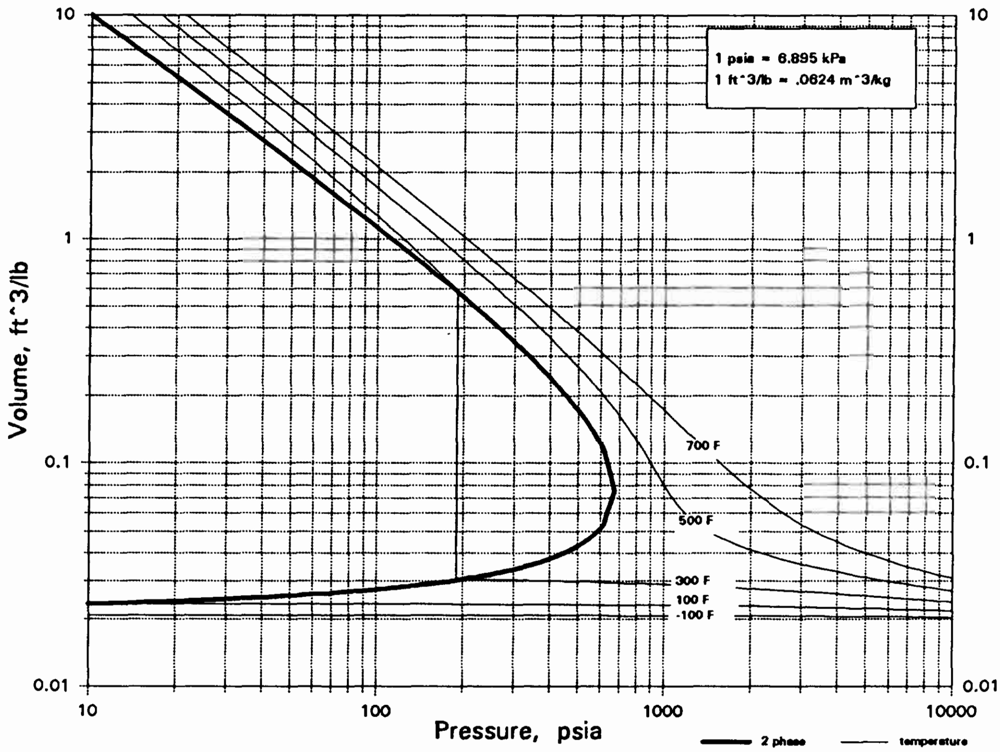


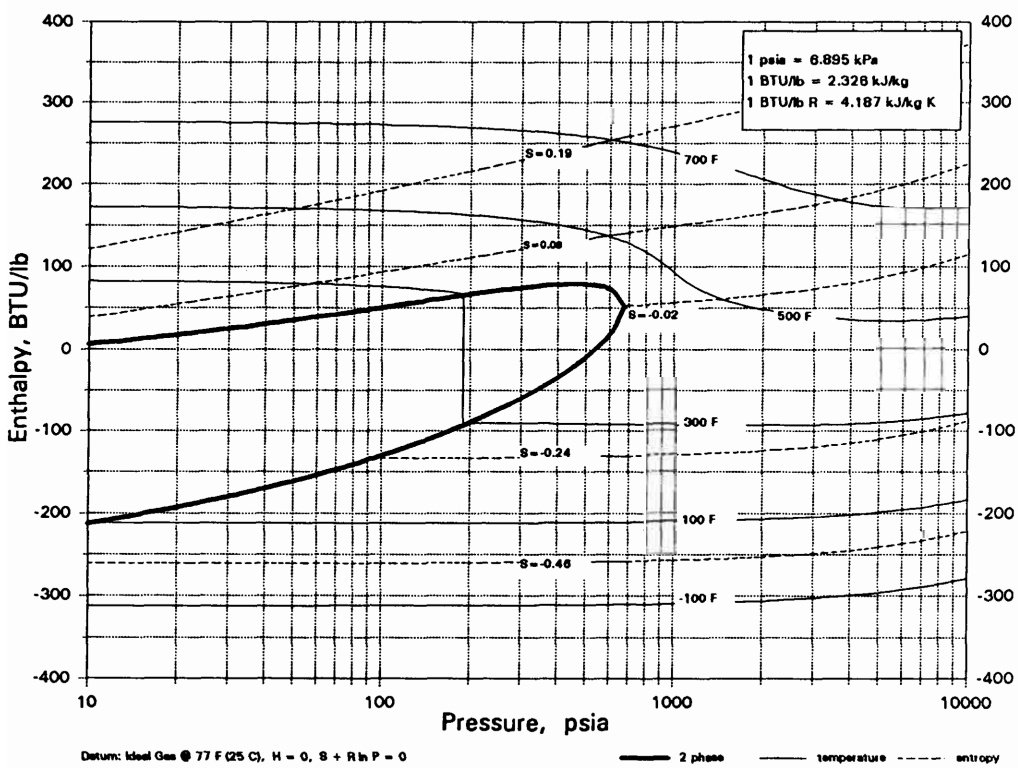
C3H6O METHYL VINYL ETHER



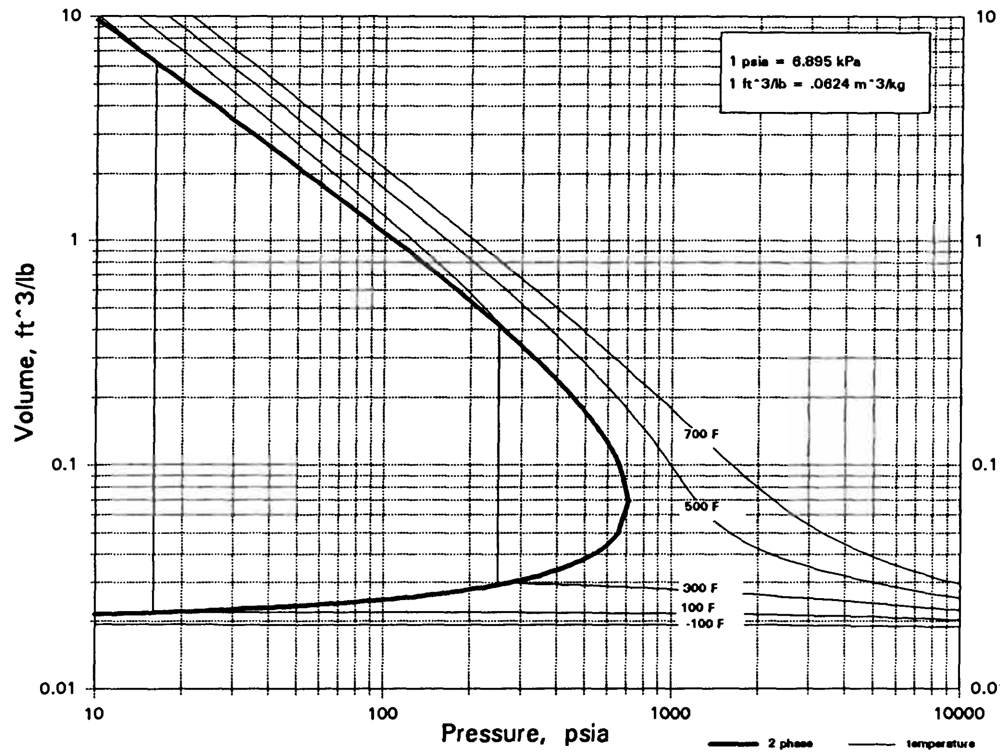


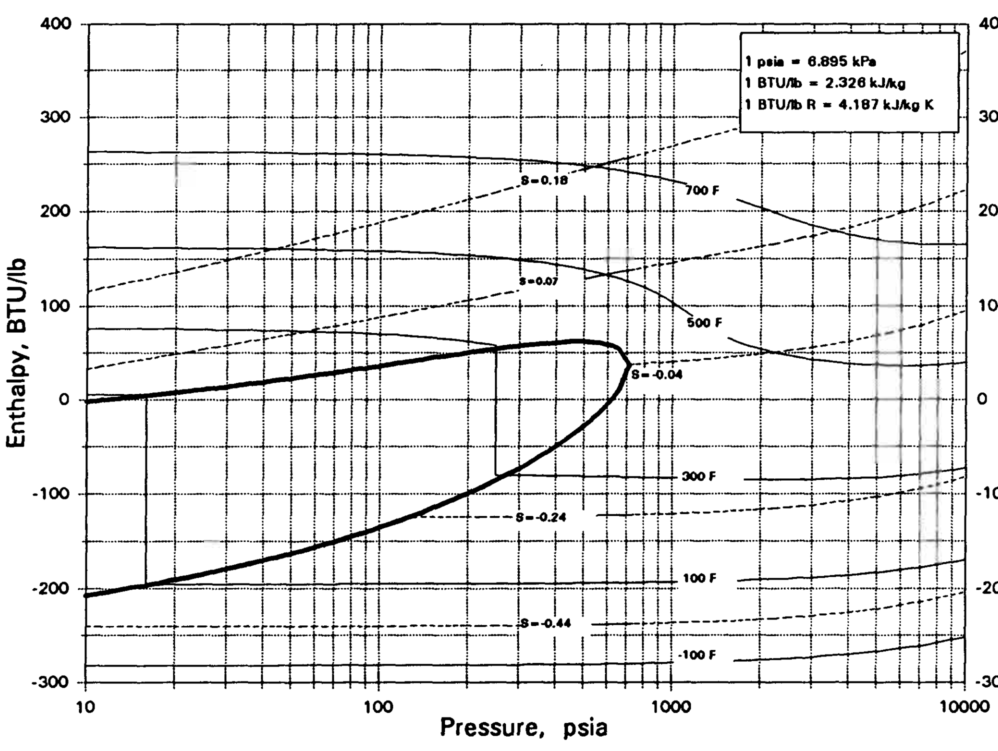
C3H6O n-PROPIONALDEHYDE



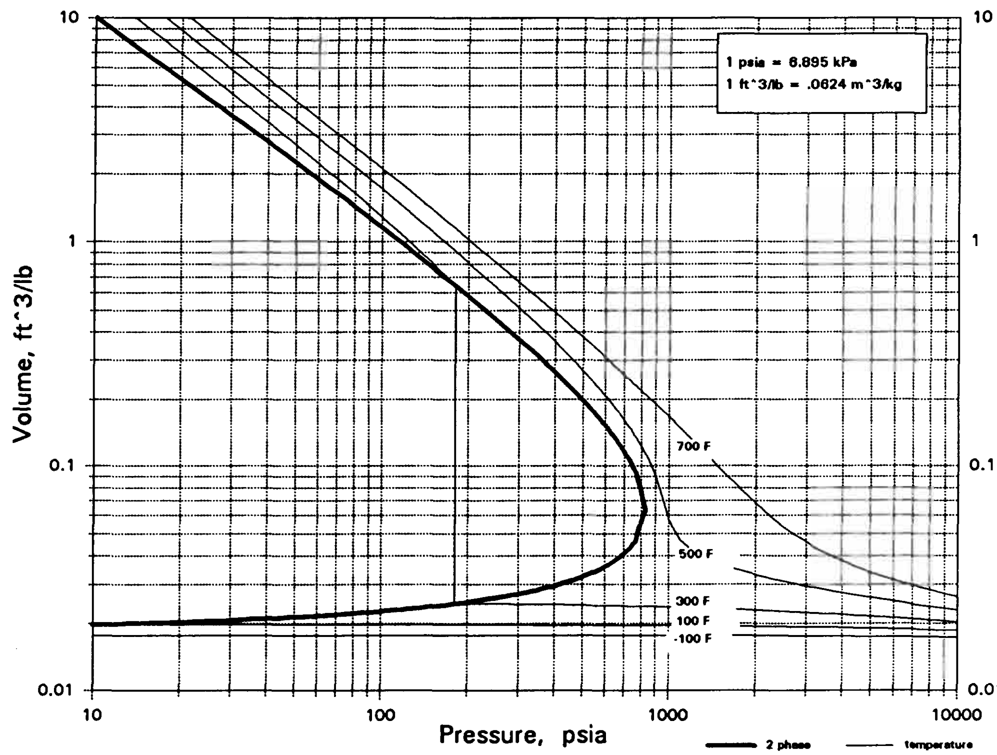


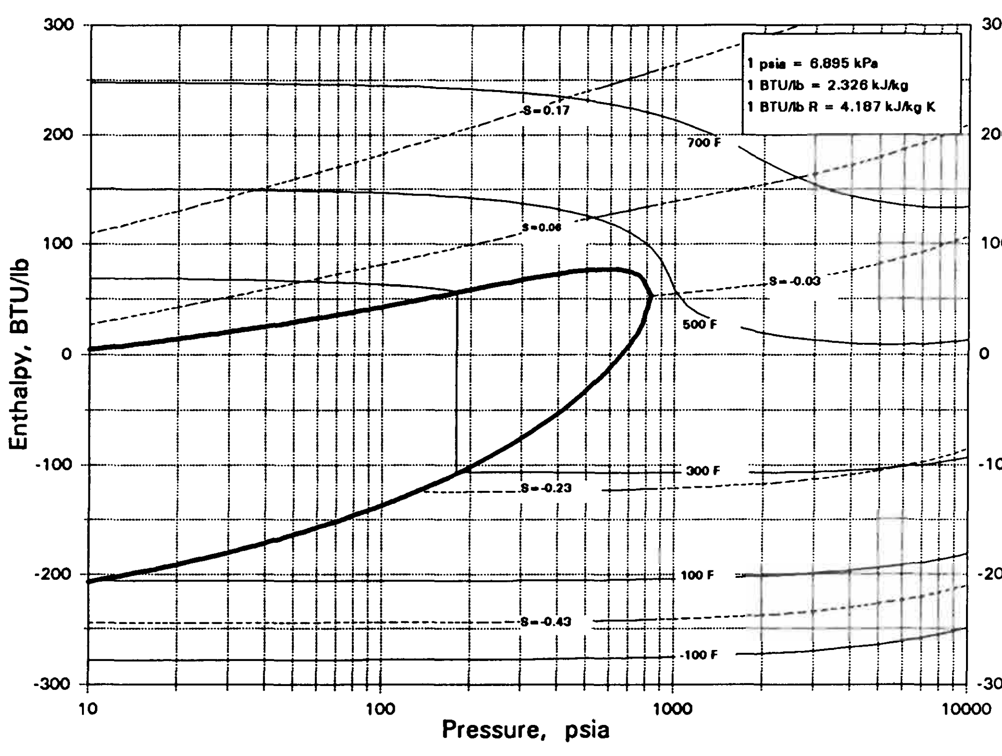
C3H6O 1-2-PROPYLENE OXIDE



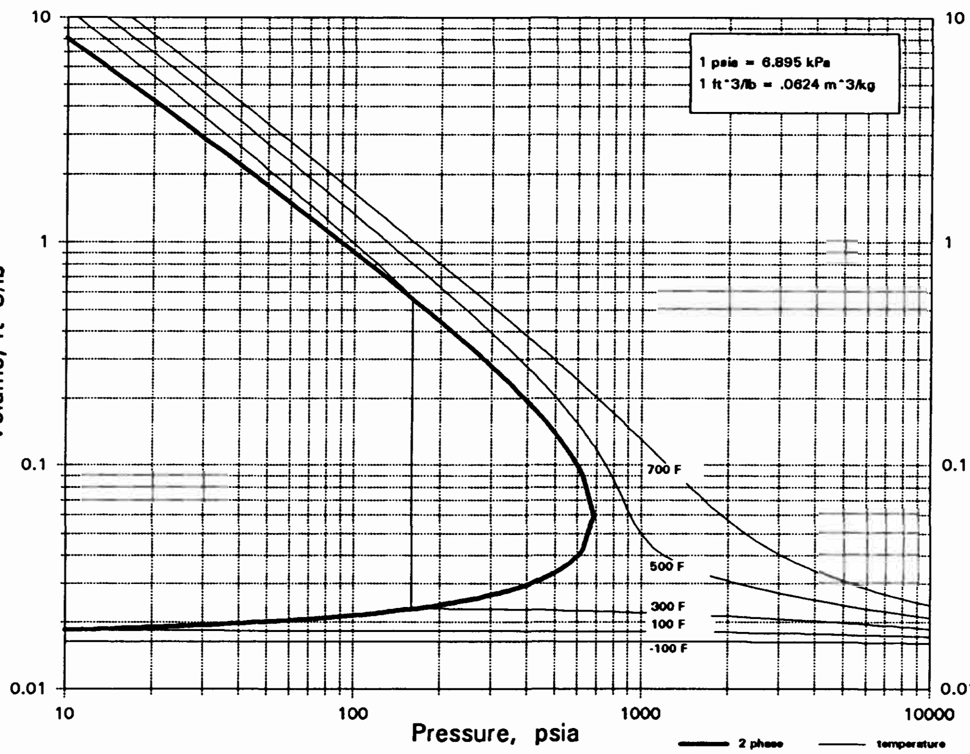


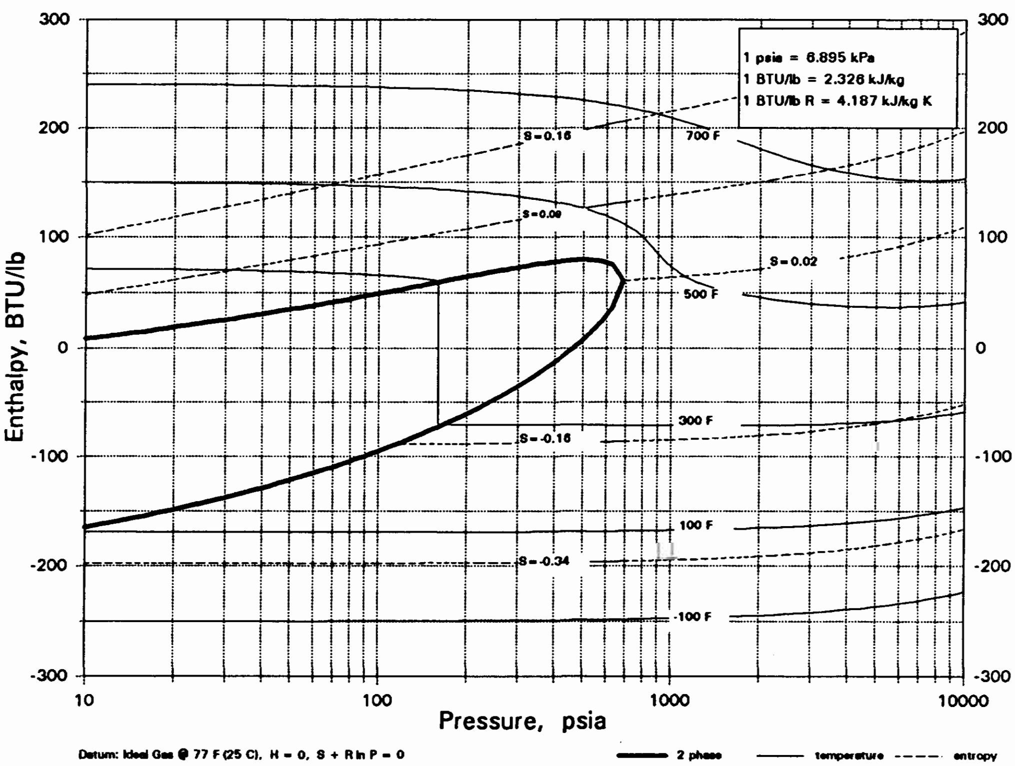
C3H6O 1-3-PROPYLENE OXIDE



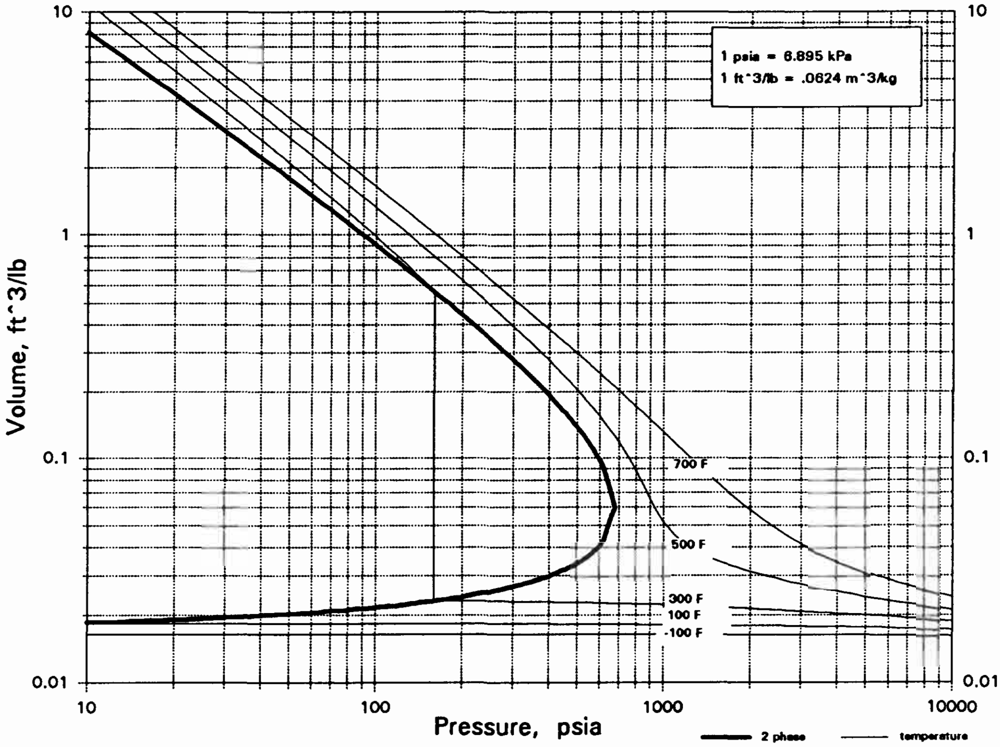


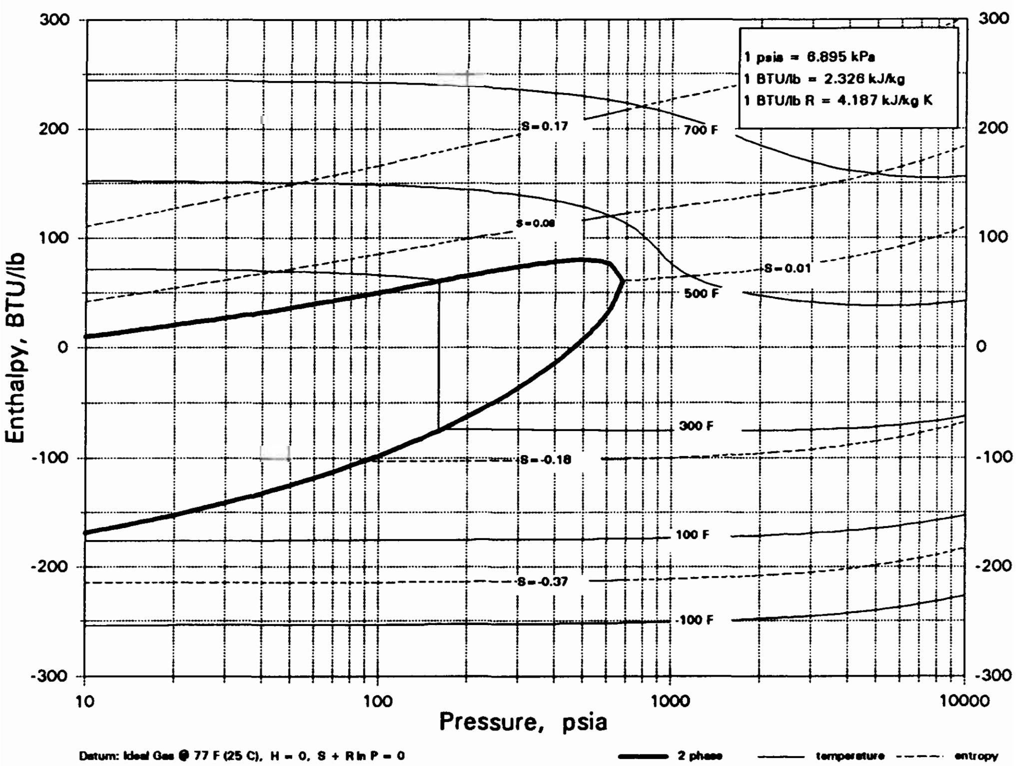
C3H6O2 ETHYL FORMATE



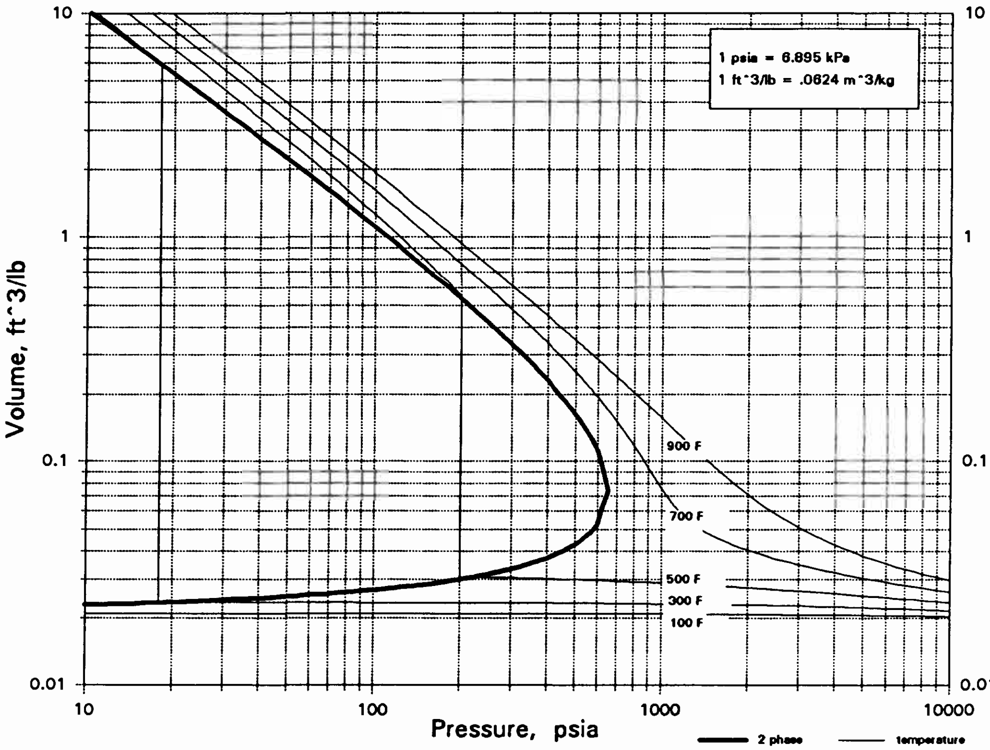


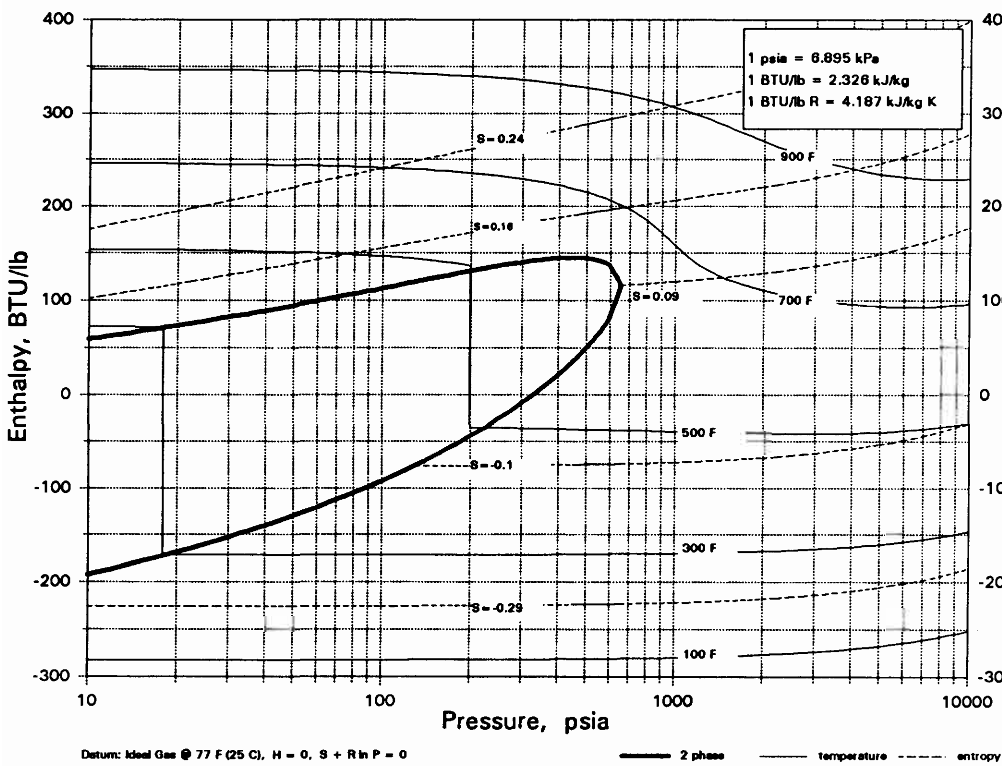
C3H6O2 METHYL ACETATE



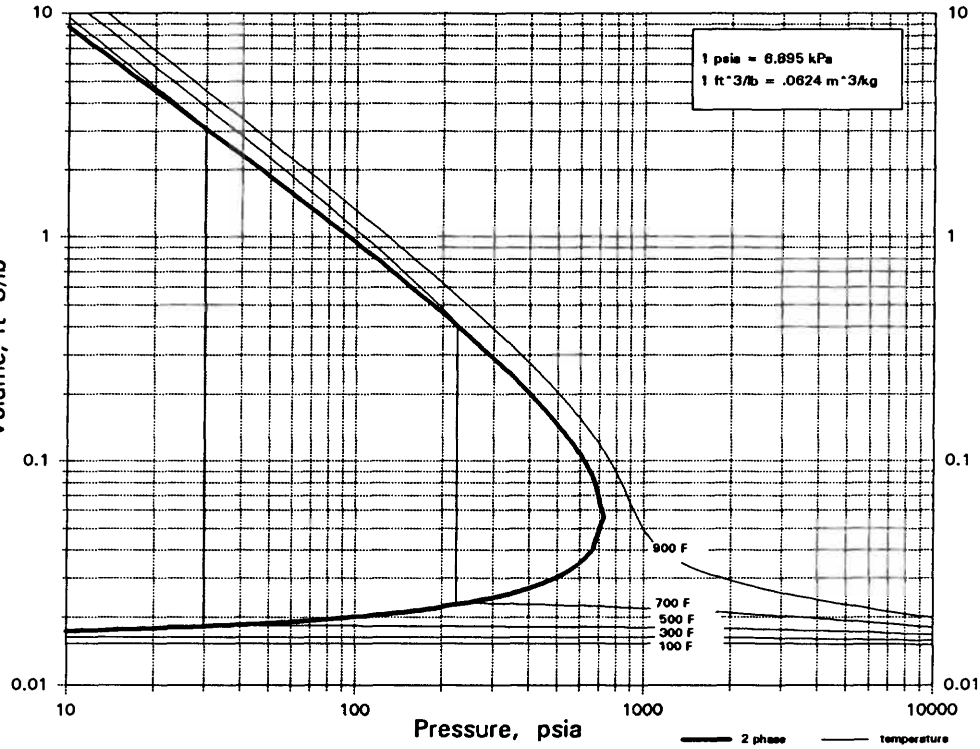


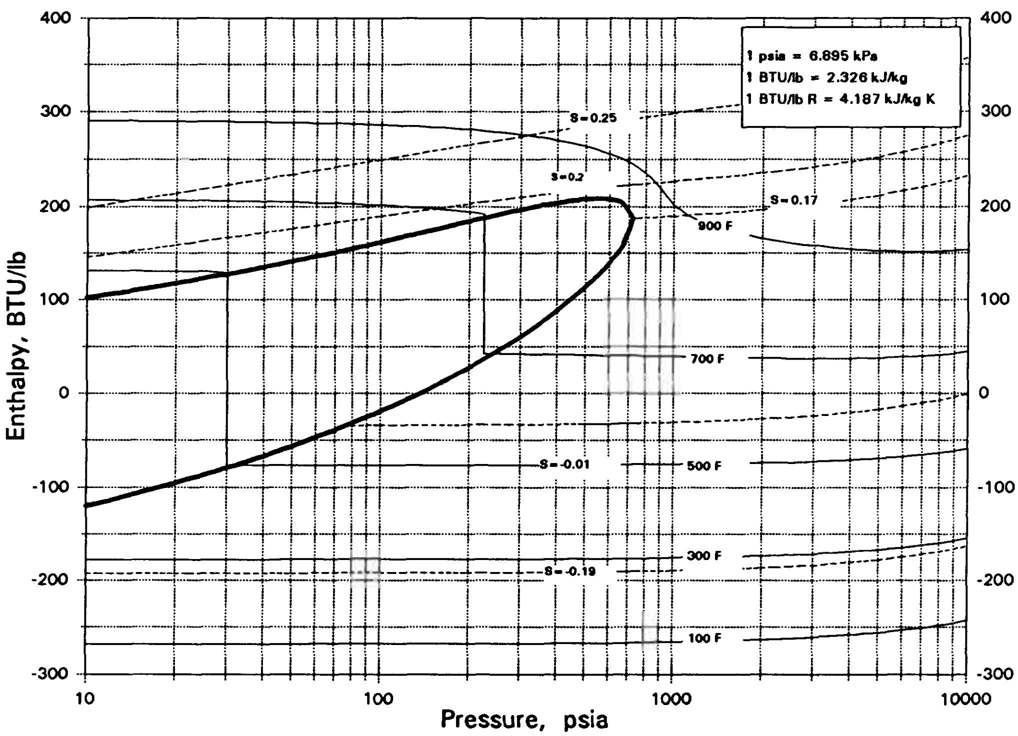
C3H6O2 PROPIONIC ACID



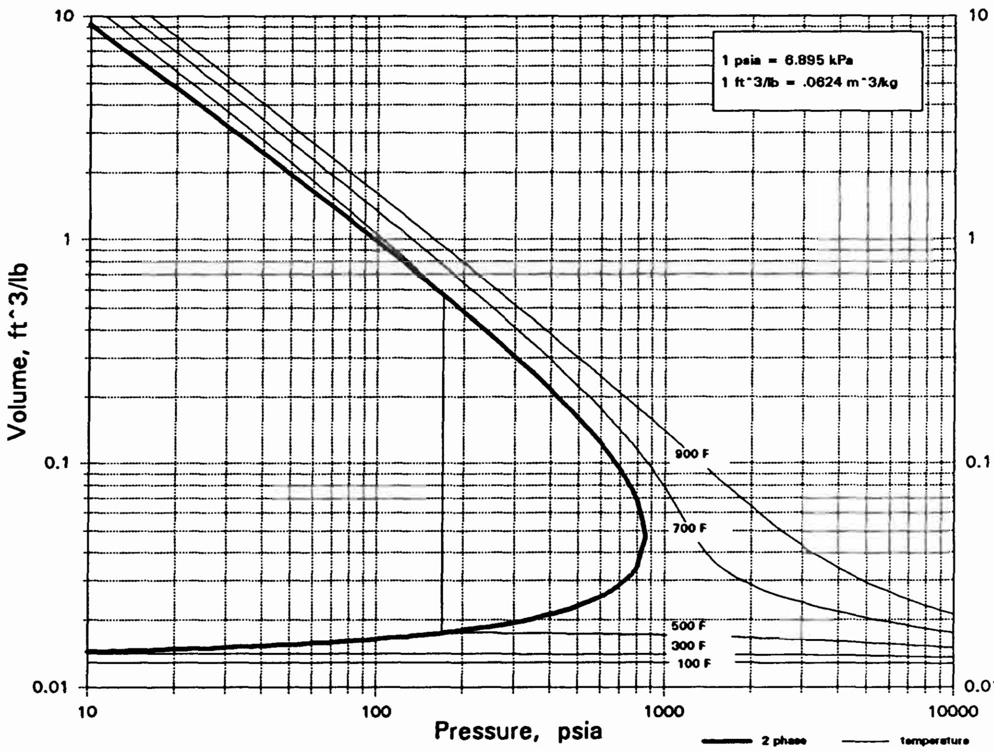


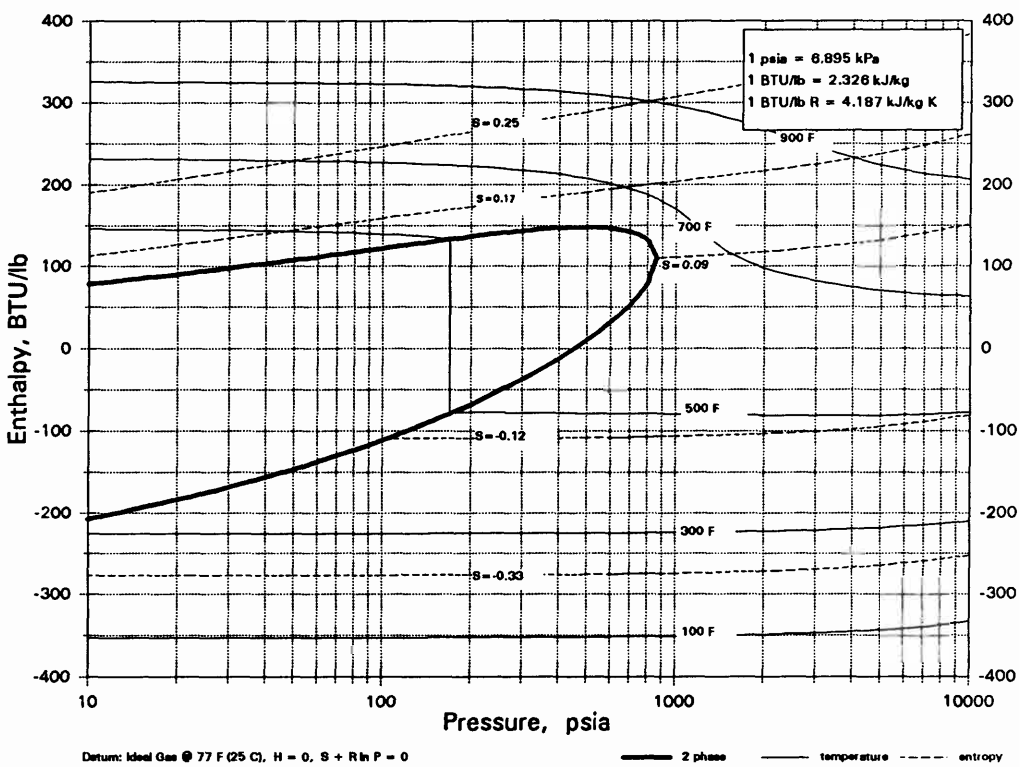
C3H6O2S 3-MERCAPTOPROPIONIC ACID



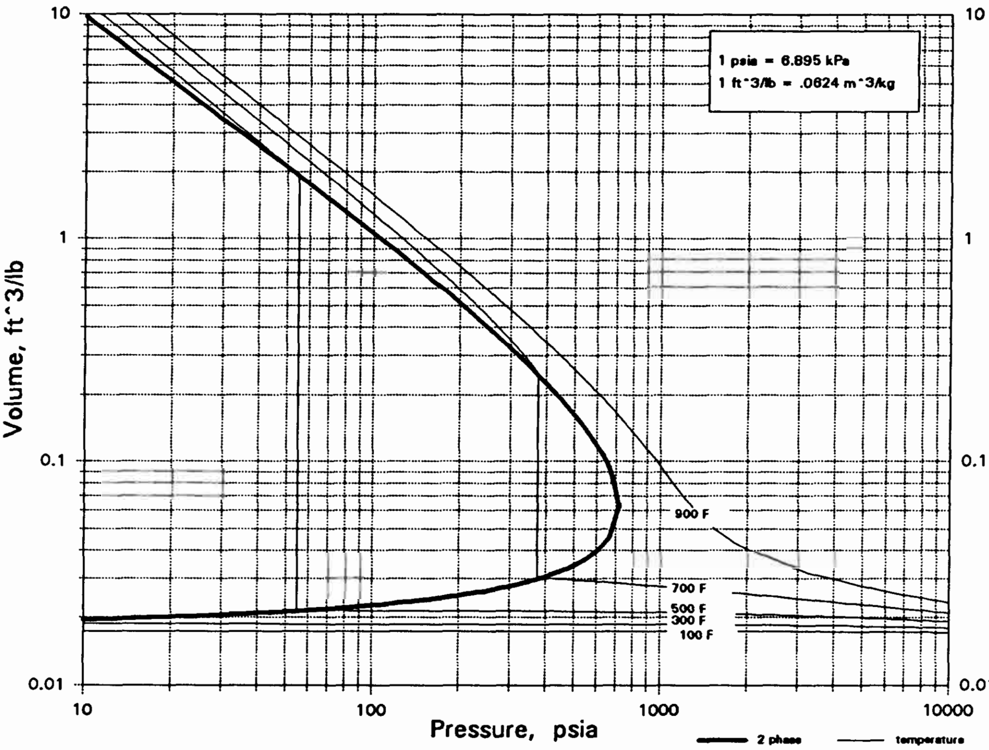


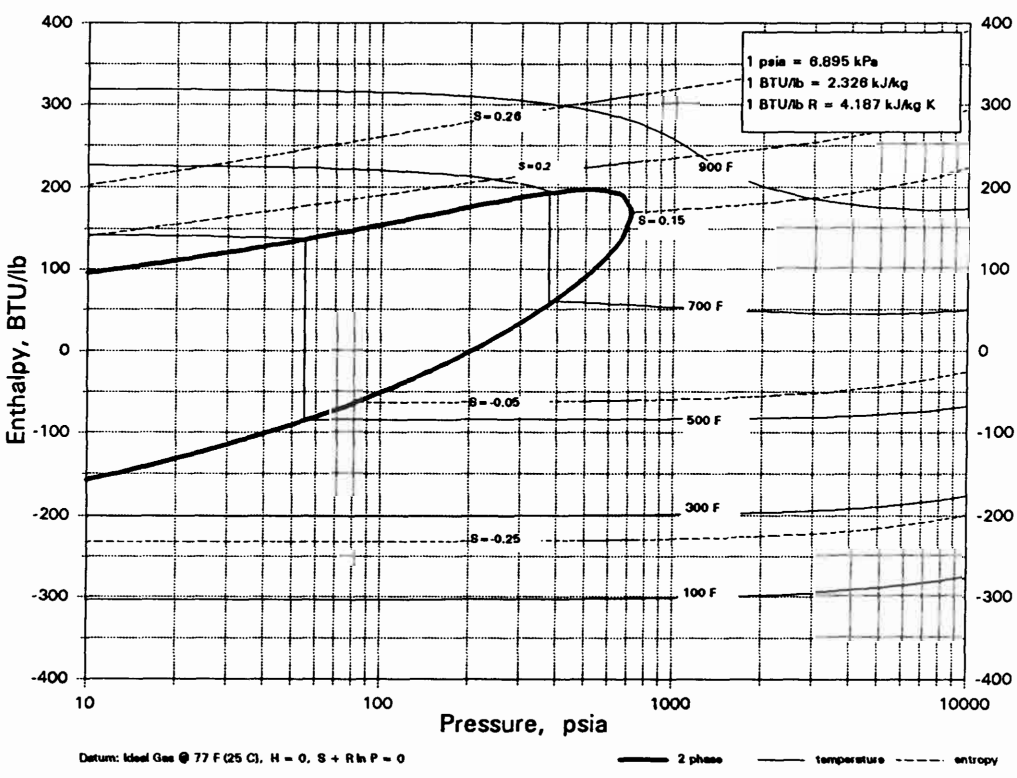
C3H6O3 LACTIC ACID



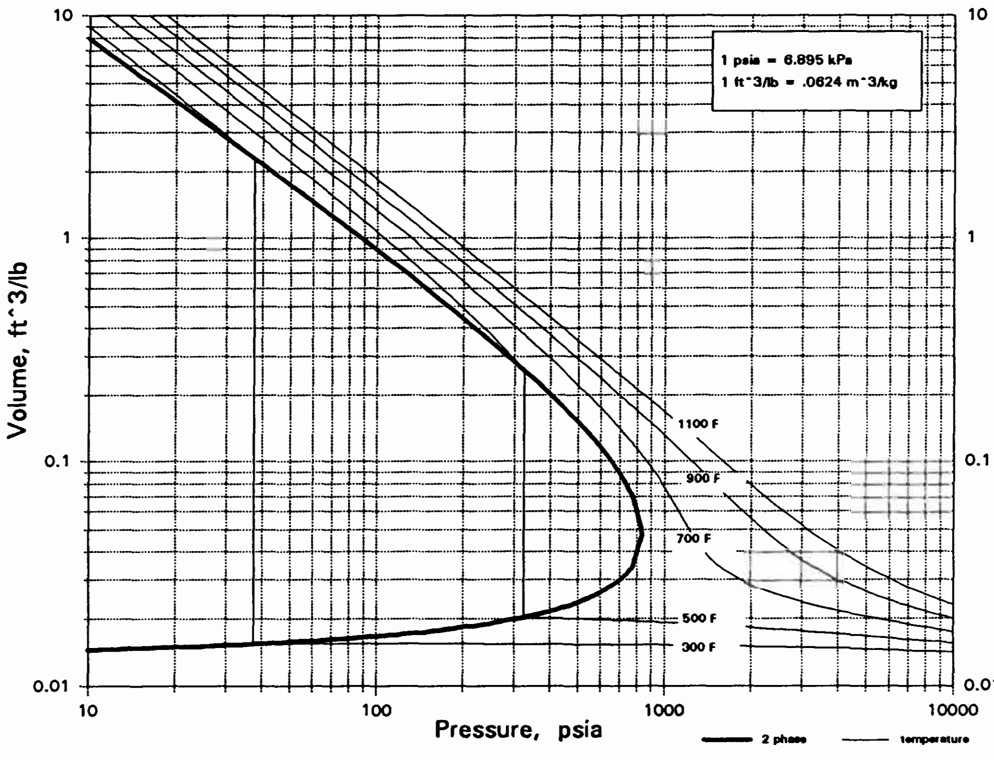


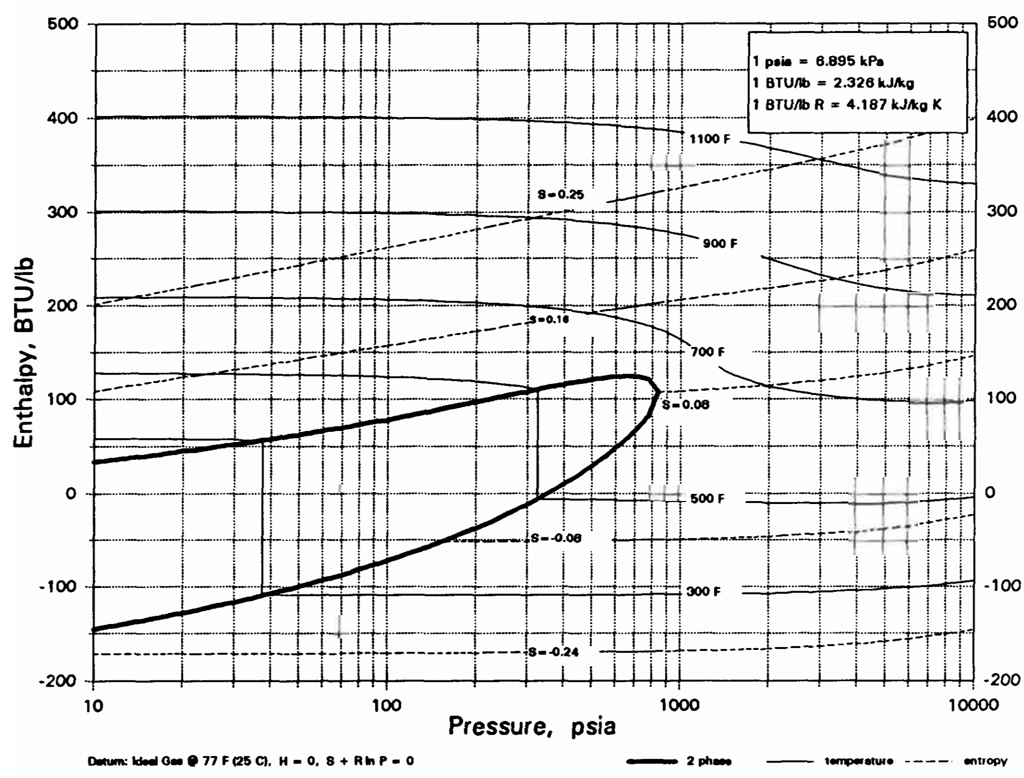
C3H6O3	METHOXYACETIC ACID



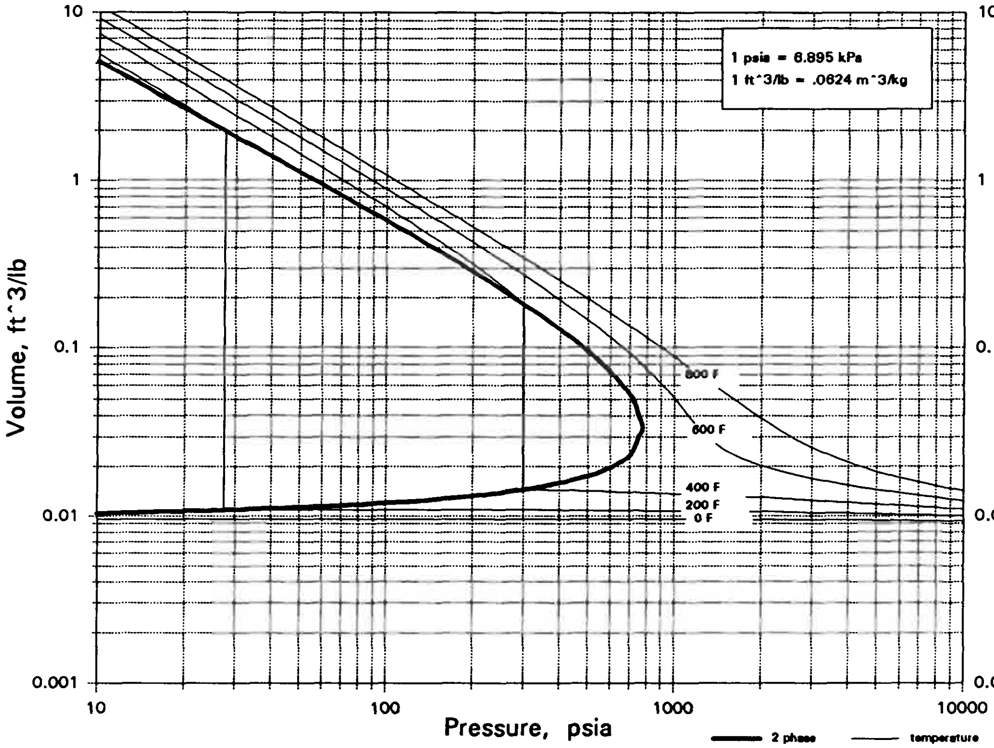


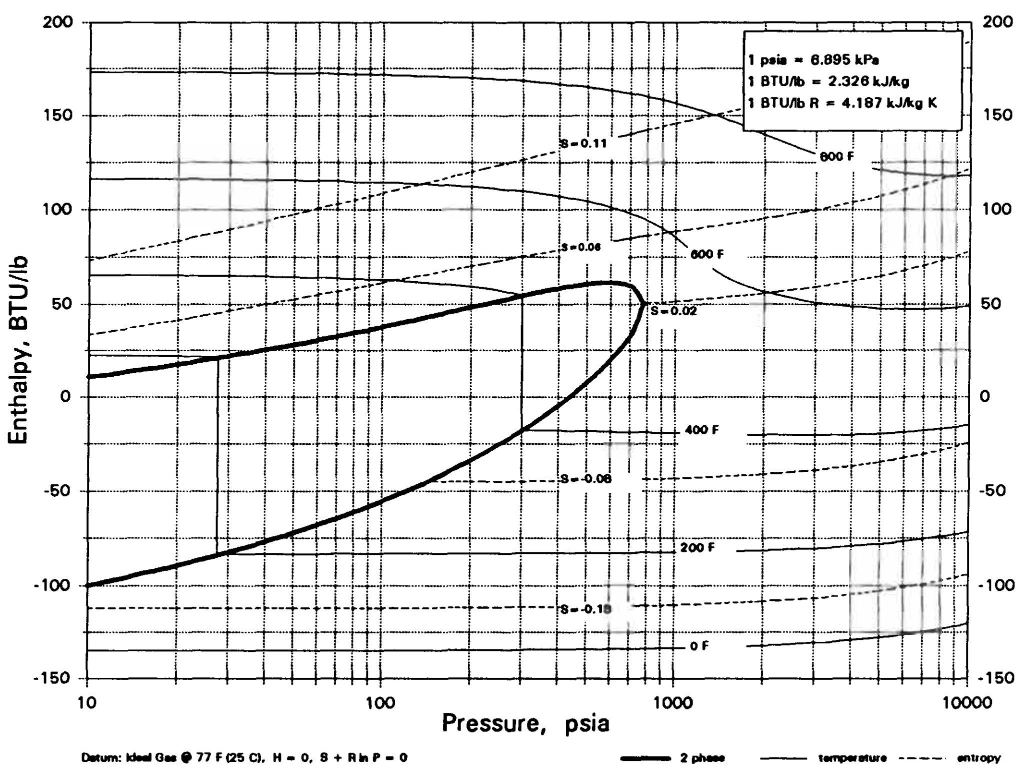
C3H6O3 TRIOXANE



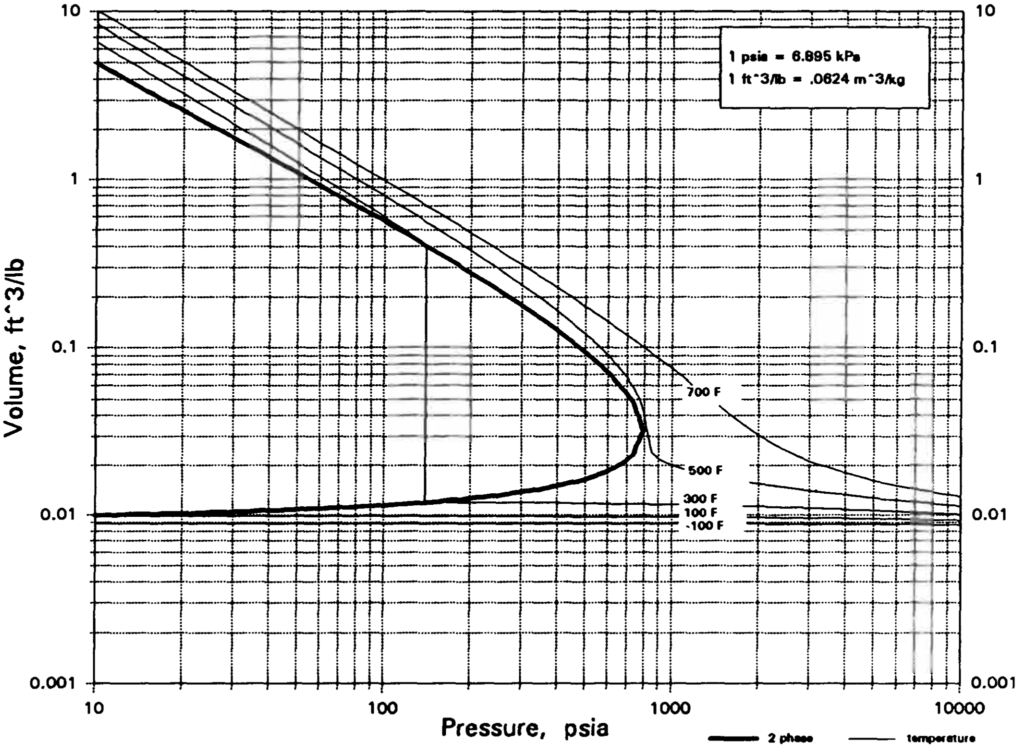


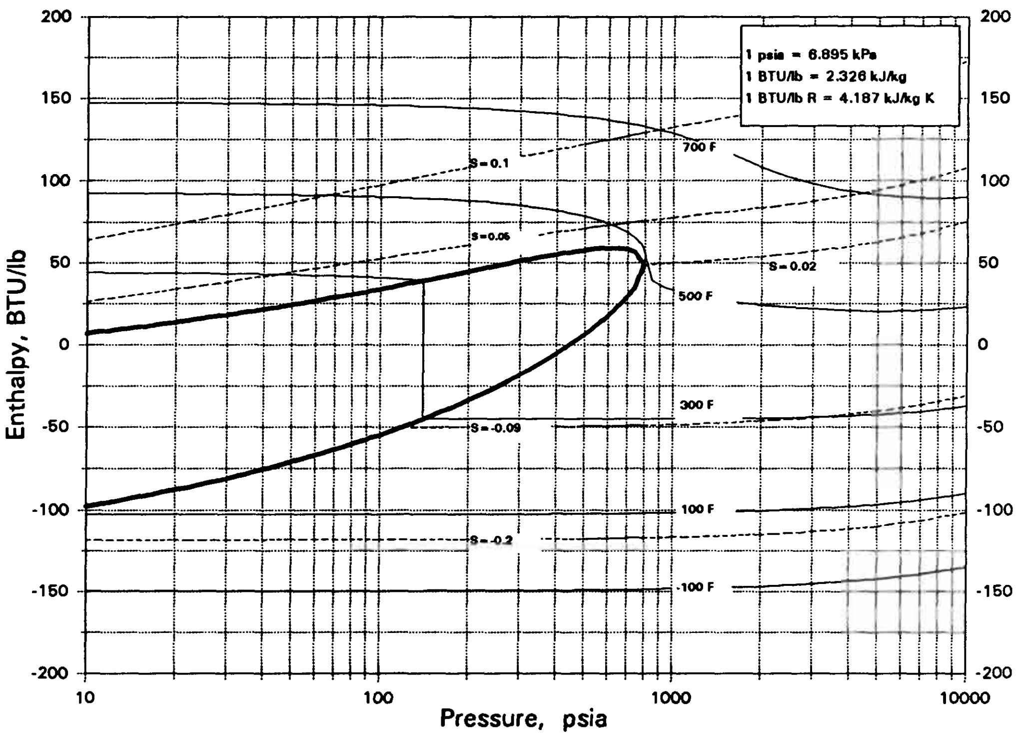
C3H7Br 1-BROMOPROPANE





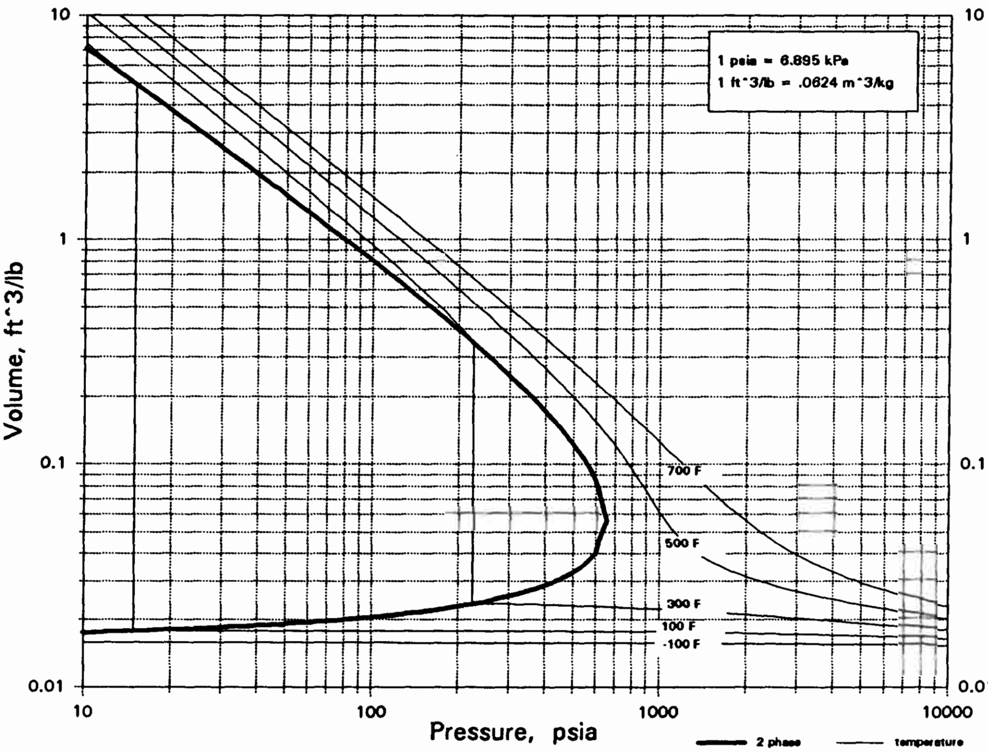
C3H7Br	2-BROMOPROPANE

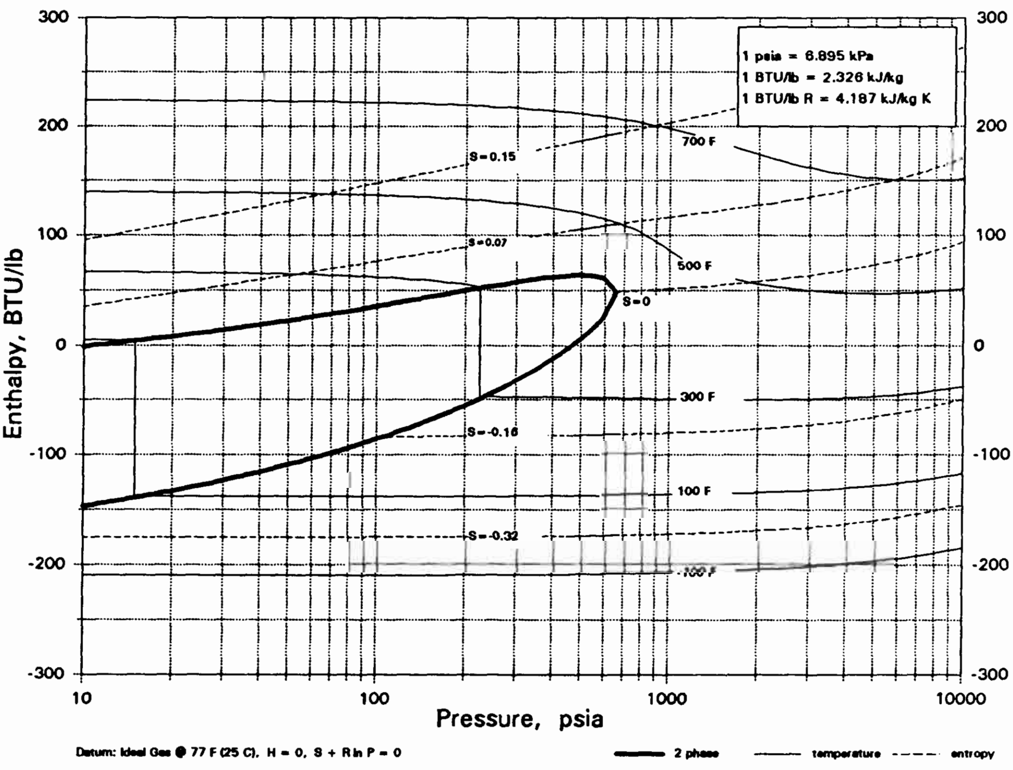




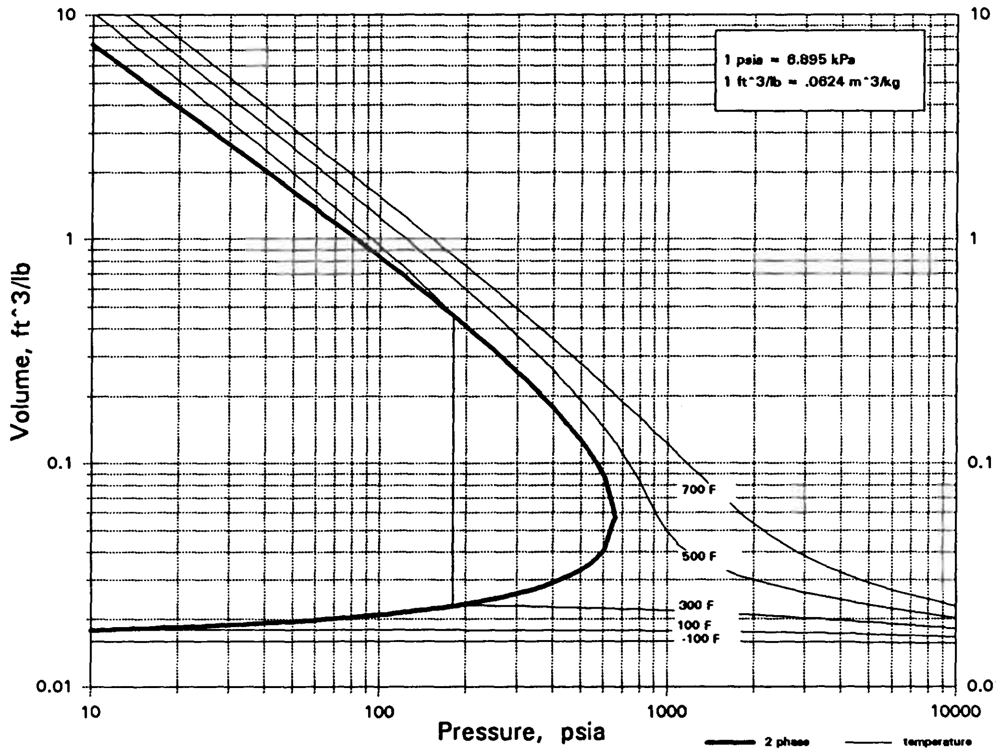
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

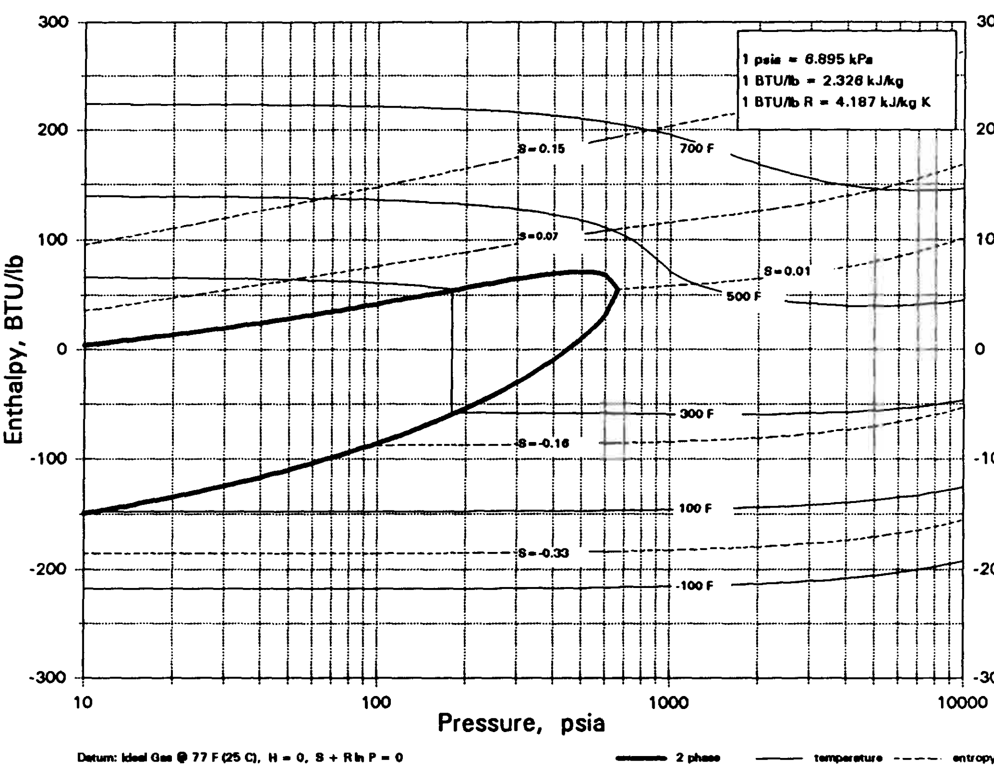
C3H7Cl ISOPROPYL CHLORIDE



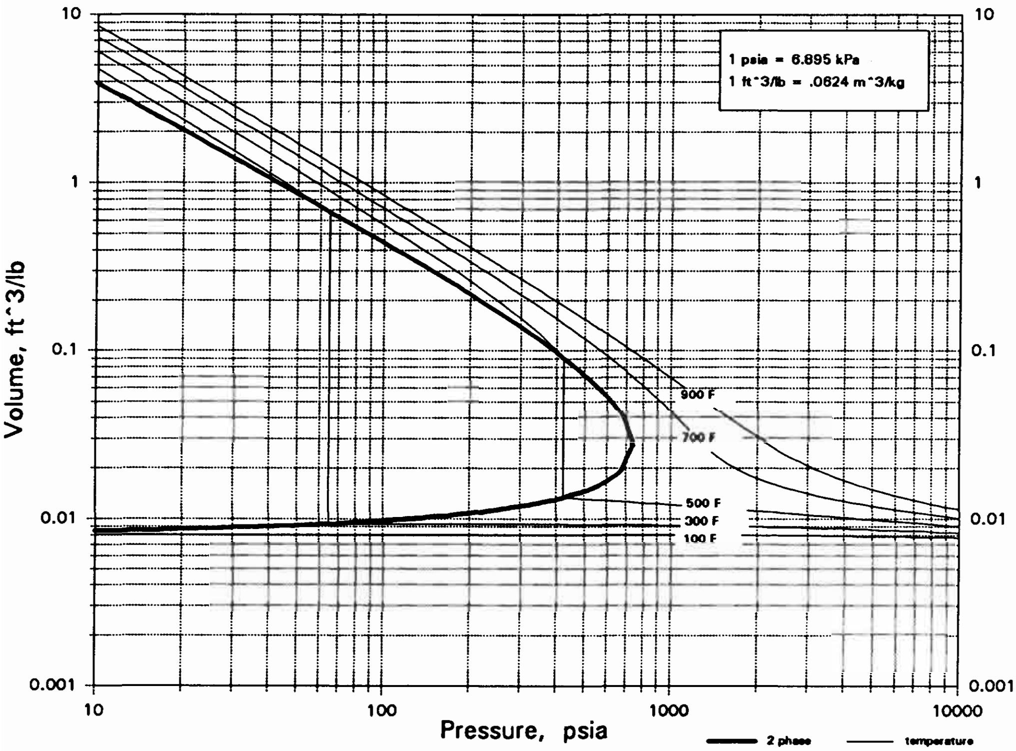


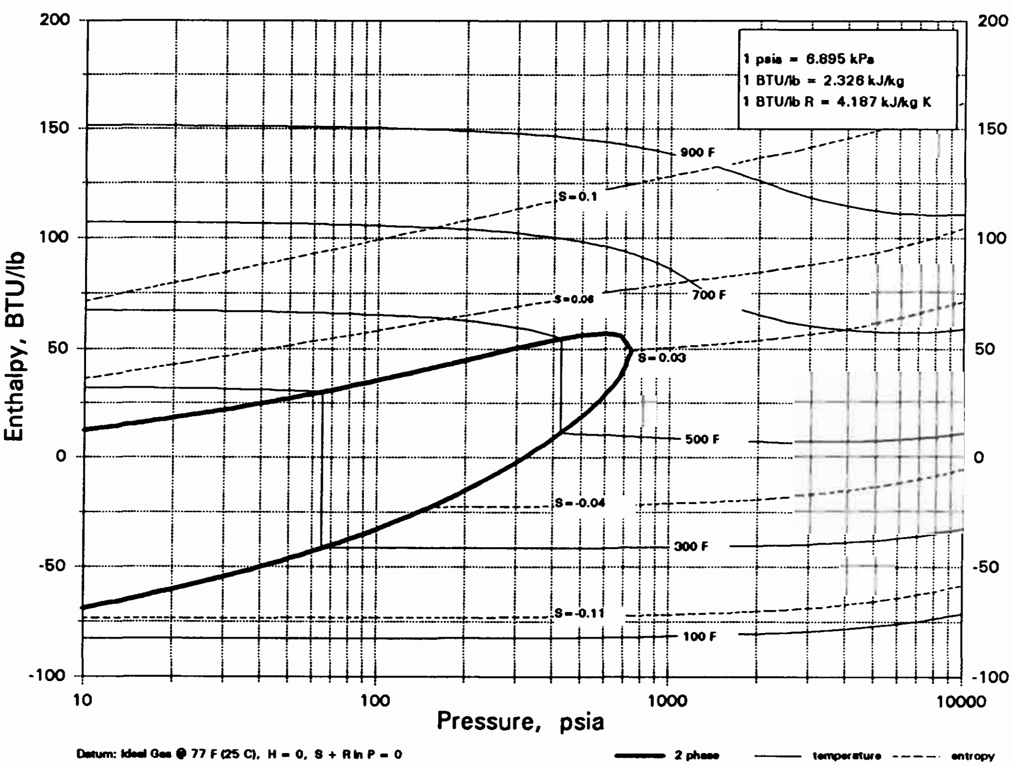
C3H7Cl n-PROPYL CHLORIDE



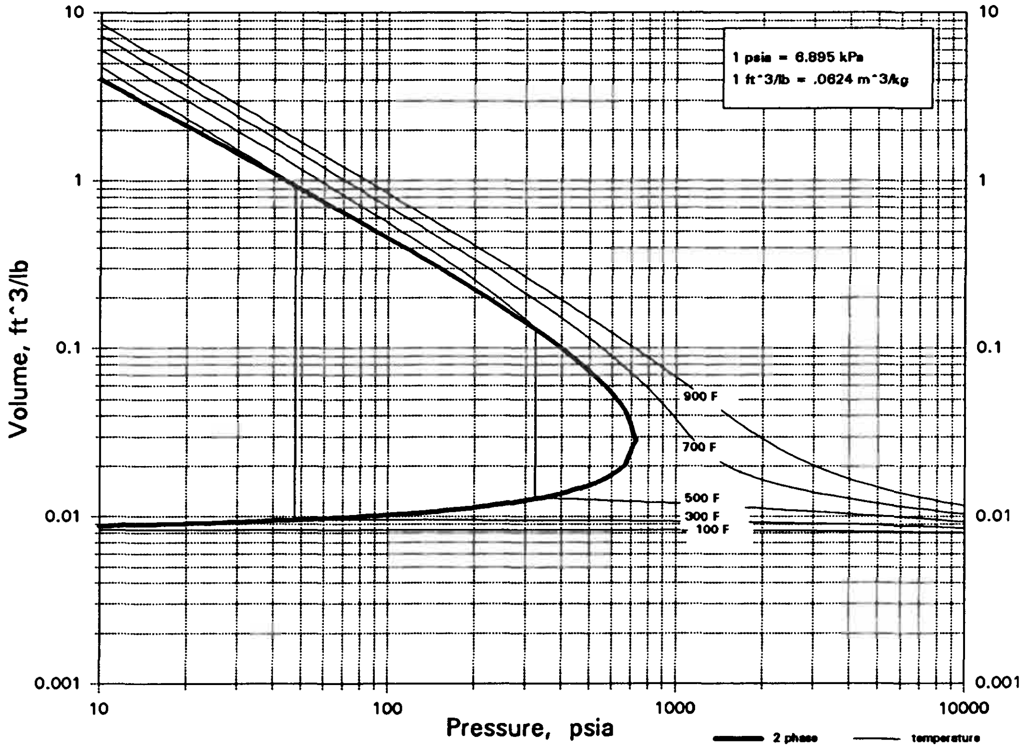


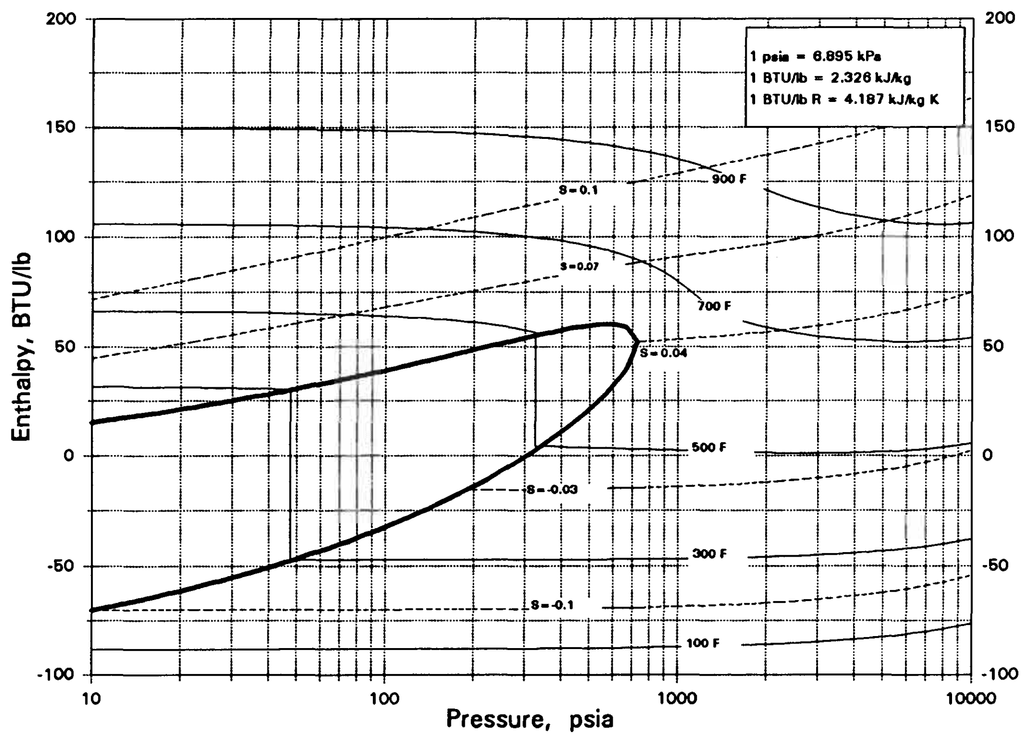
C3H7I ISOPROPYL IODIDE



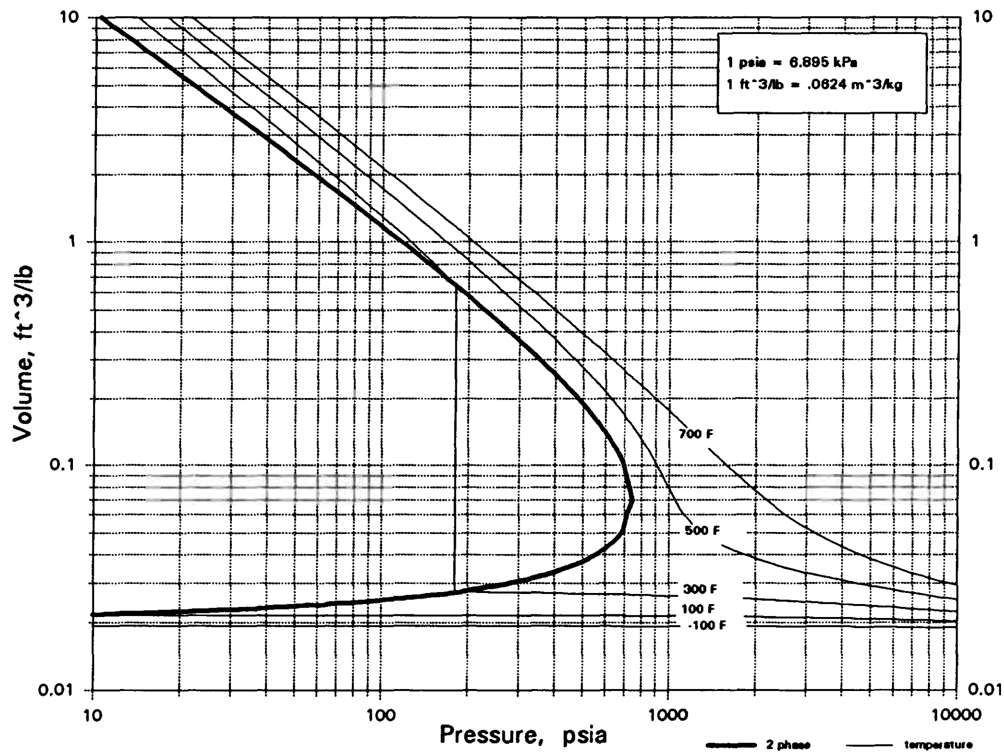


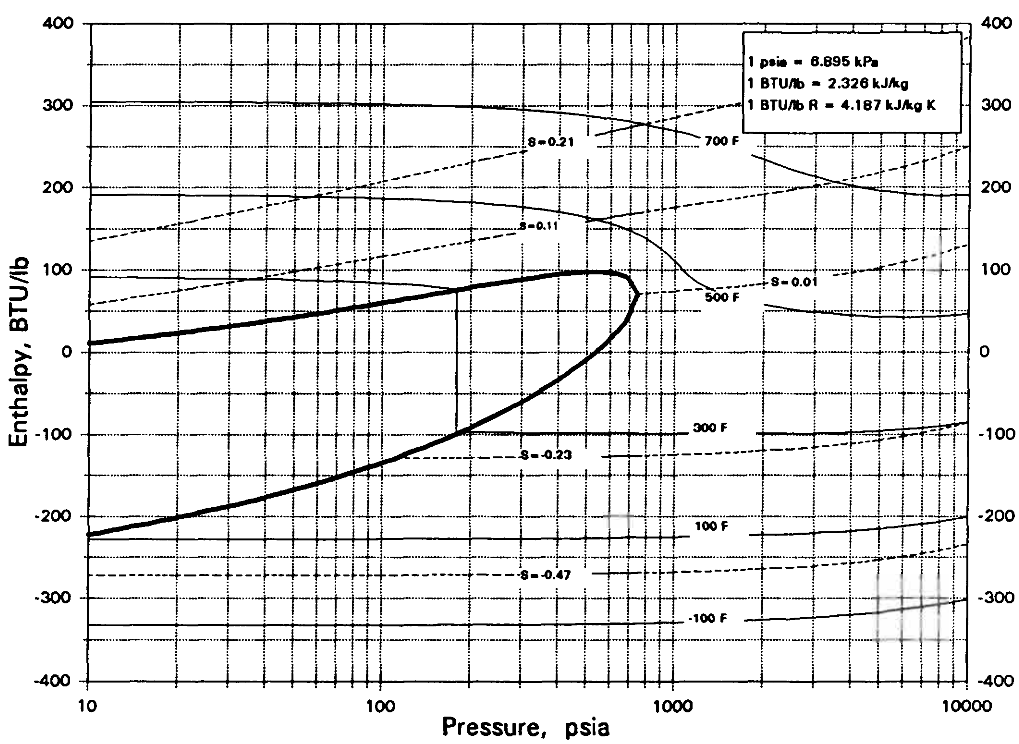
C3H7I	n-PROPYL IODIDE





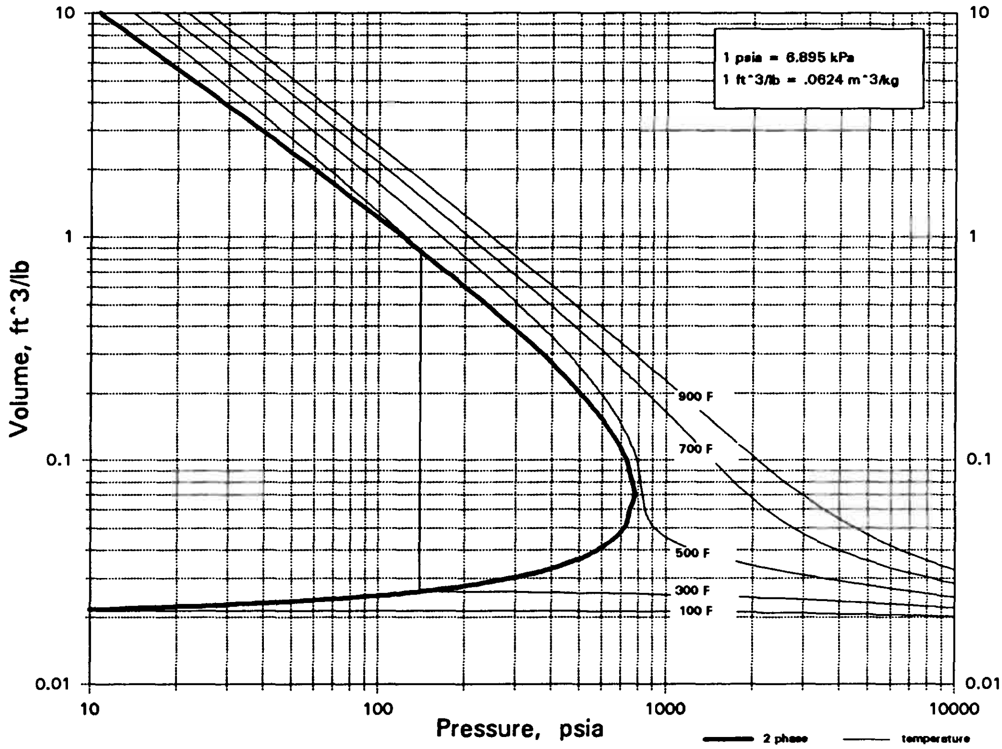
C3H7N ALLYLAMINE

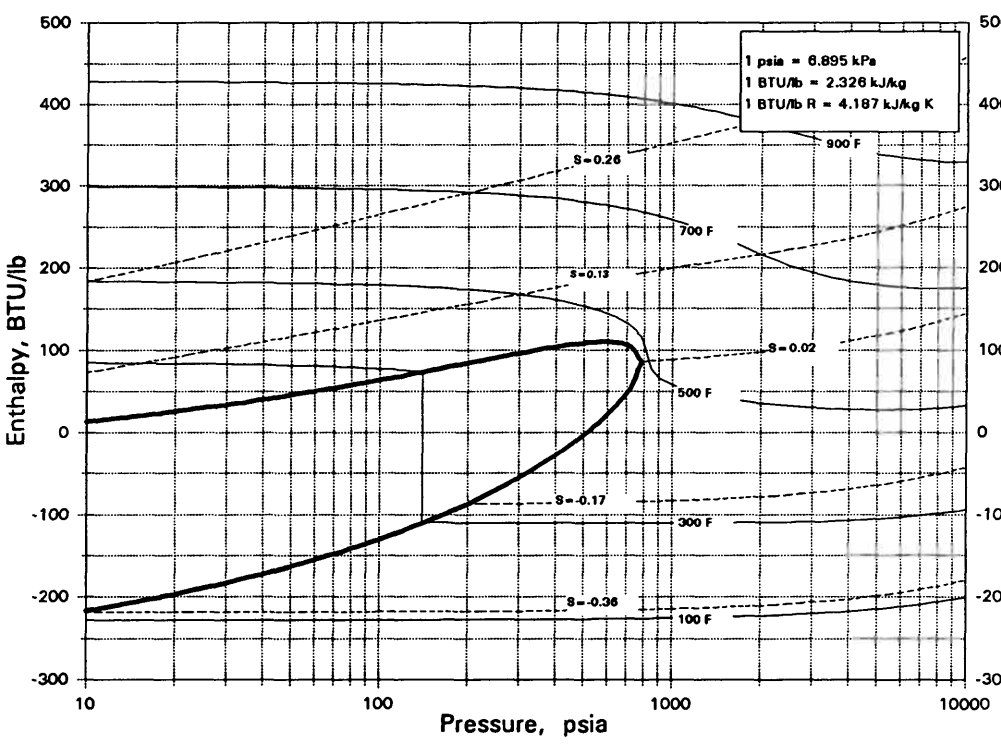




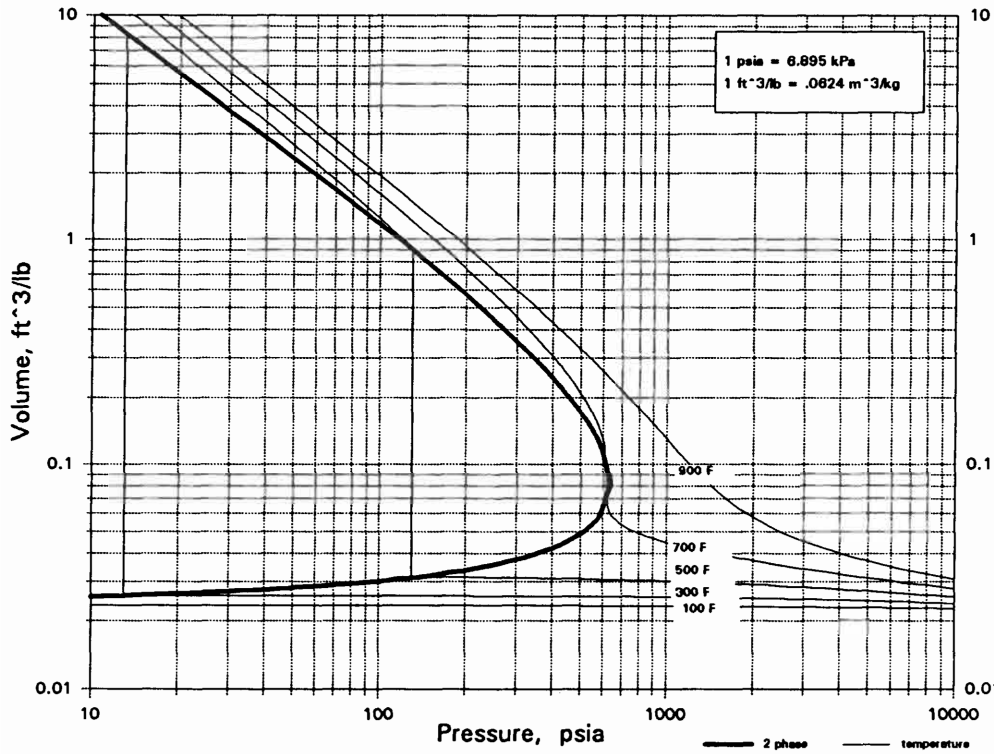
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

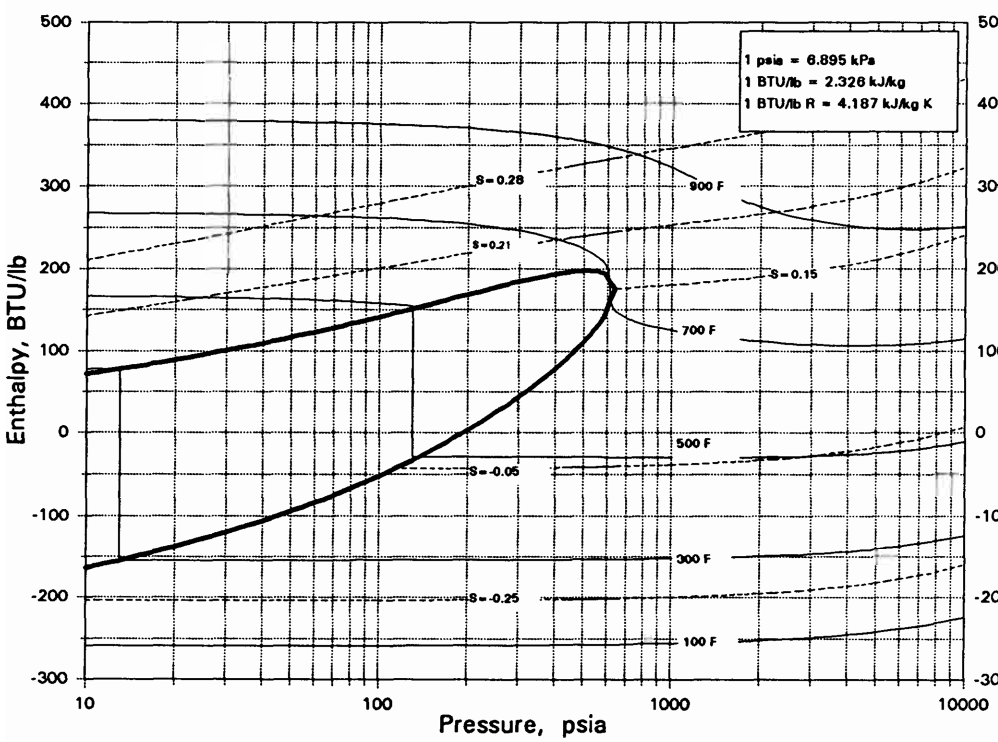
C3H7N PROPYLENEIMINE





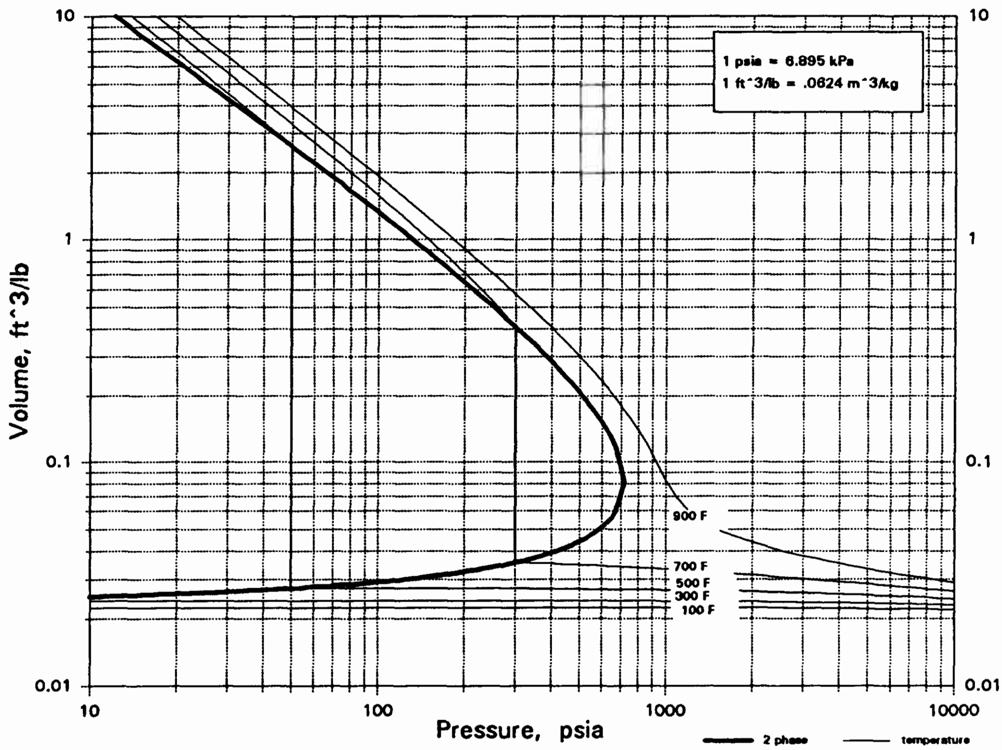
C3H7NO N-N-DIMETHYLFORMAMIDE

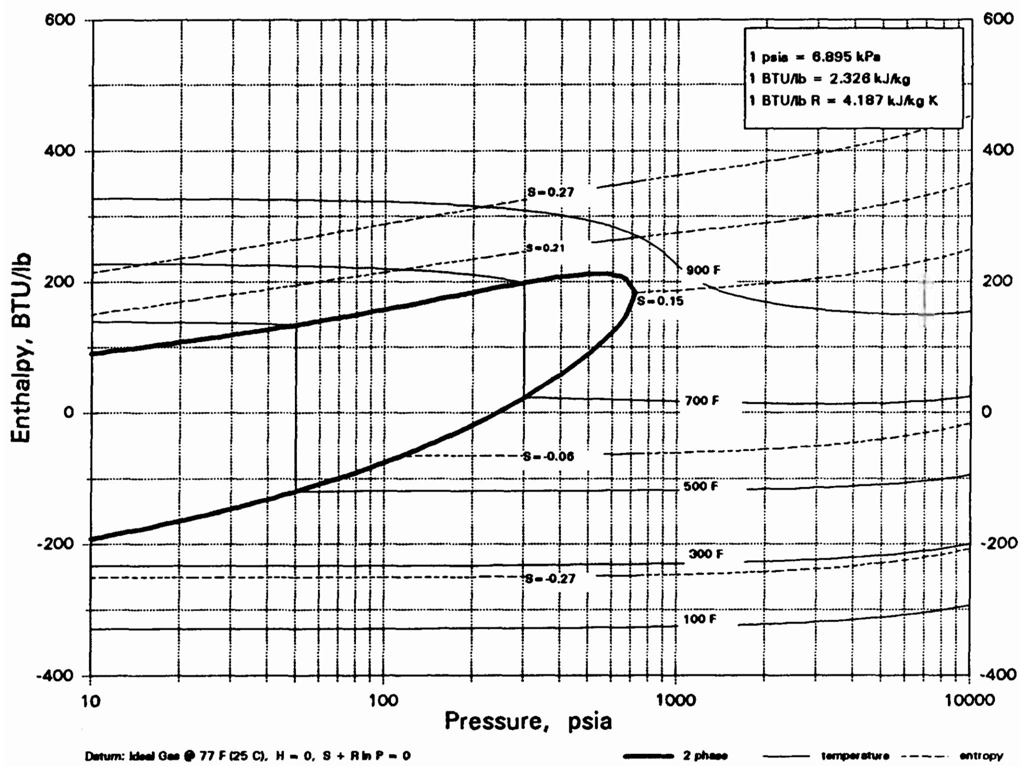




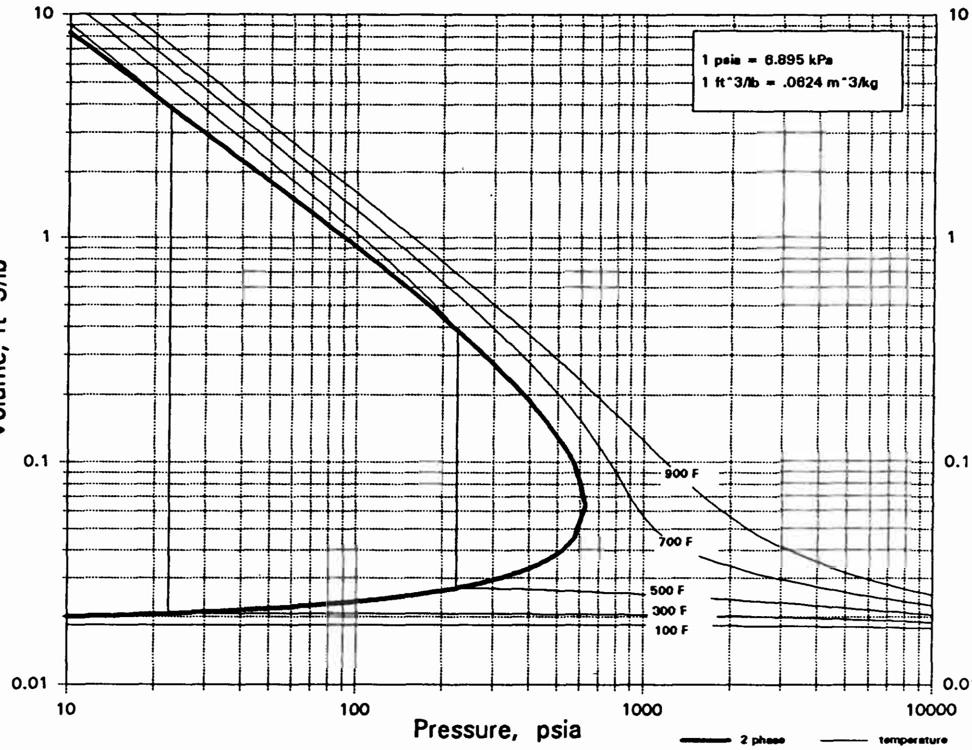
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

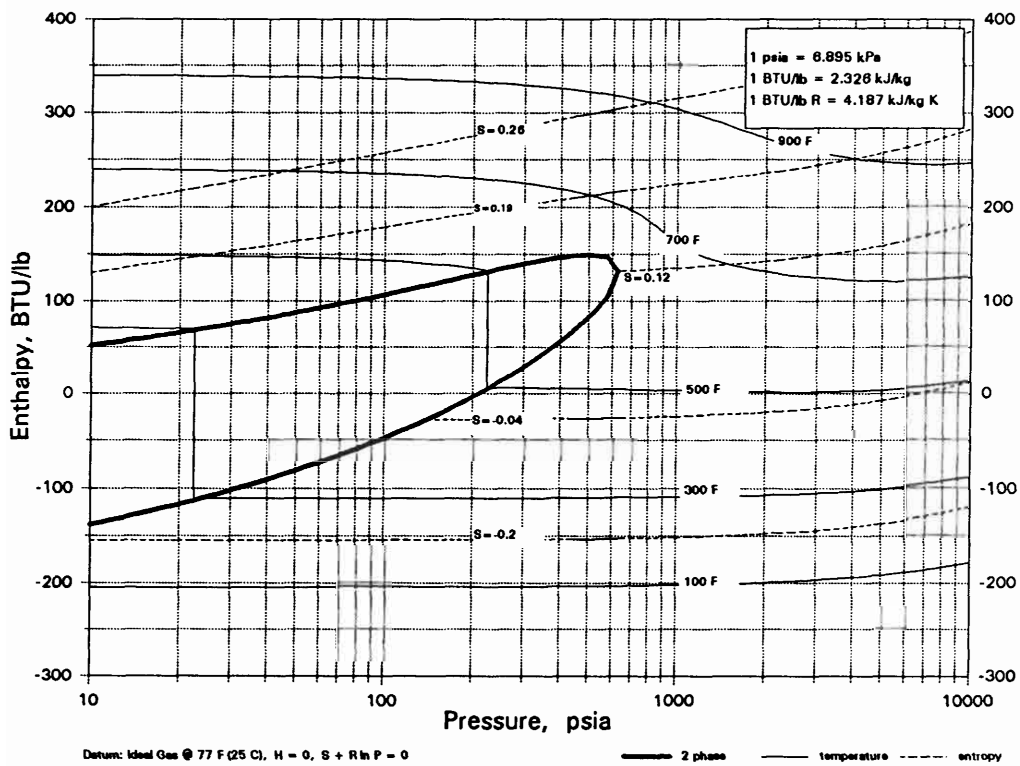
C3H7NO N-METHYLACETAMIDE



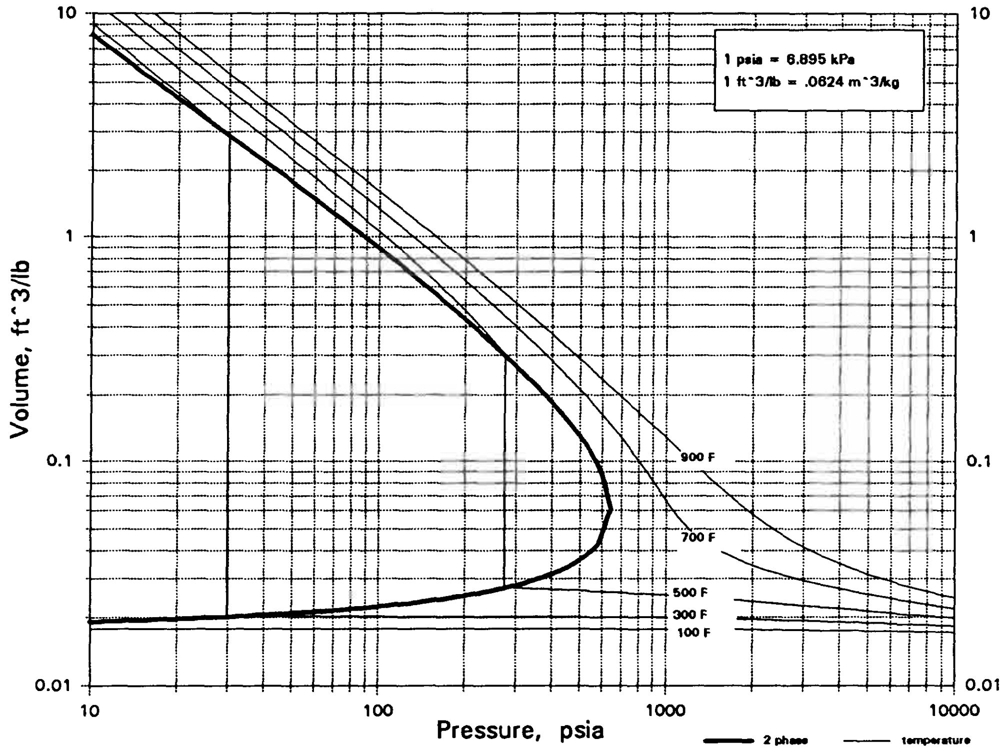


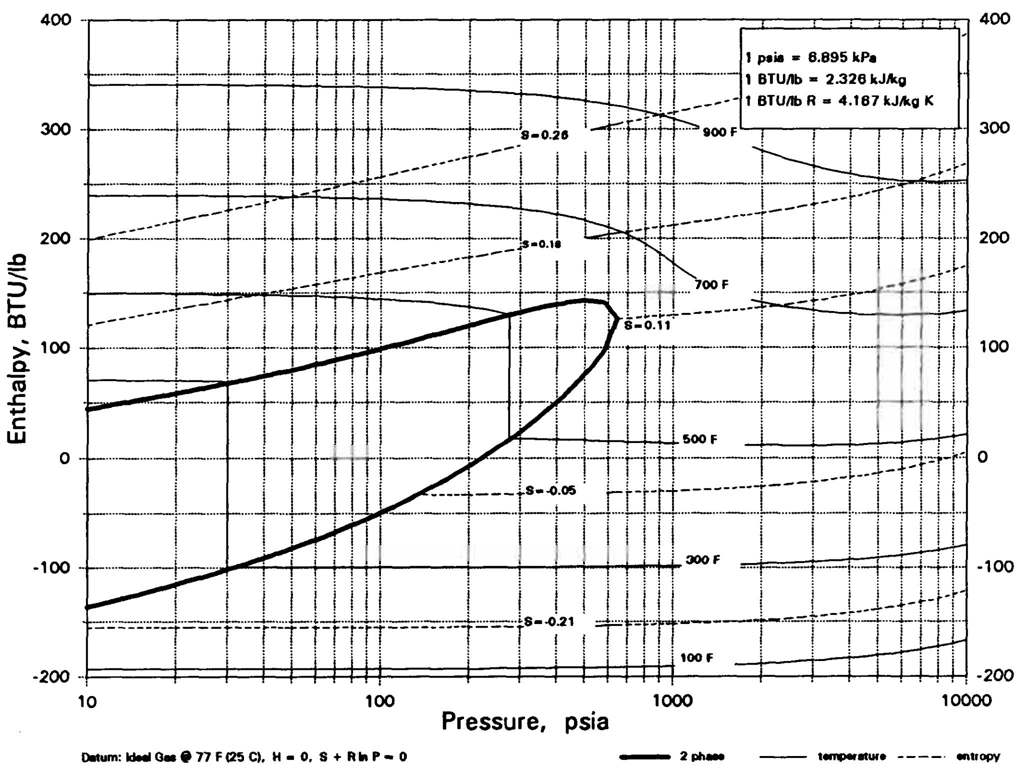
C3H7NO2 1-NITROPROPANE



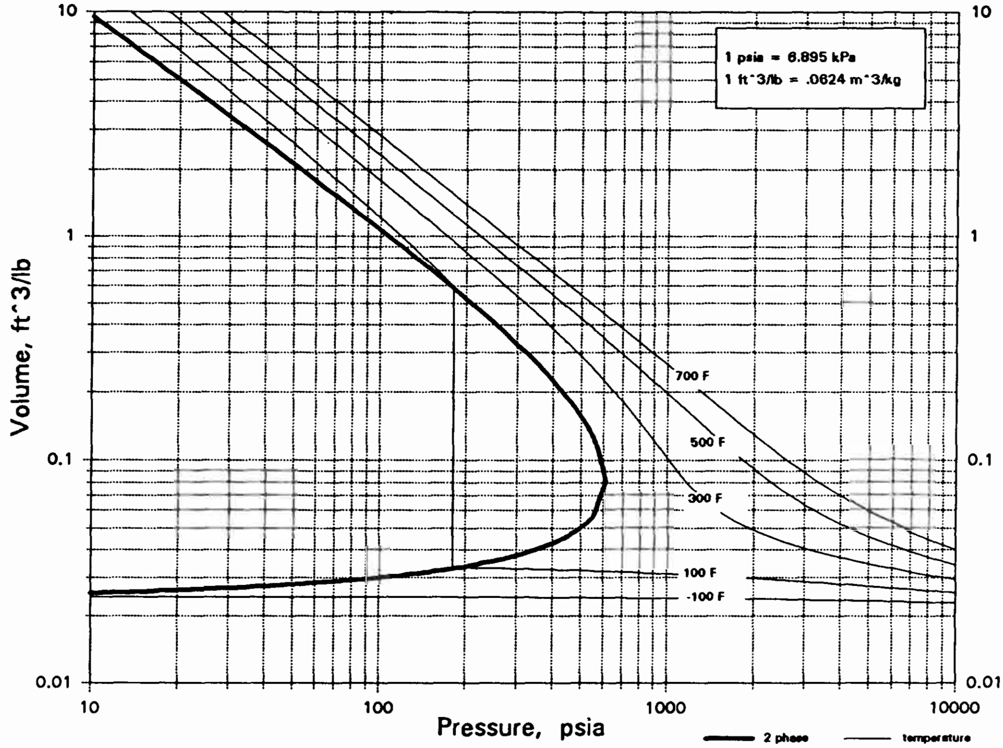


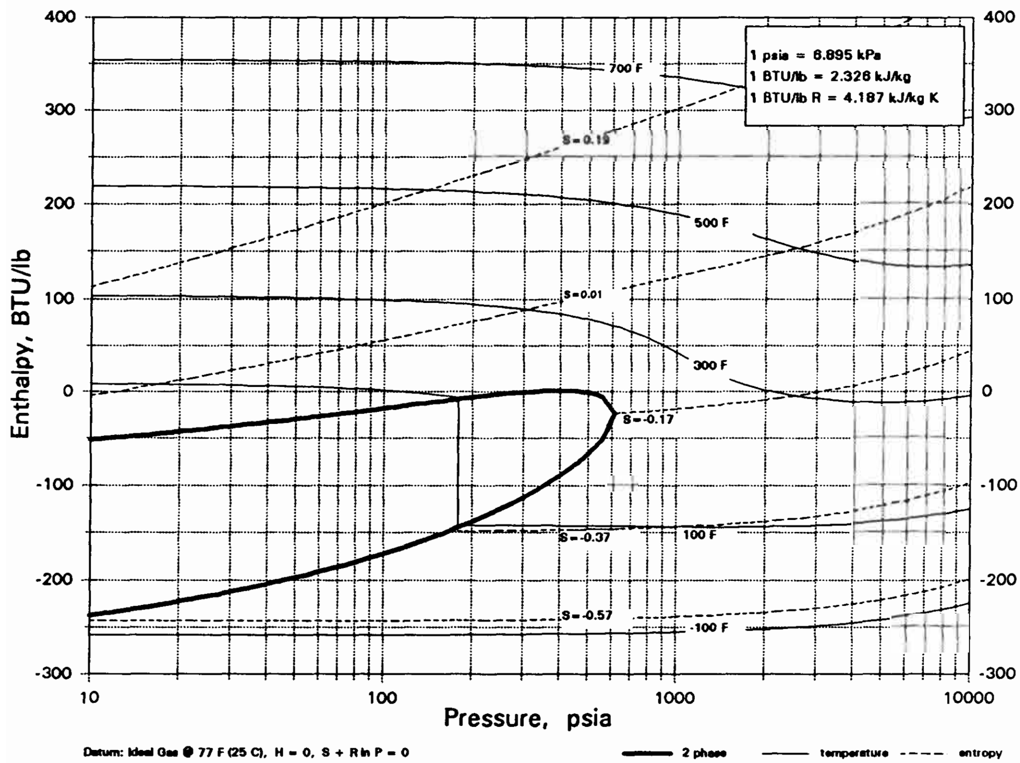
C3H7NO2 2-NITROPROPANE

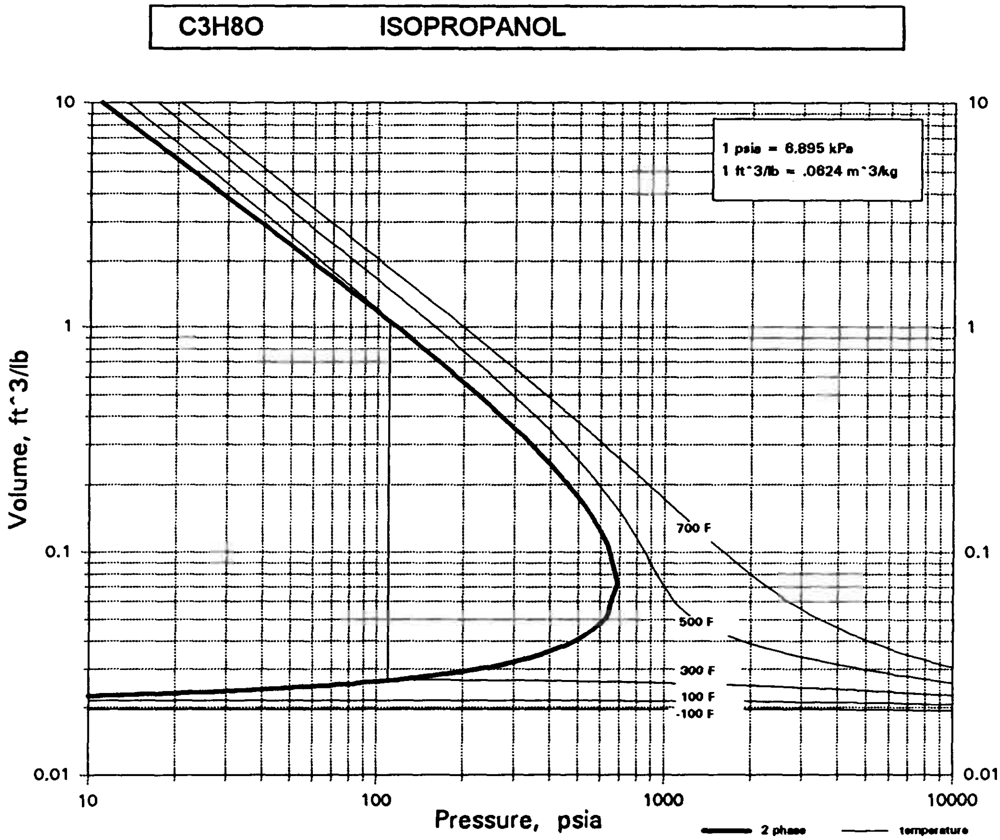


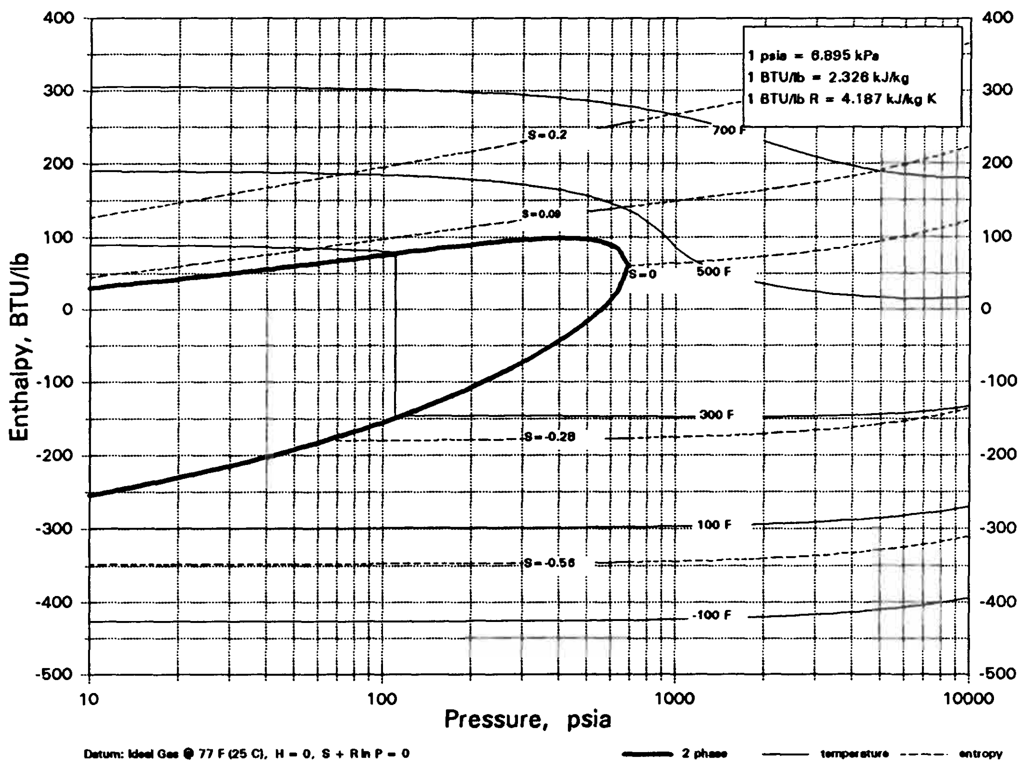


C3H8 PROPANE

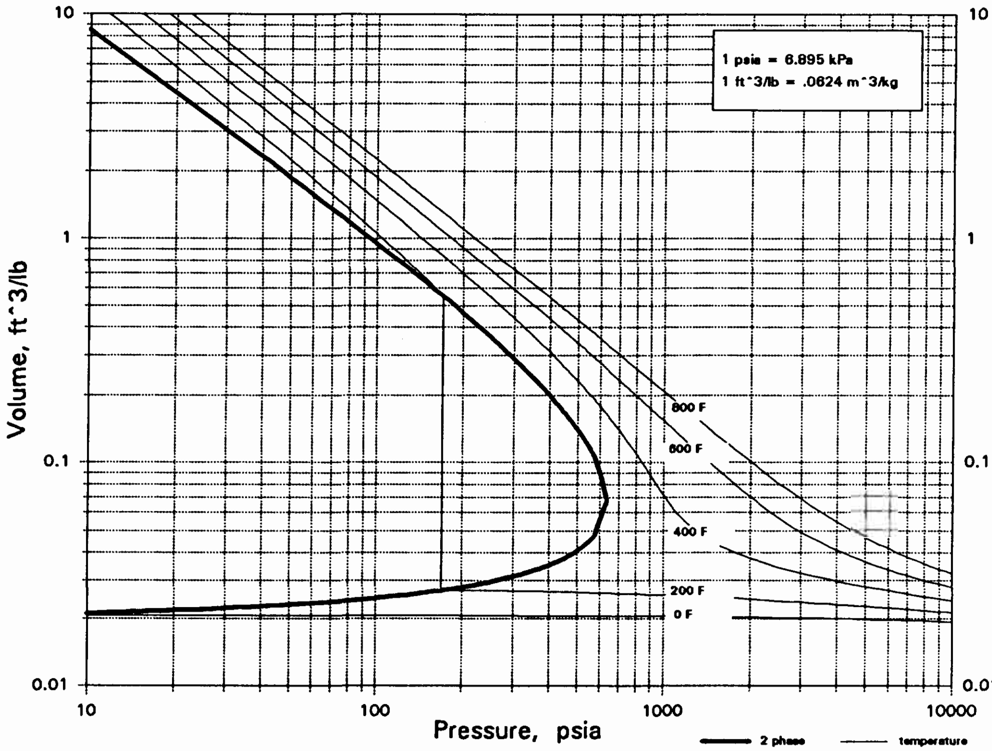


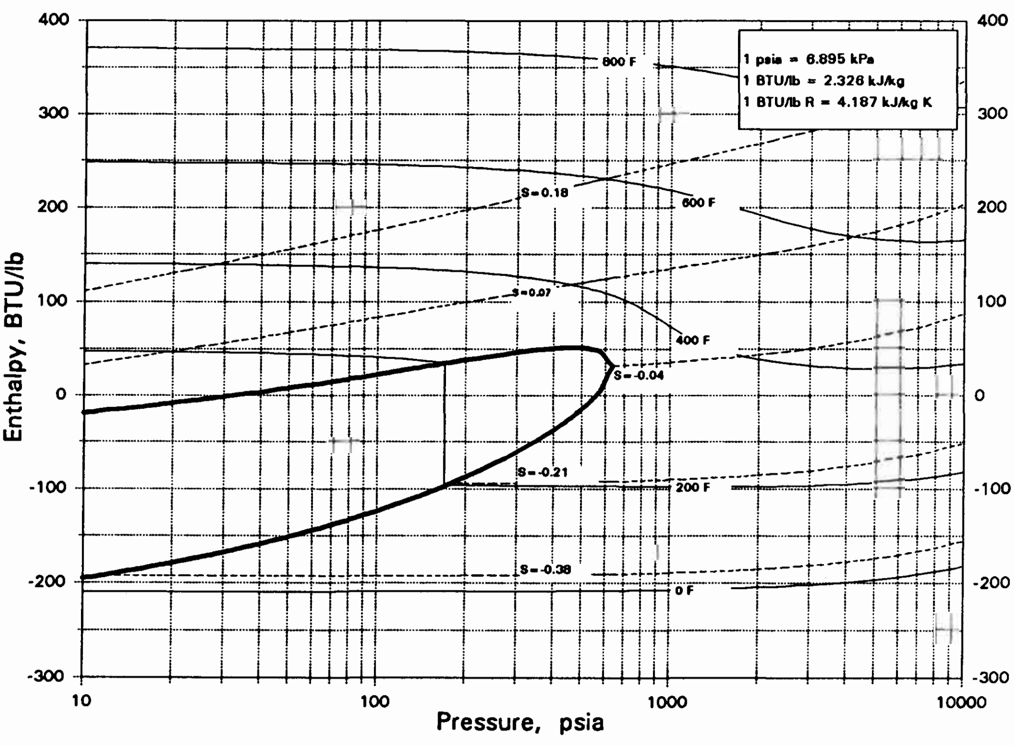



C3H8O ISOPROPANOL
1 psia = 6.895 kPa
1 ft^3/lb = .0624 m^3/kg
Volume, ft^3/lb
Pressure, psia
700 F
500 F
300 F
100 F
-100 F
10
1
0.1
0.01
10
100
1000
10000
2 phase
temperature


1 psia = 6.895 kPa
1 BTU/lb = 2.326 kJ/kg
1 BTU/lb R = 4.187 kJ/kg K
Enthalpy, BTU/lb
Pressure, psia
S=0.2
S=0.09
S=0
S=-0.28
S=-0.56
700 F
500 F
300 F
100 F
-100 F
400
300
200
100
0
-100
-200
-300
-400
-500
10
100
1000
10000
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0
2 phase
temperature
entropy

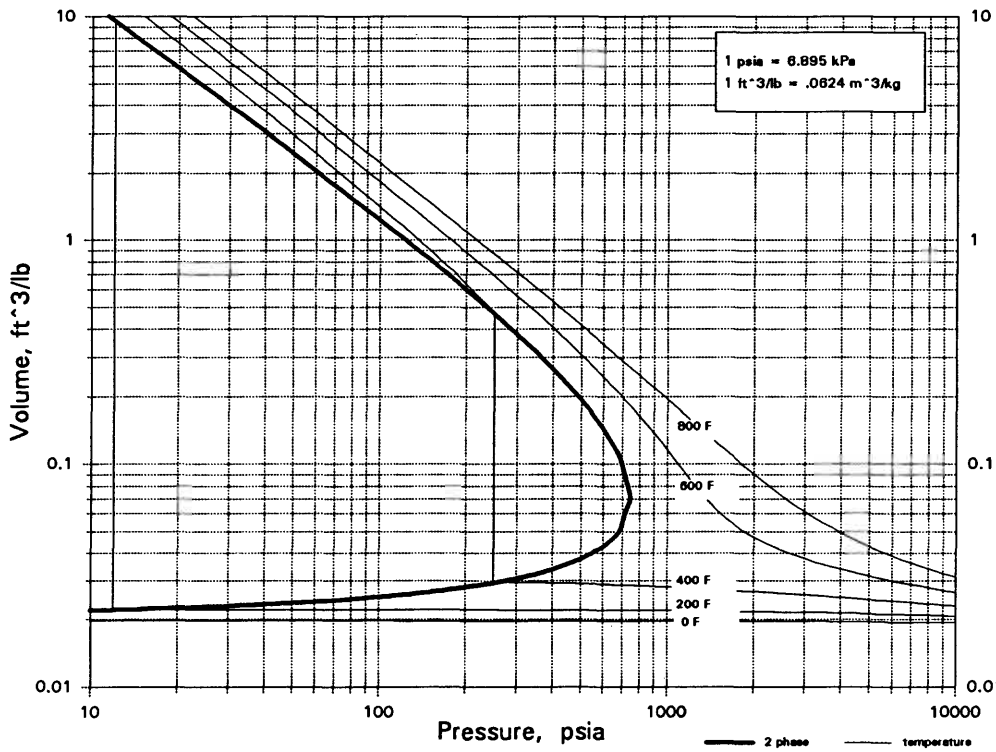
C3H8O METHYL ETHYL ETHER

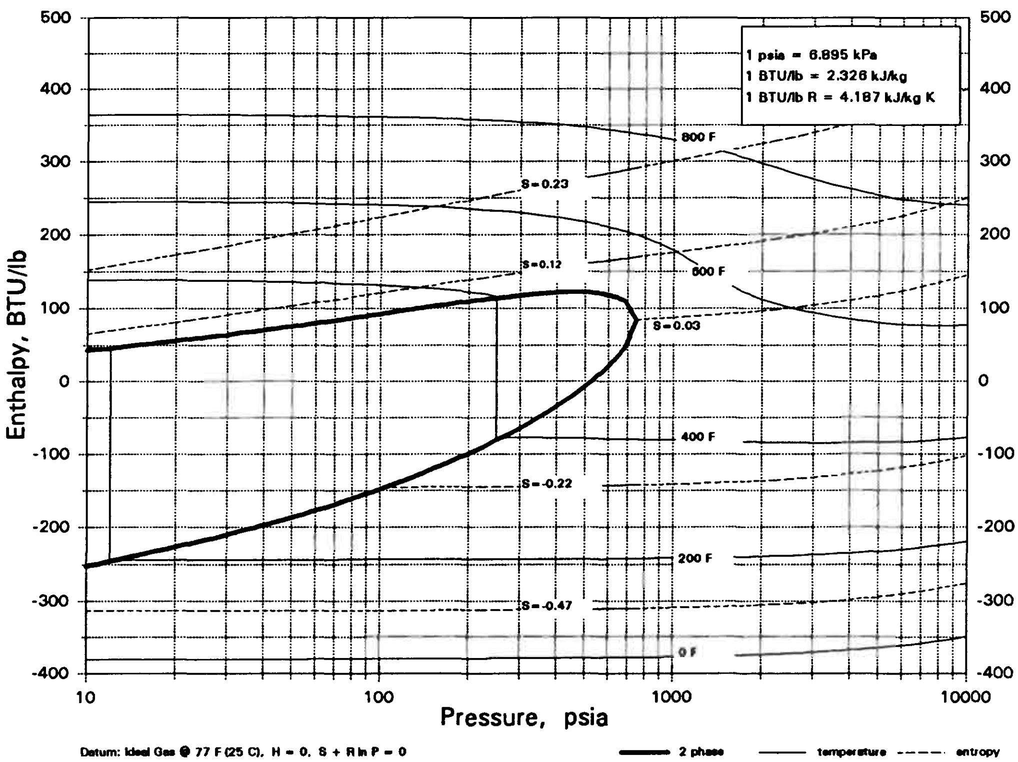




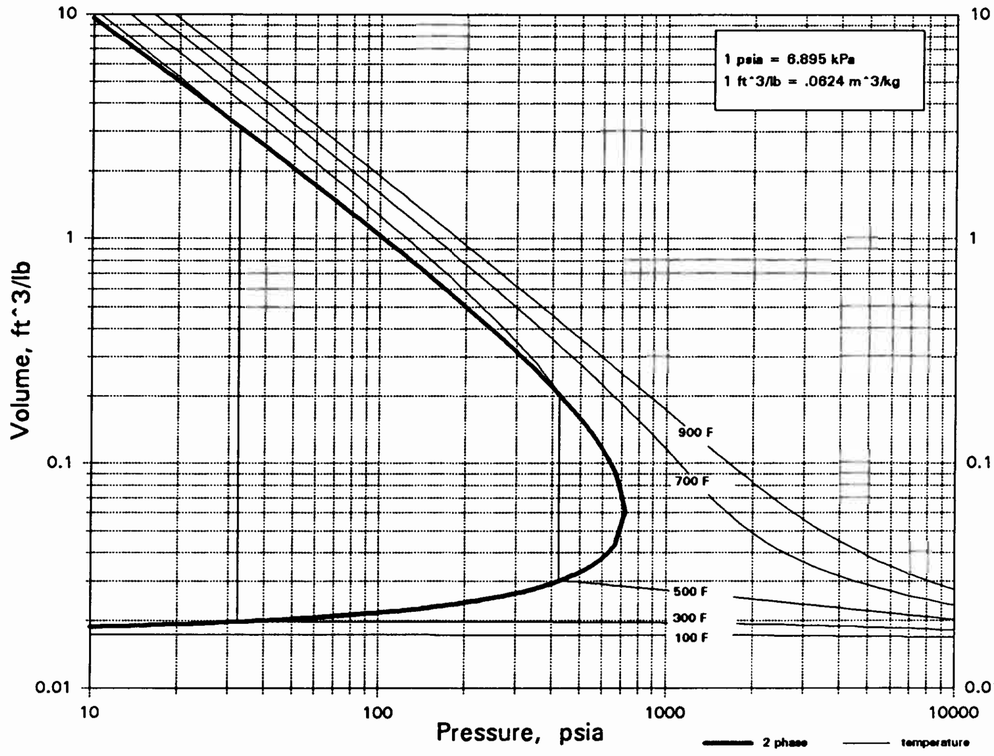
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

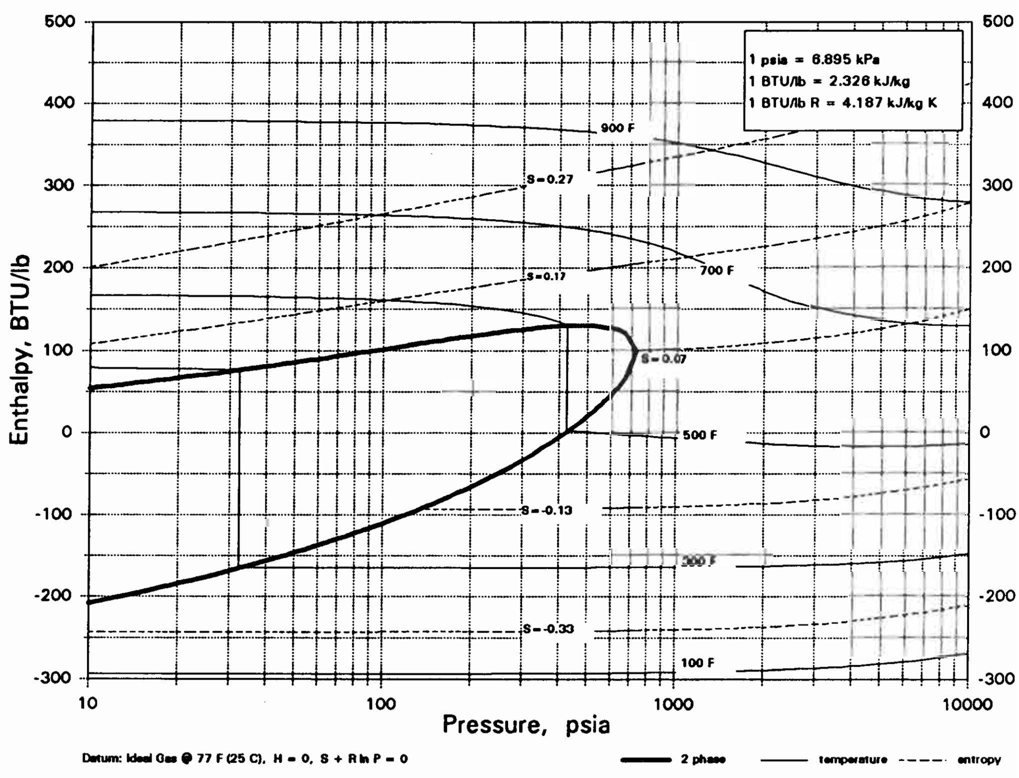
C3H8O n-PROPANOL



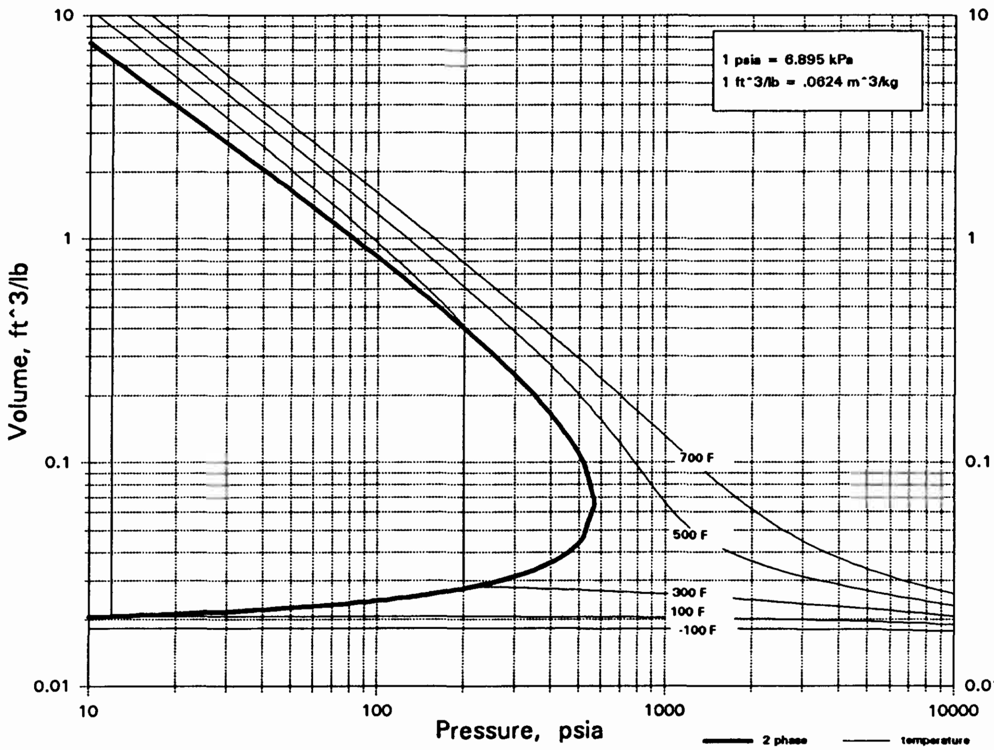


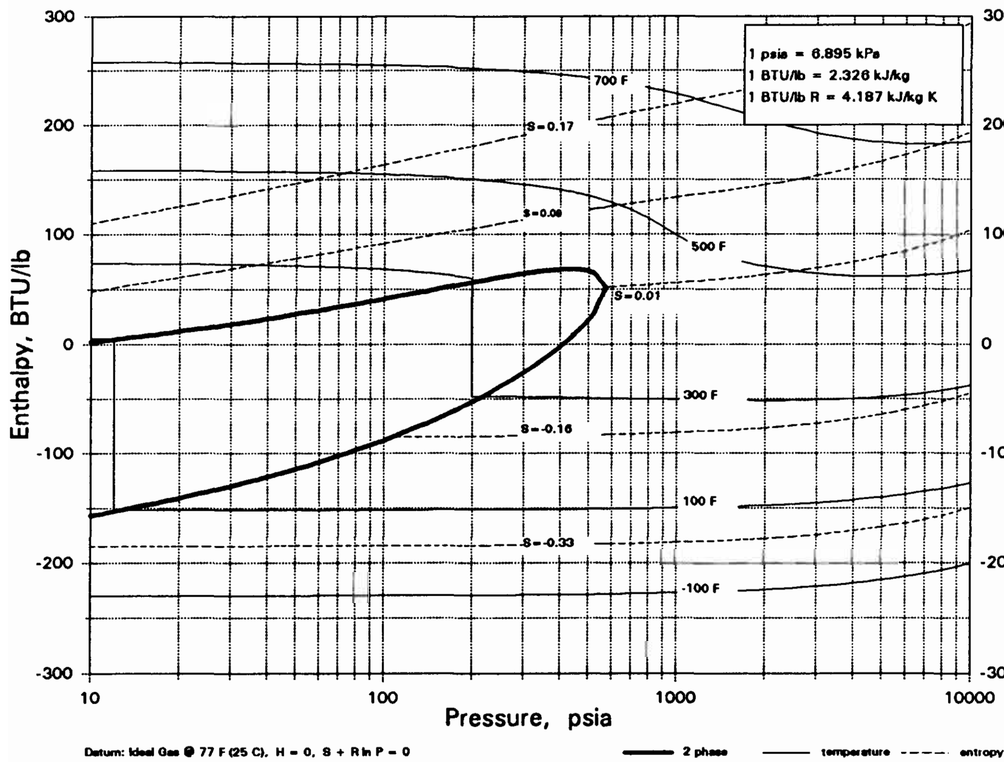
C3H8O2 2-METHOXYETHANOL



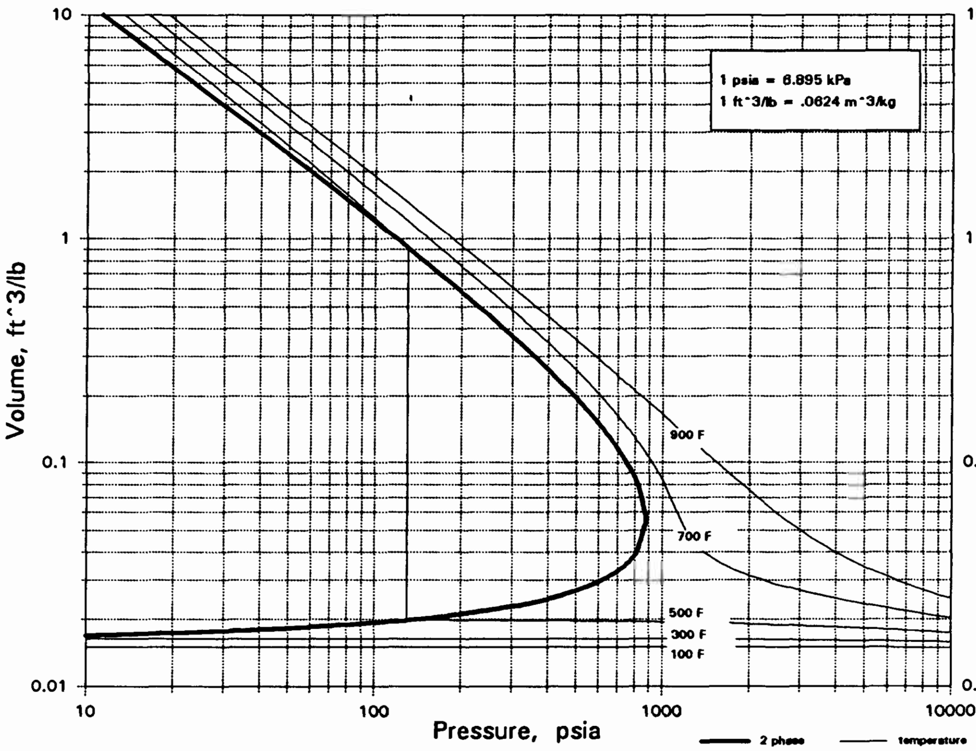


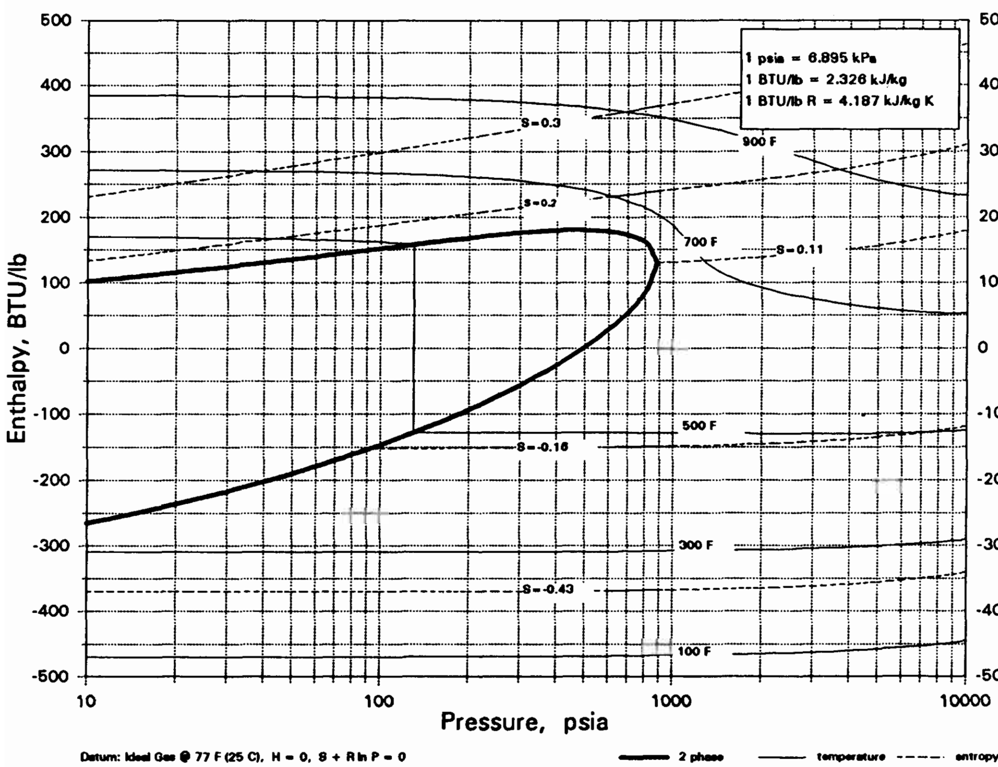
C3H8O2 METHYLAL



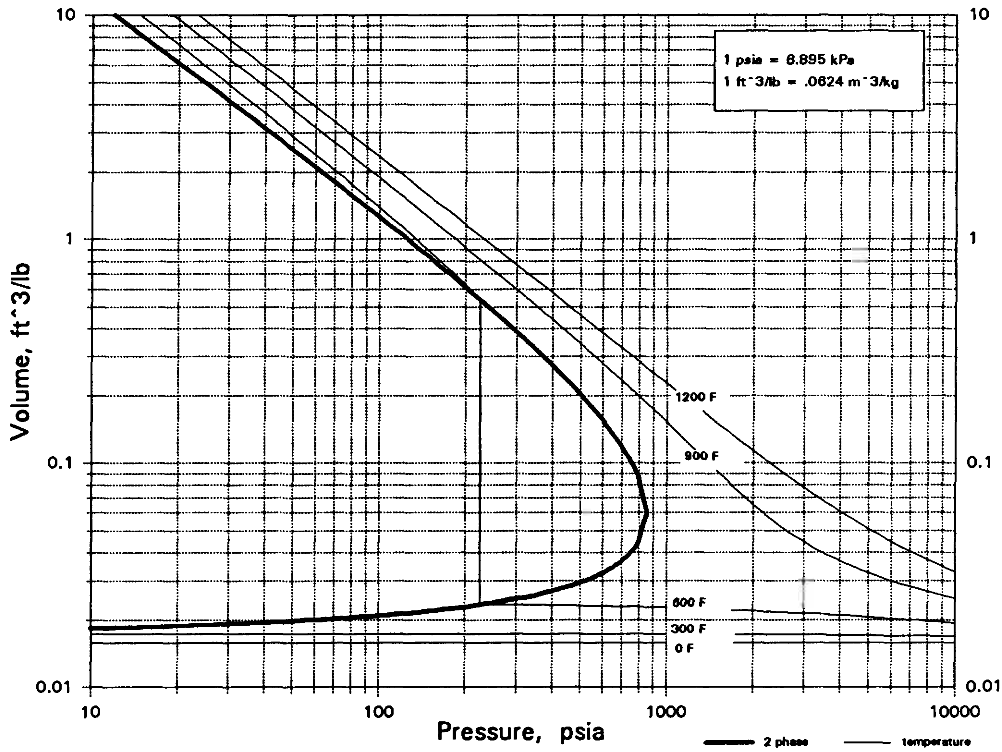


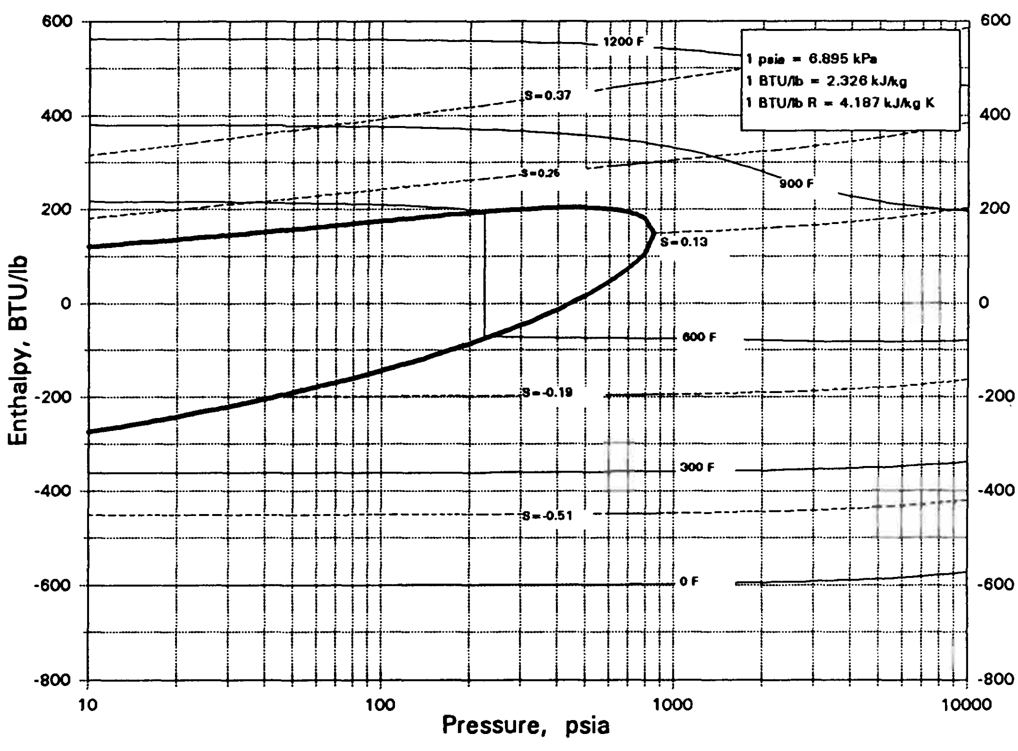
C3H8O2 1-2-PROPYLENE GLYCOL



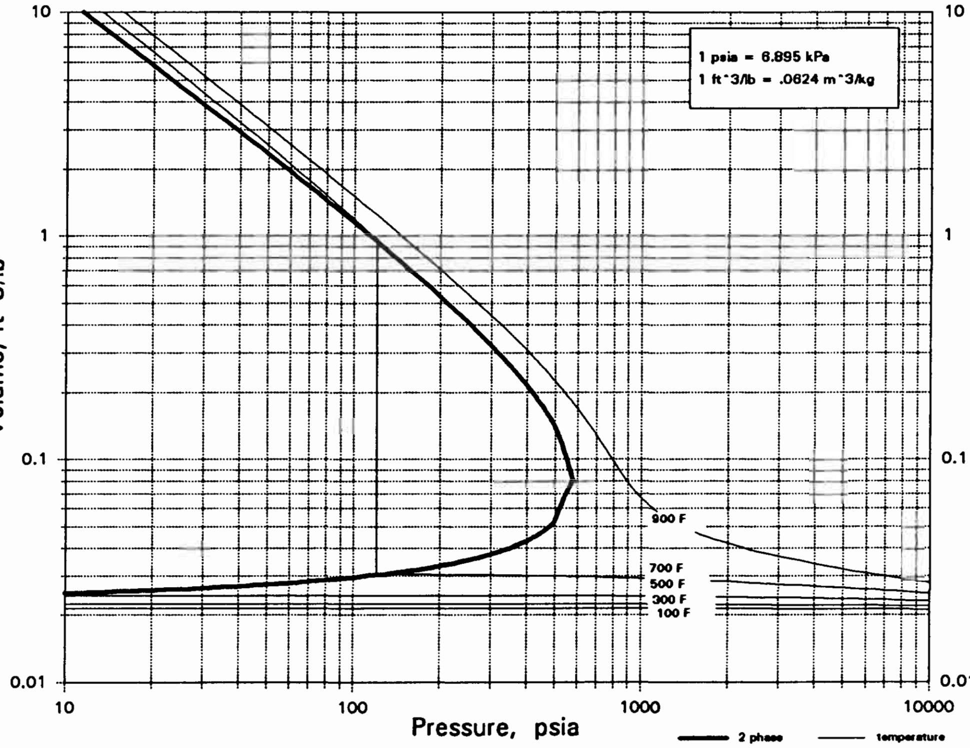


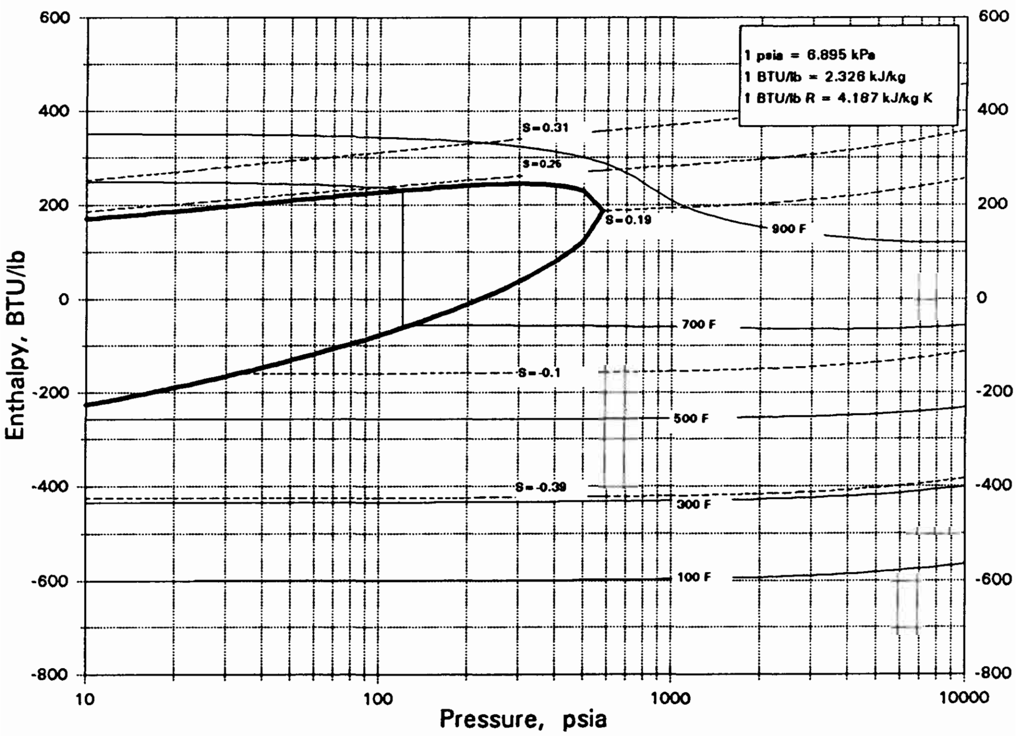
C3H8O2 1-3-PROPYLENE GLYCOL





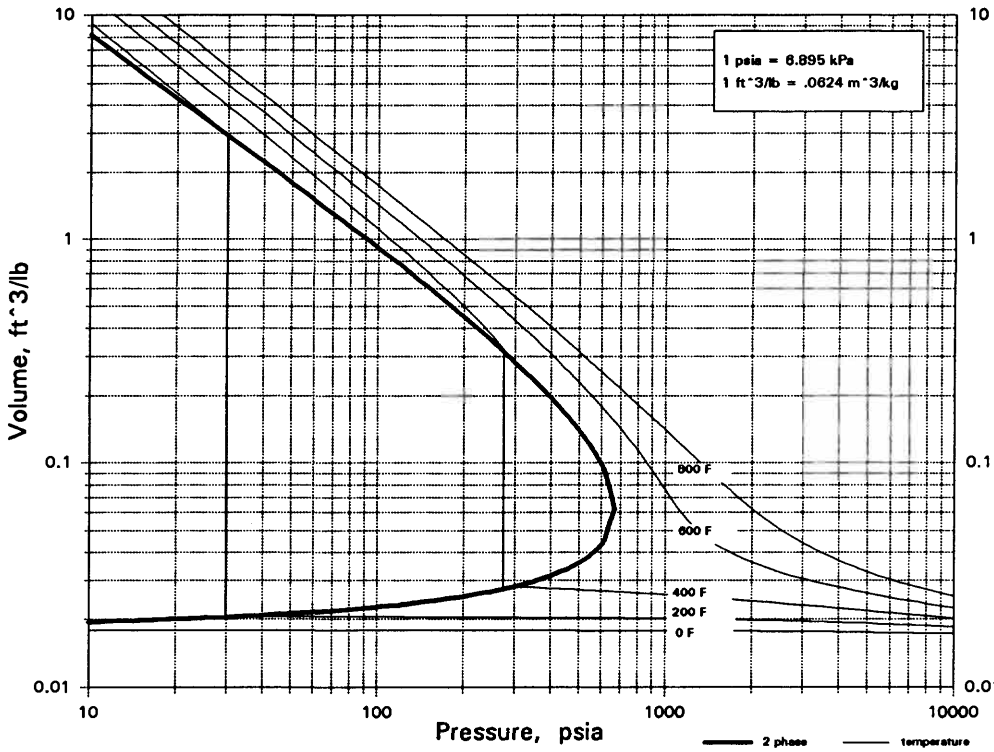
C3H8O3 GLYCEROL

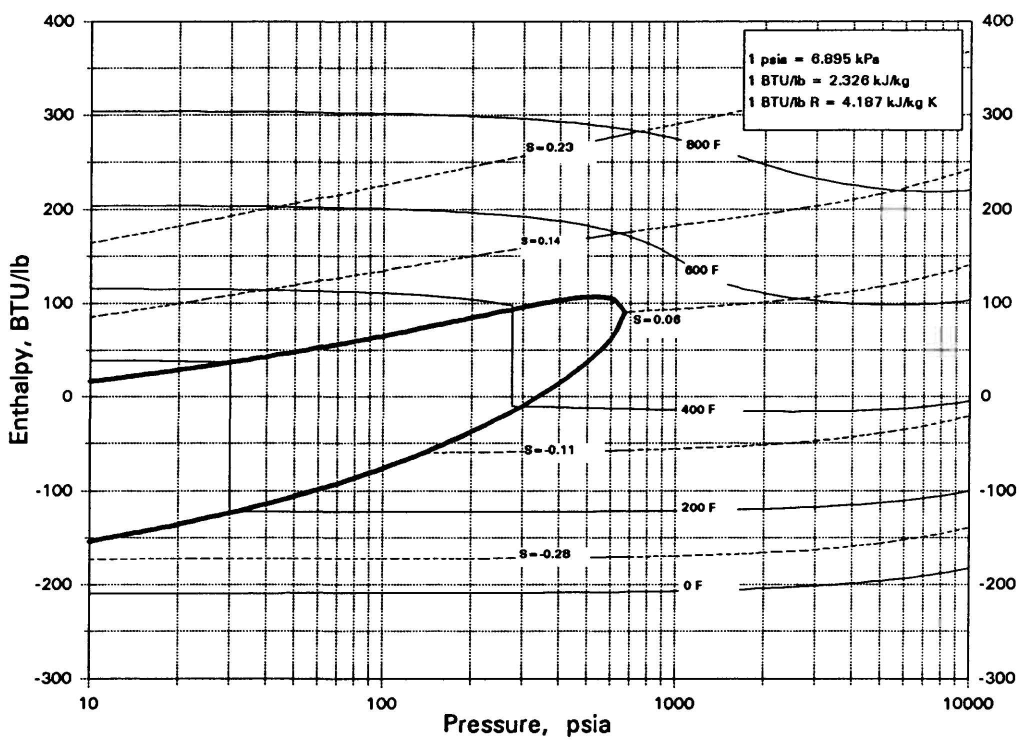




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

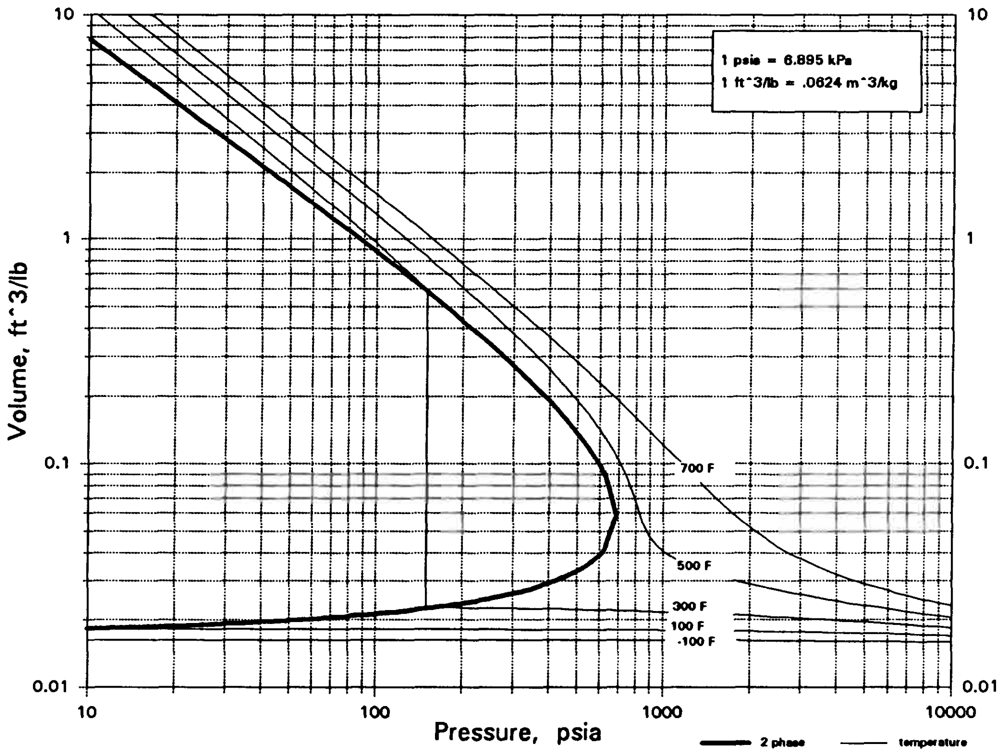
C3H8S n-PROPYLMERCAPTAN

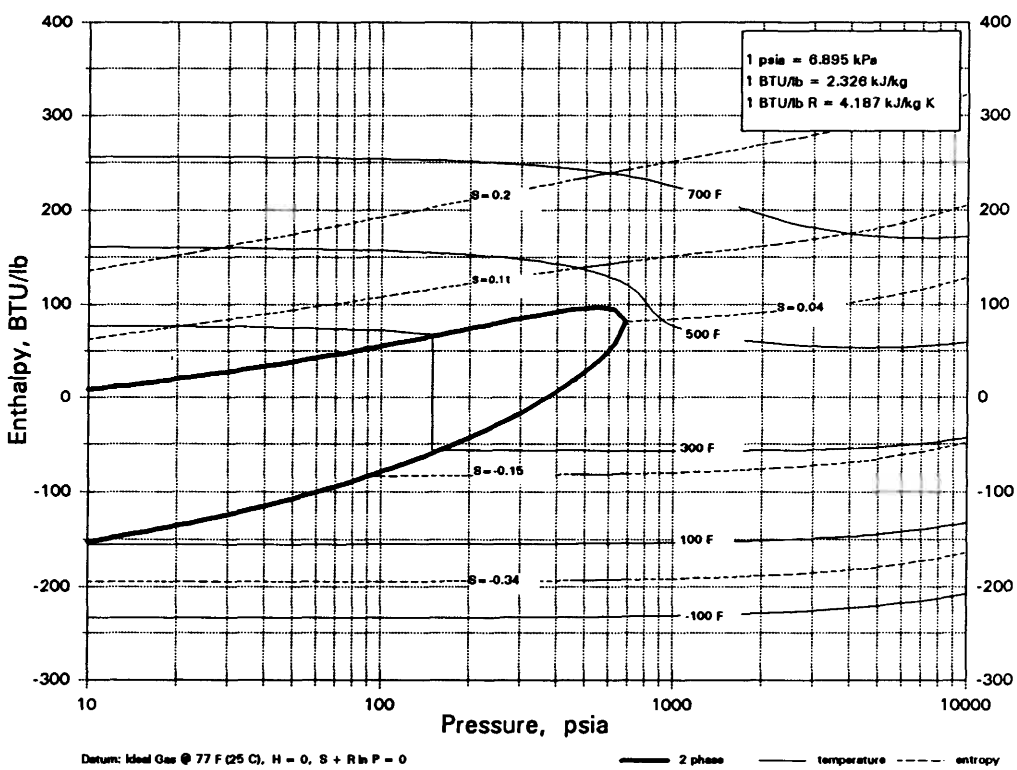




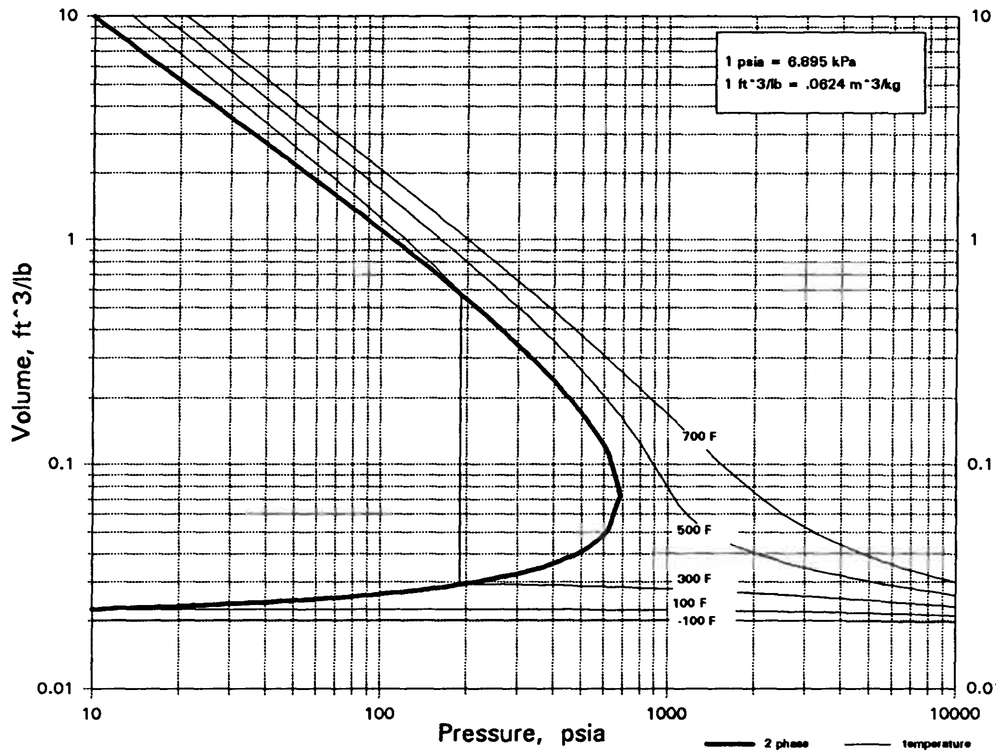
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

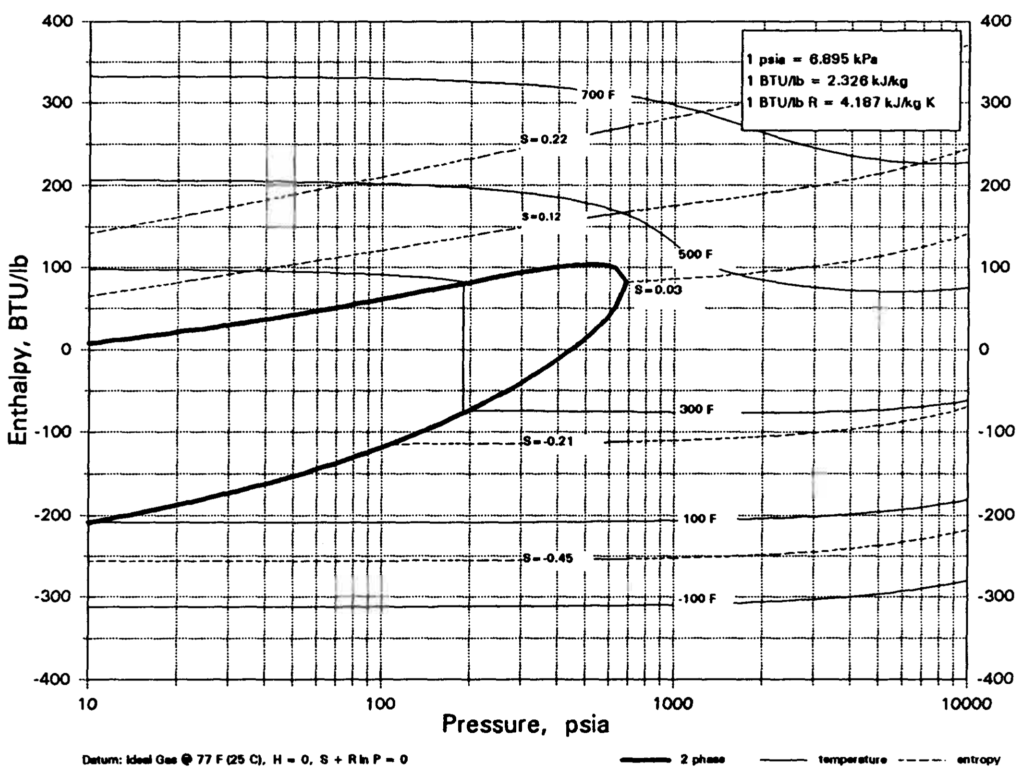
C3H8S ISOPROPYL MERCAPTAN



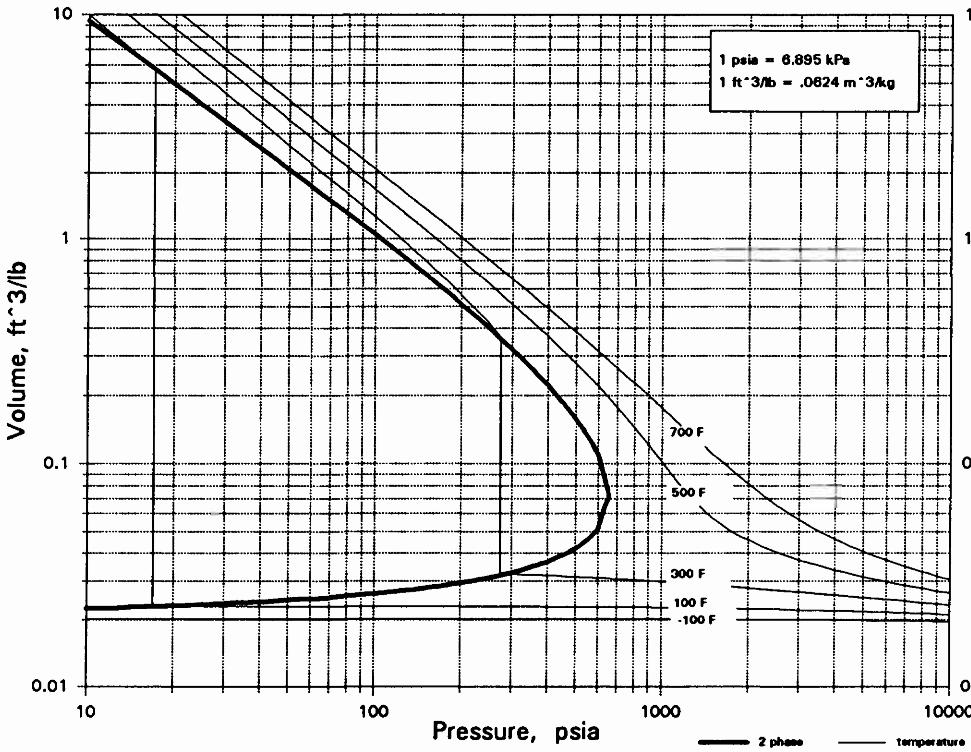


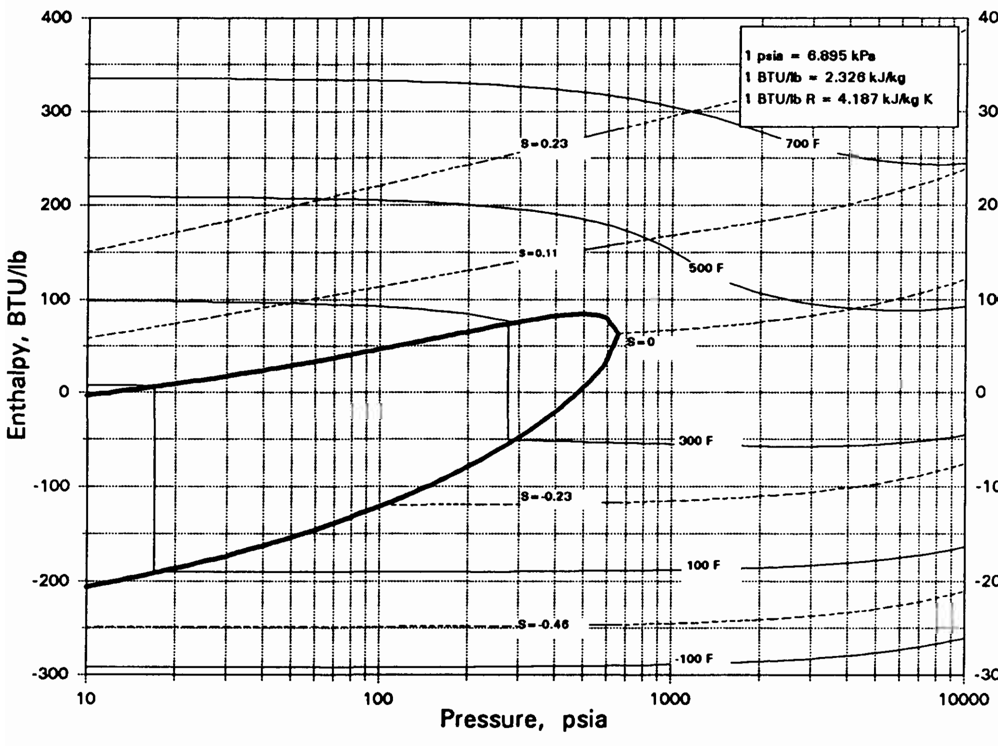
C3H9N n-PROPYLAMINE



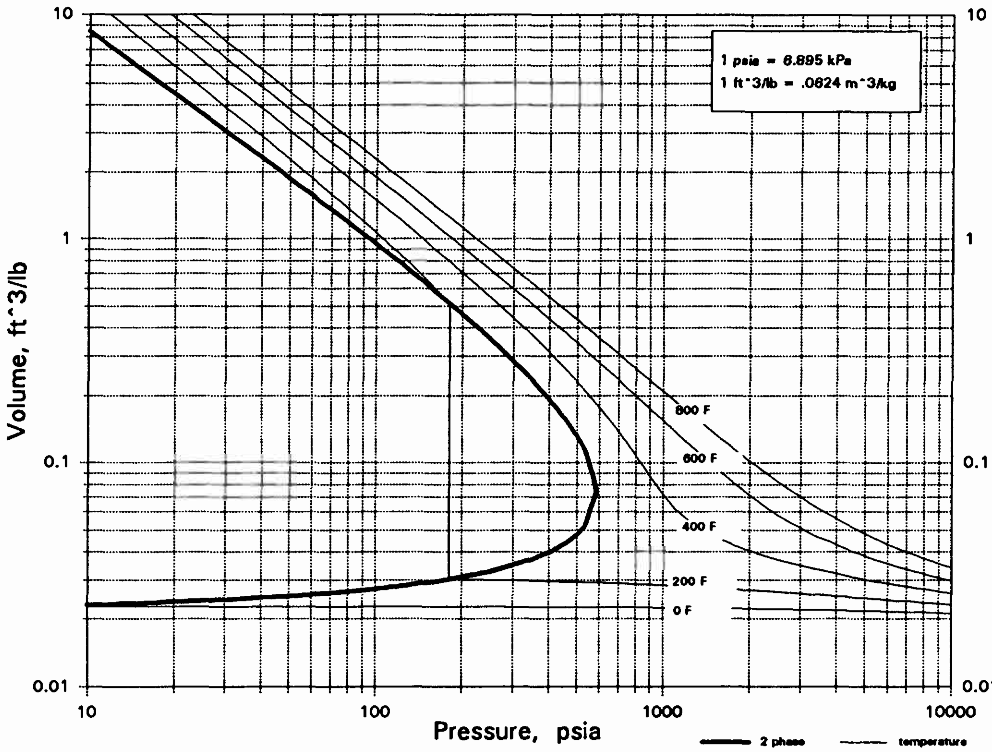


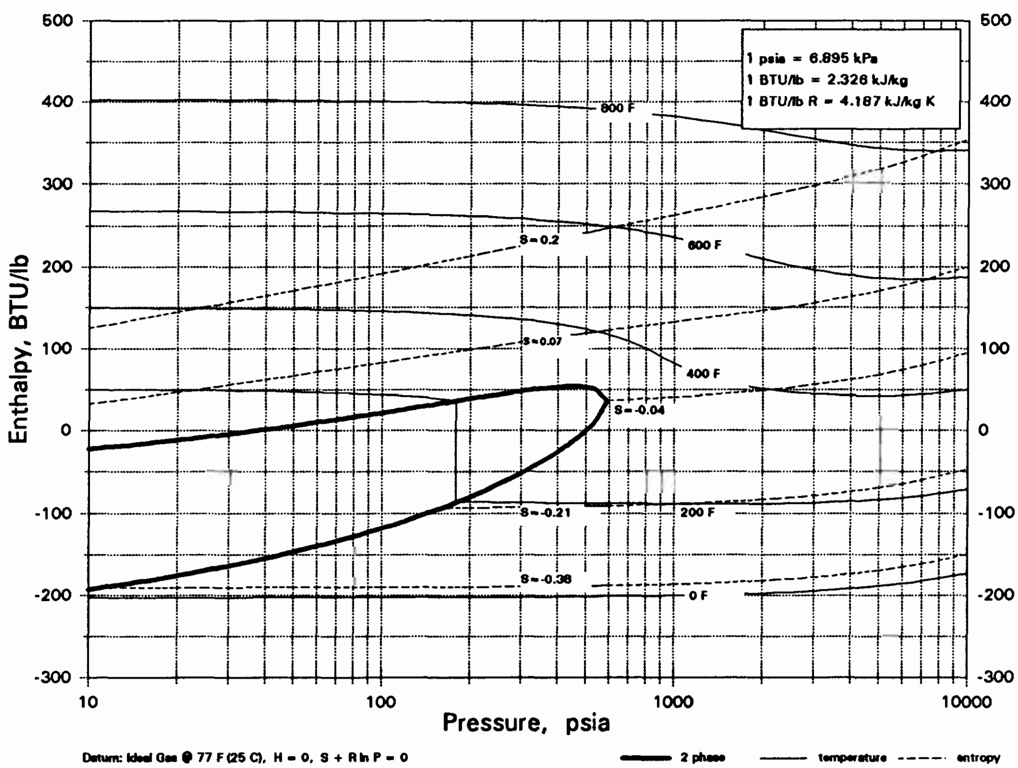
C3H9N ISOPROPYLAMINE



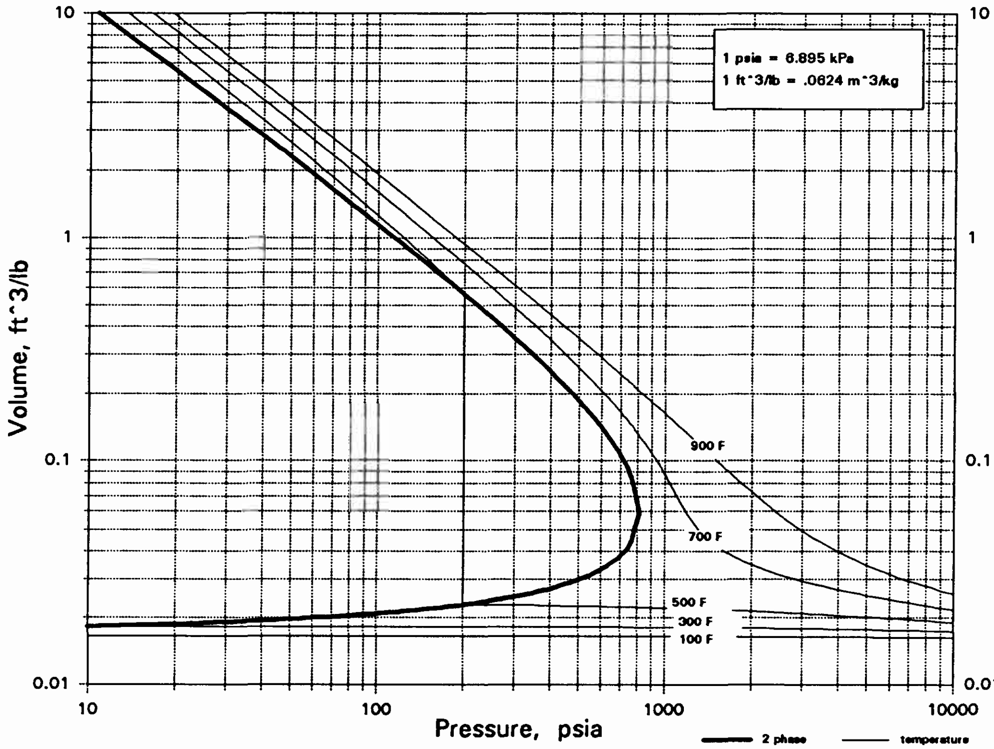


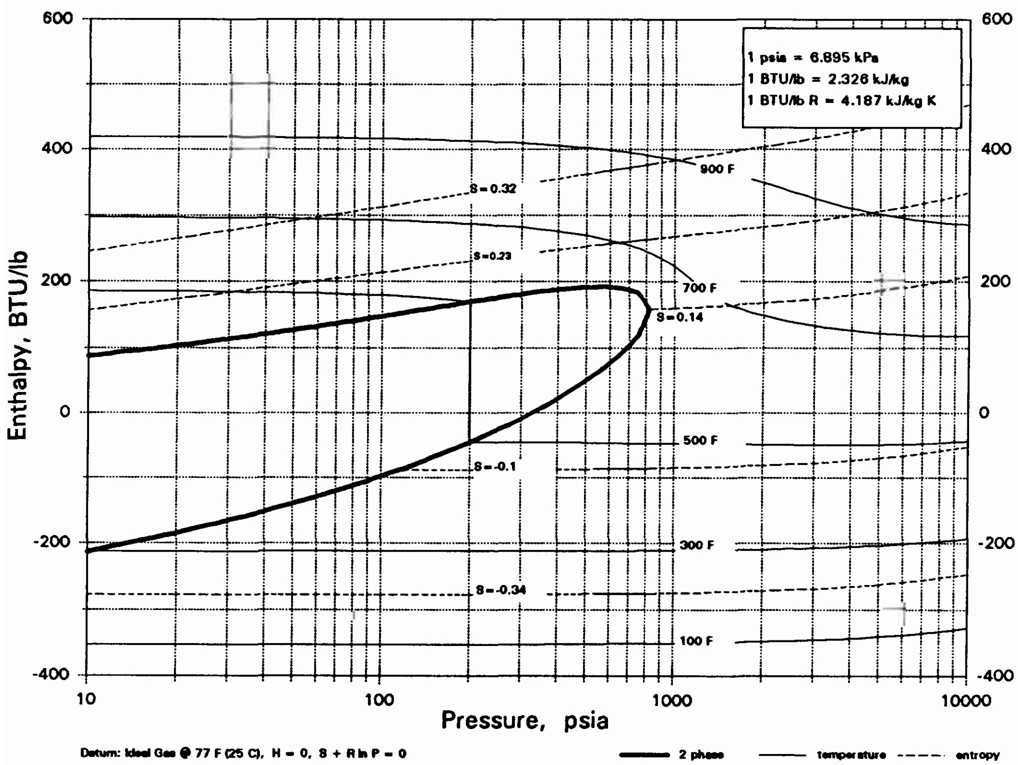
C3H9N TRIMETHYLAMINE



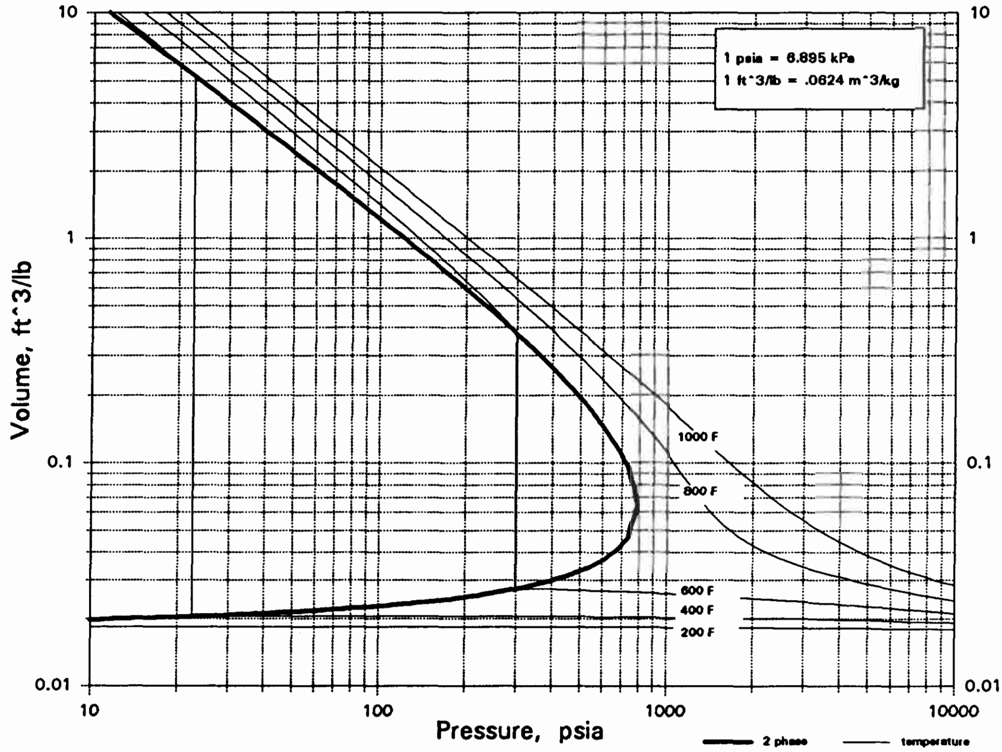


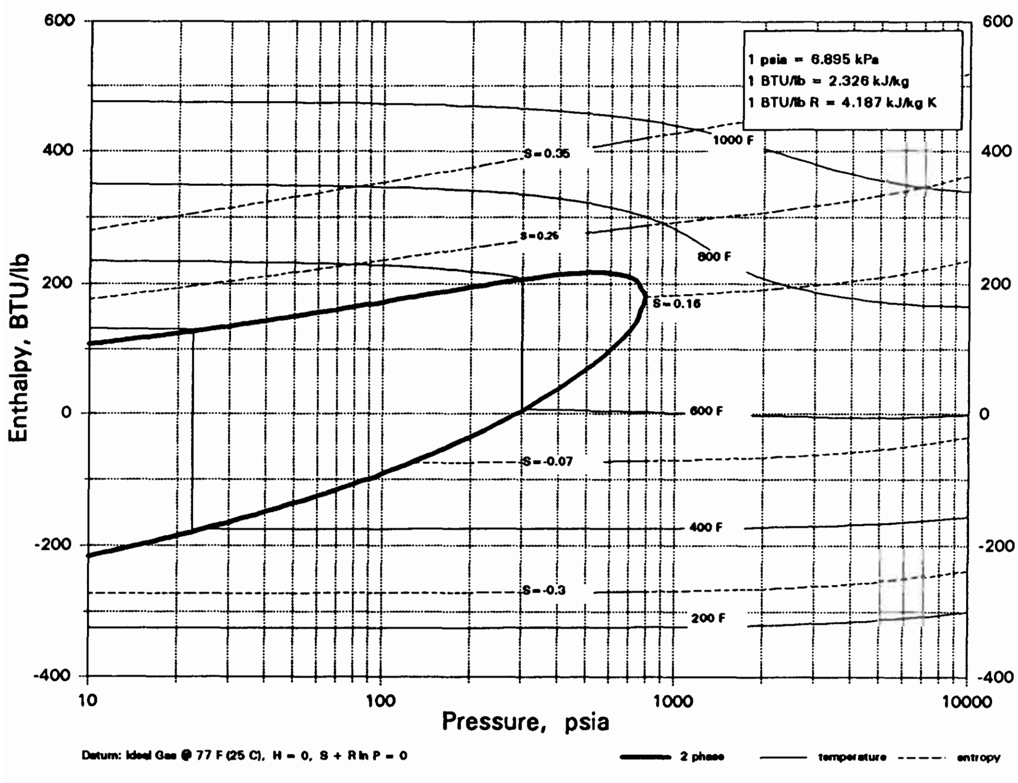
C3H9NO 1-AMINO-2-PROPANOL



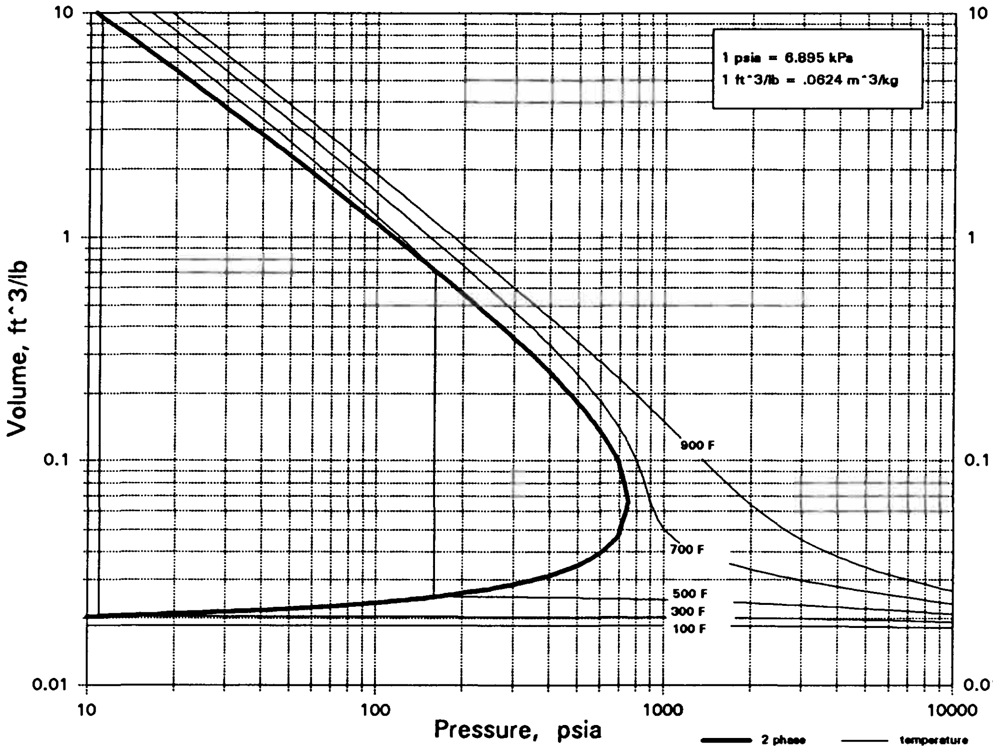


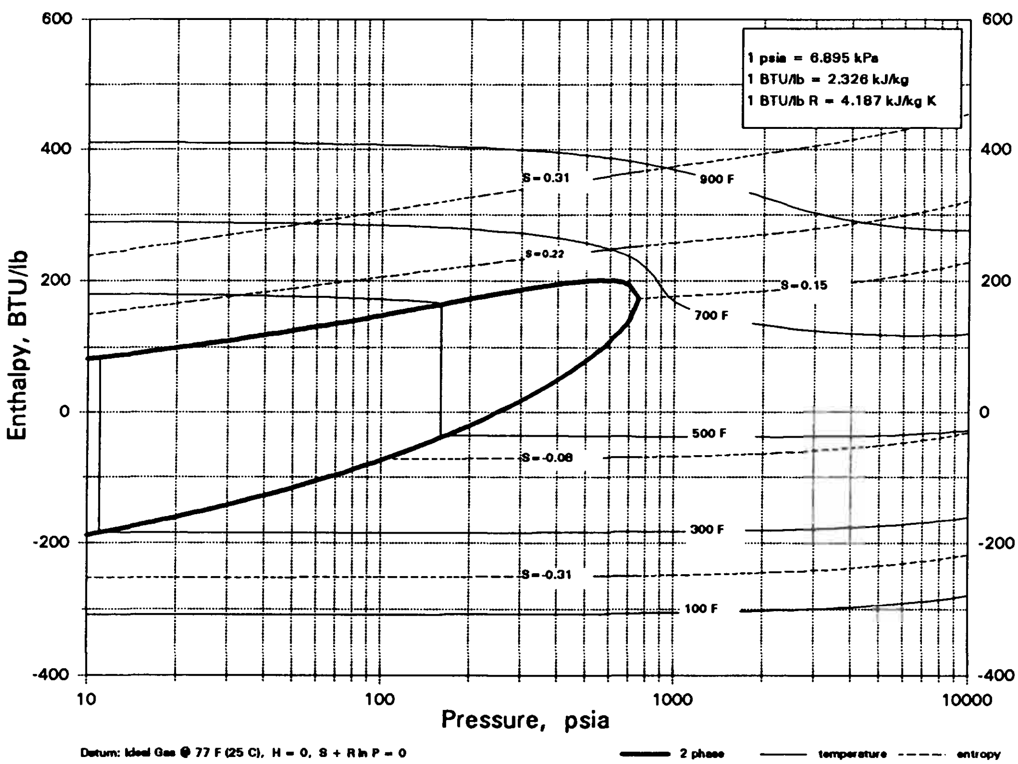
C3H9NO 3-AMINO-1-PROPANOL



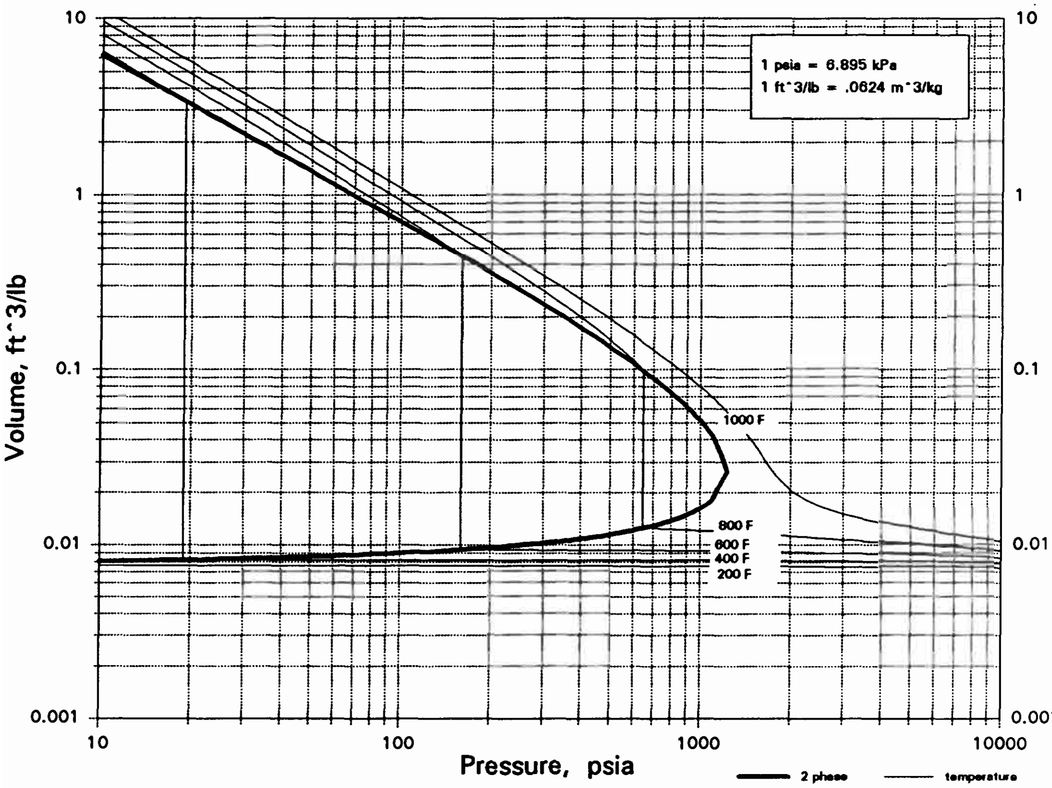


C3H9NO METHYLETHANOLAMINE





C3H9O4P	TRIMETHYL PHOSPHATE



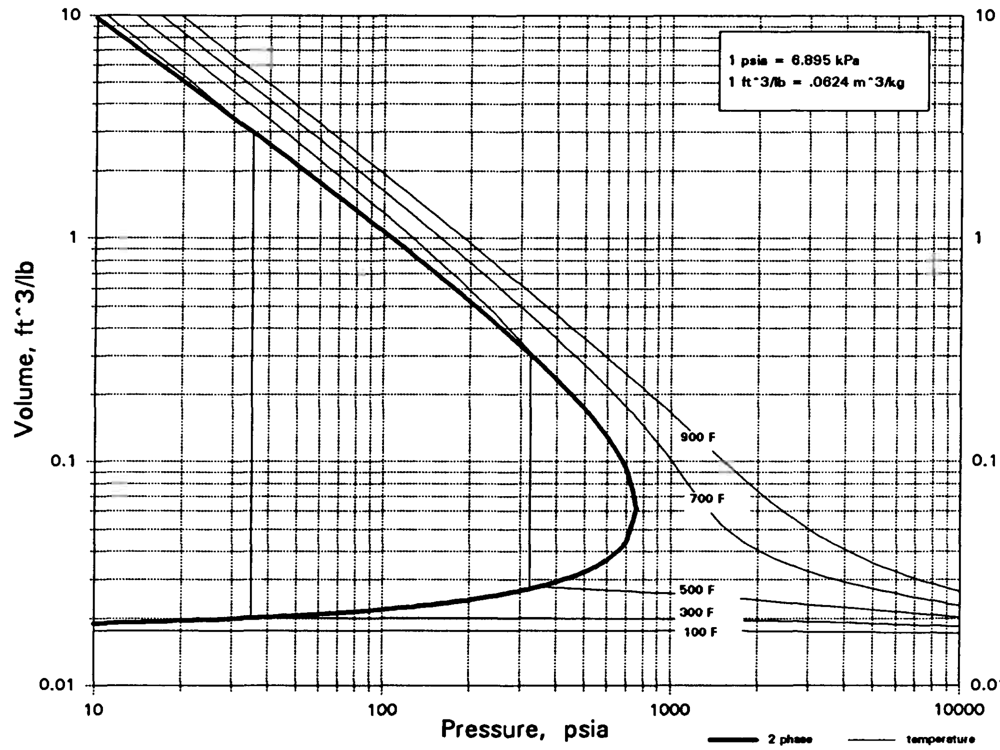
1. Boiling Point, K................ 465.85

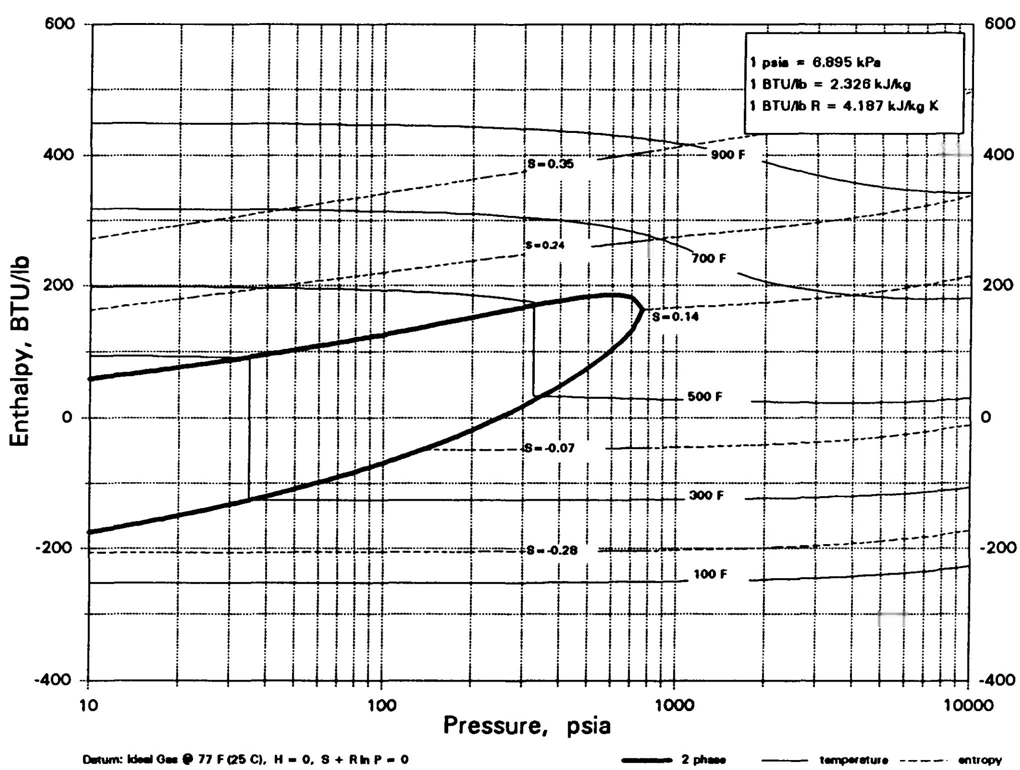
2. Critical Temperature, K.... 764.00

3. Critical Pressure, atm....... 83.89

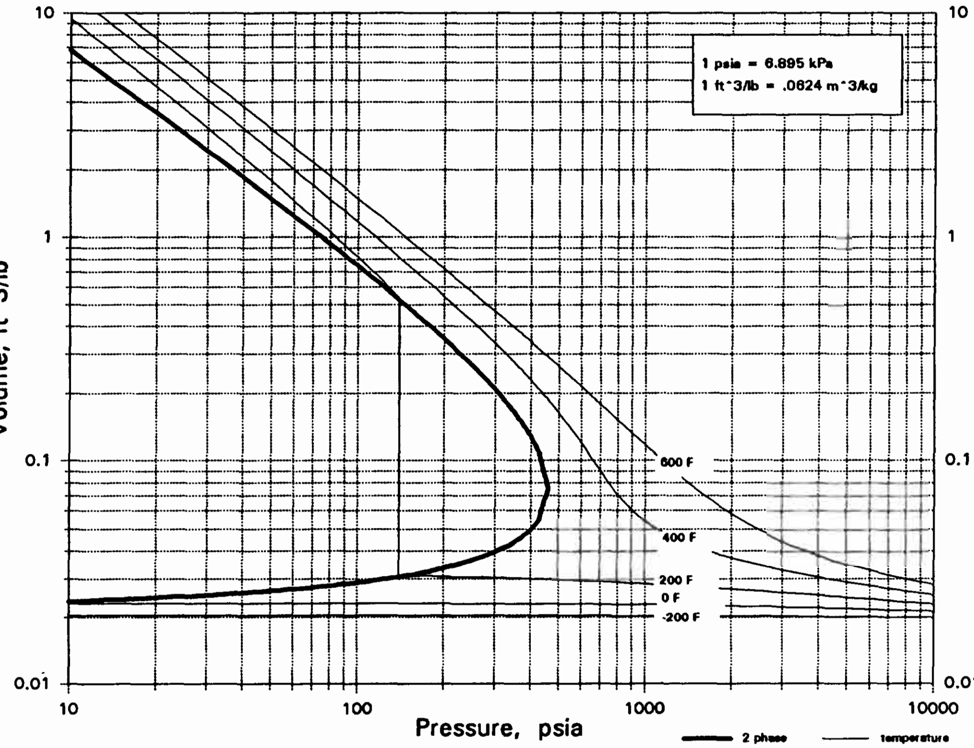
Heat capacity data are not available.

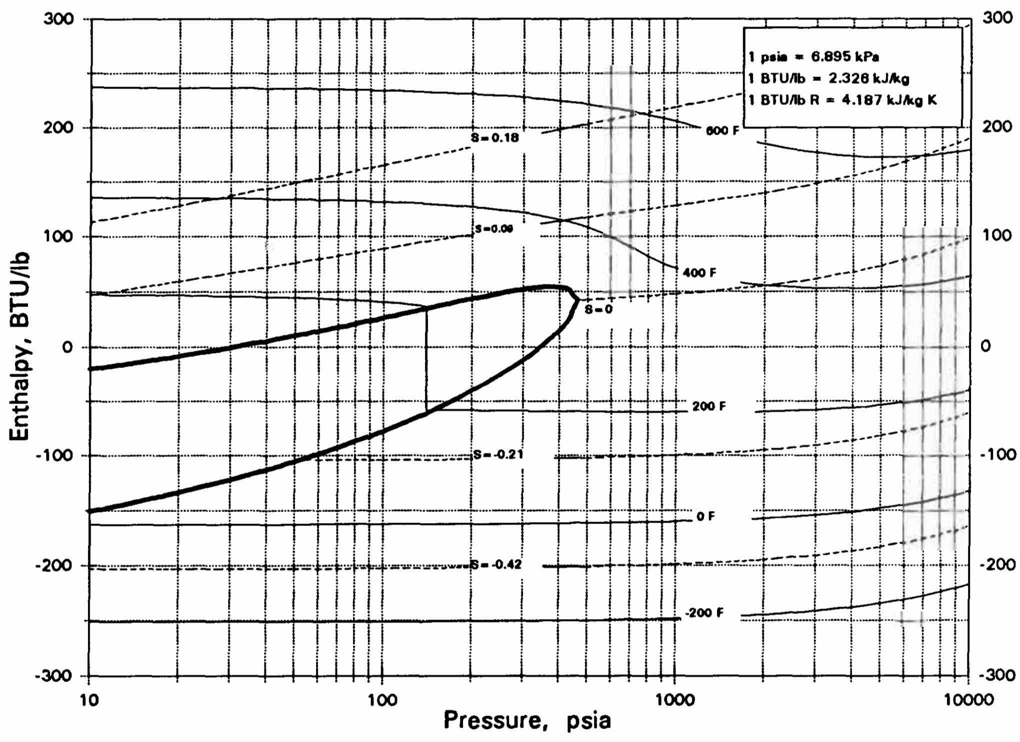
C3H10N2 1-2-PROPANEDIAMINE



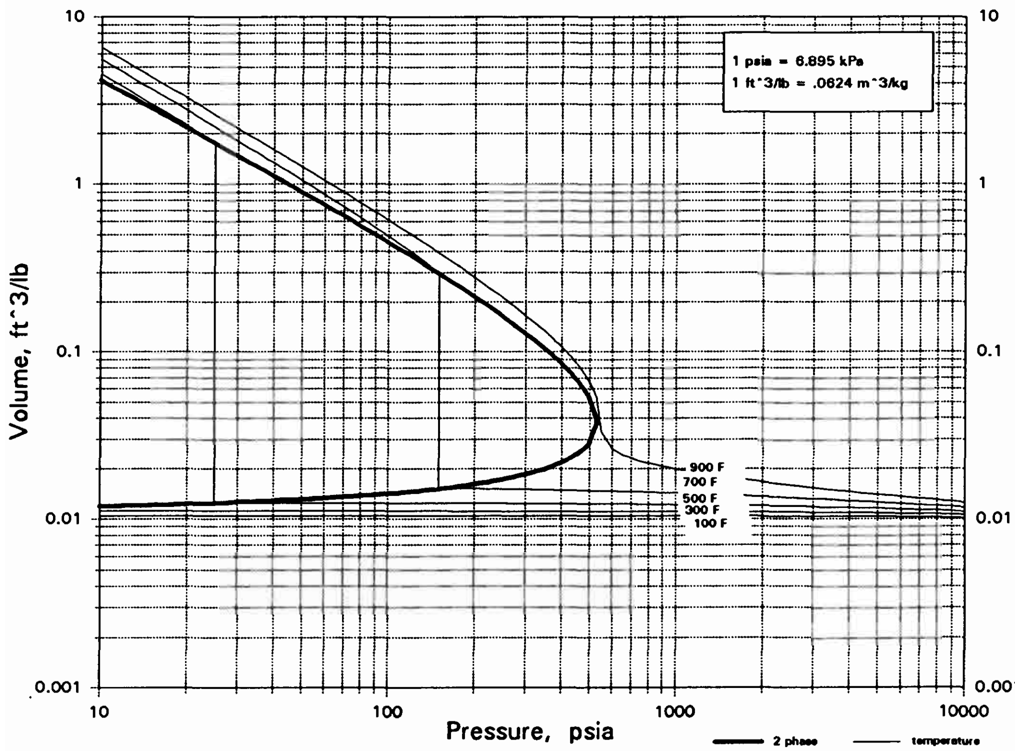


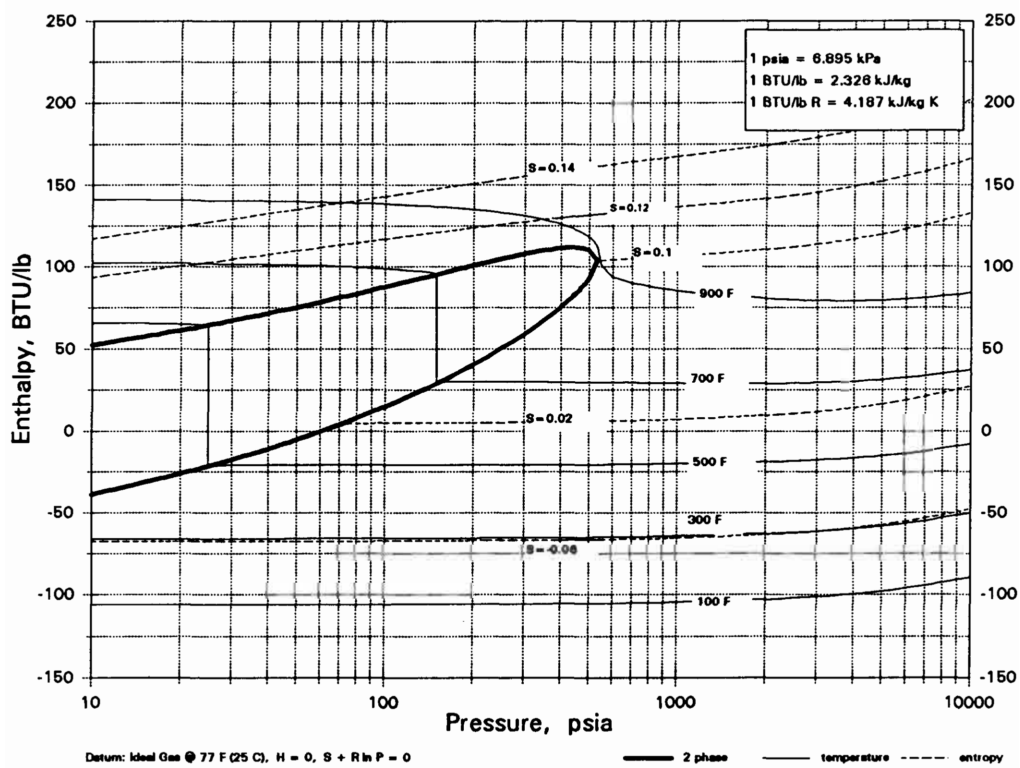
C3H10Si TRIMETHYL SILANE



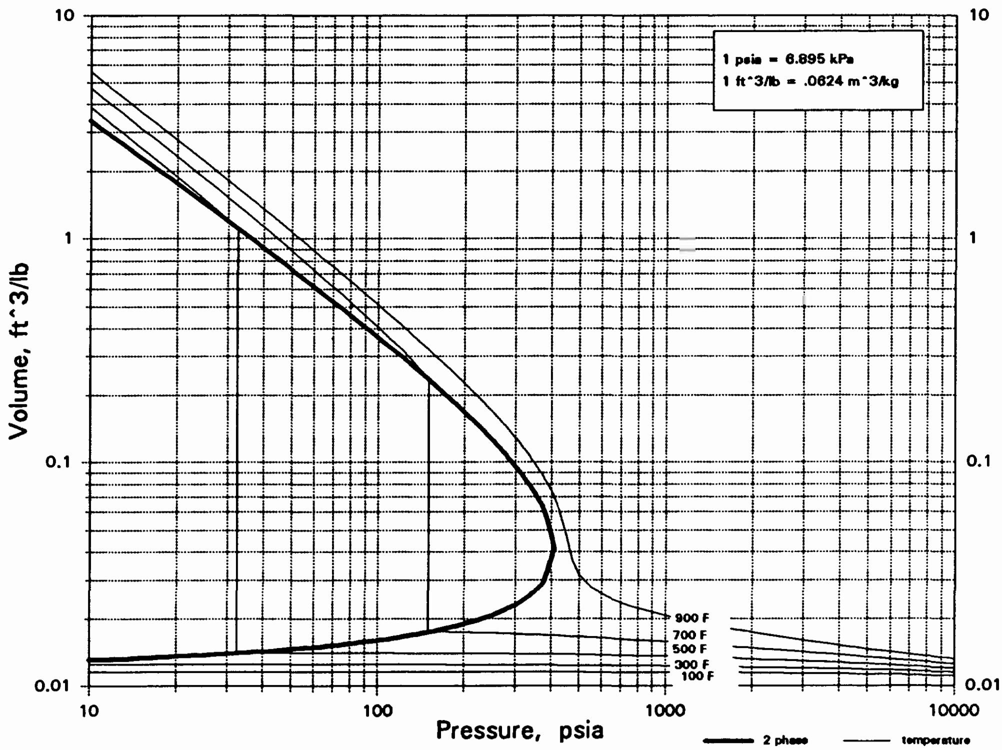


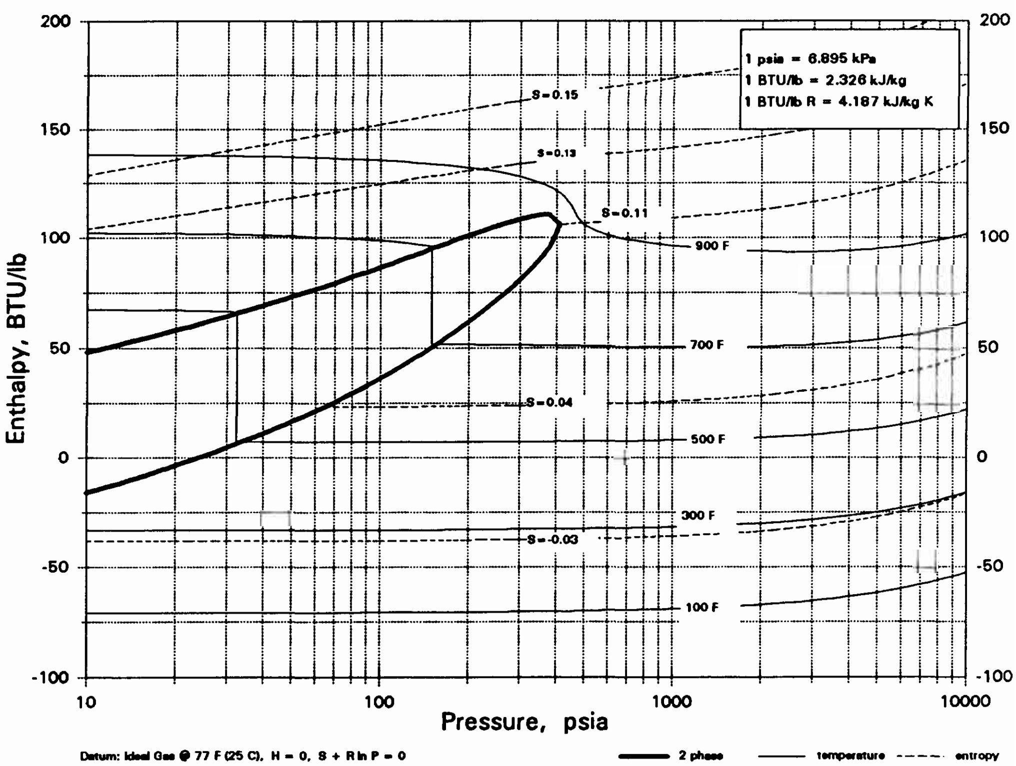
C4Cl4S TETRACHLOROTHIOPHENE



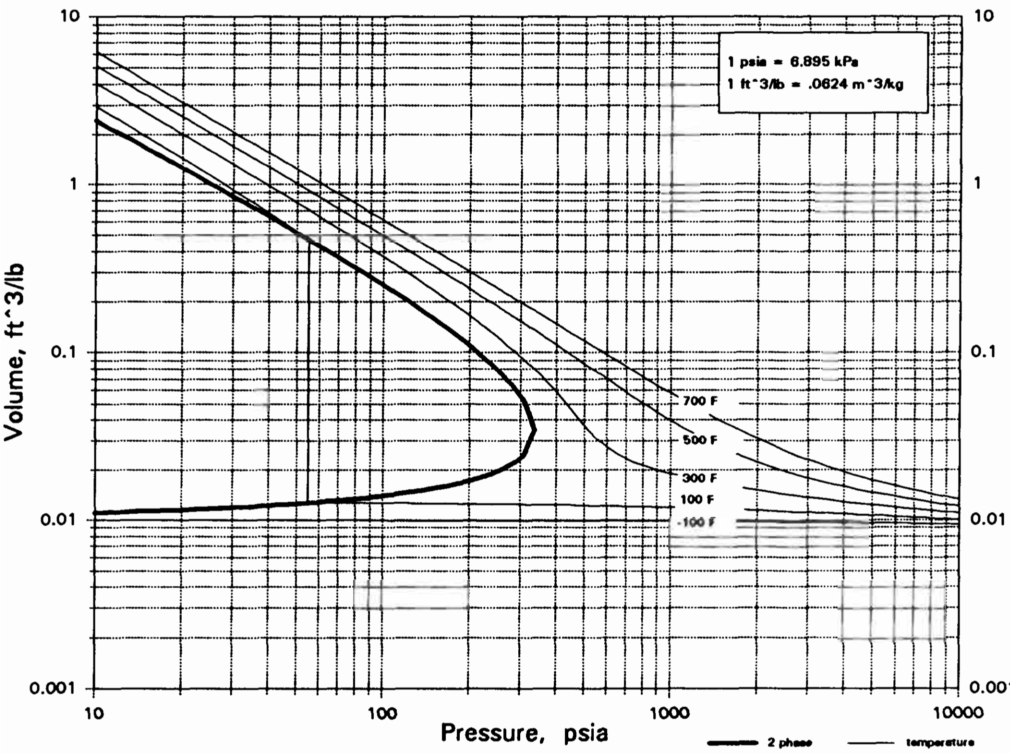


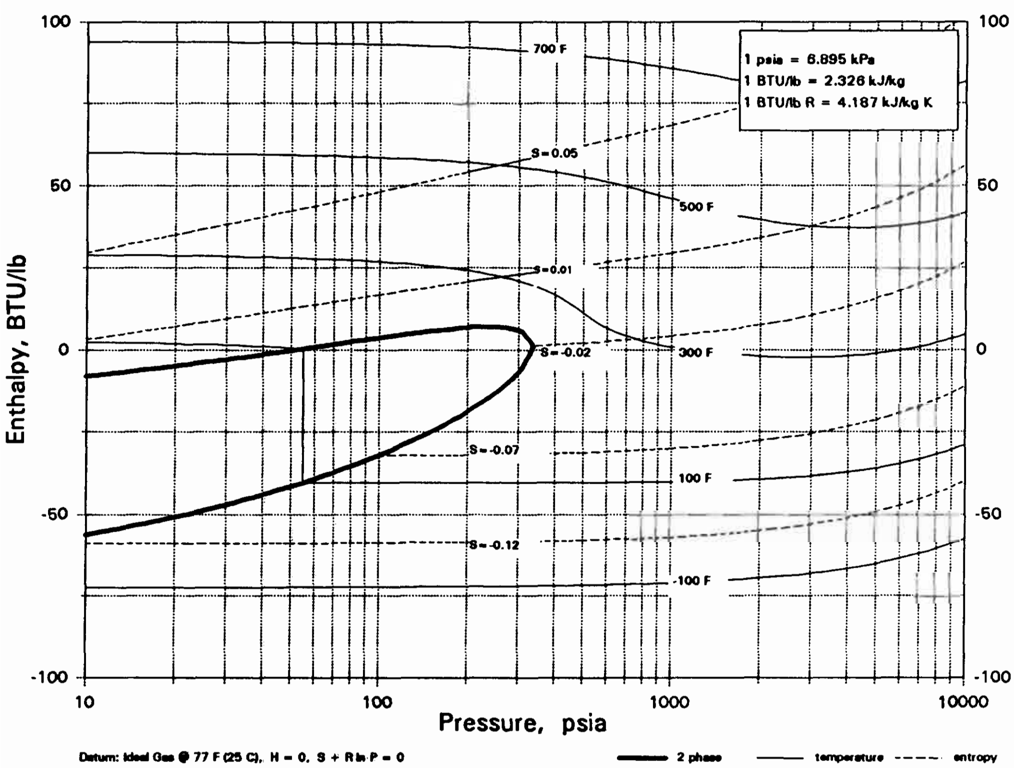
C4Cl6 HEXACHLORO-1-3-BUTADIENE



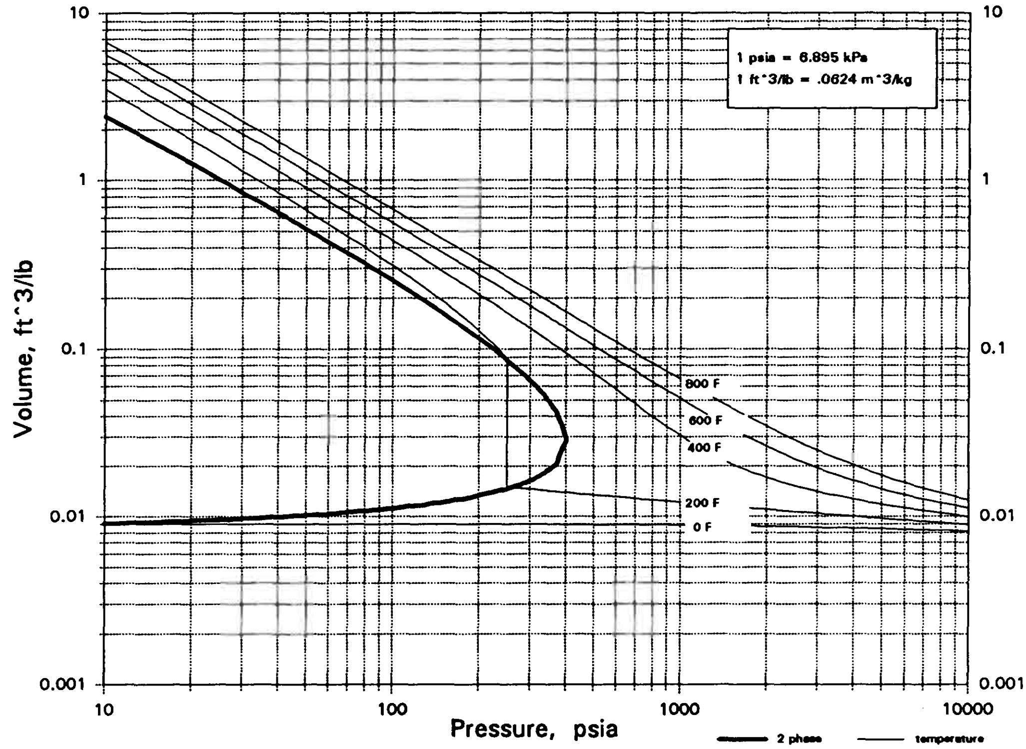


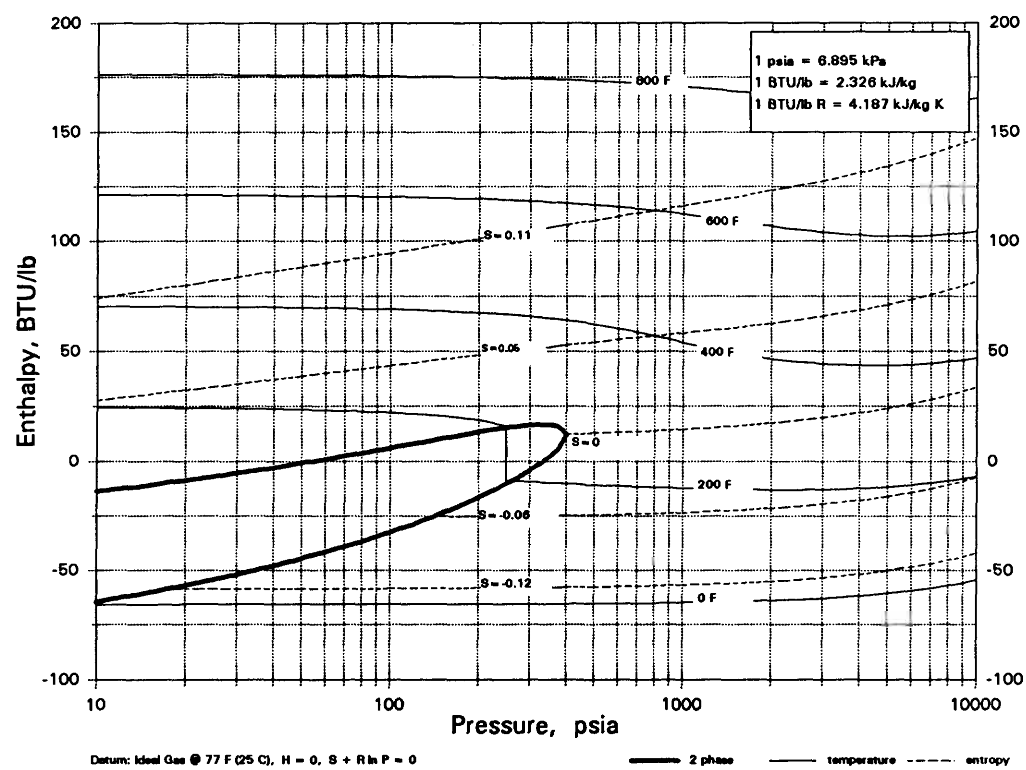
C4F8 OCTAFLUORO-2-BUTENE



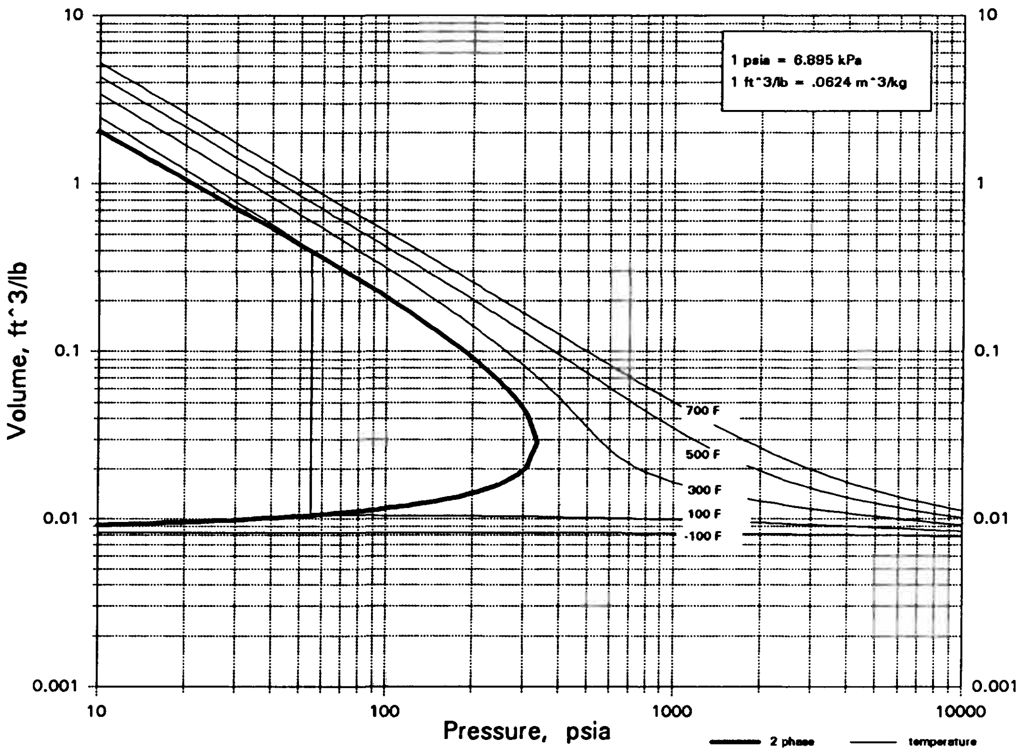


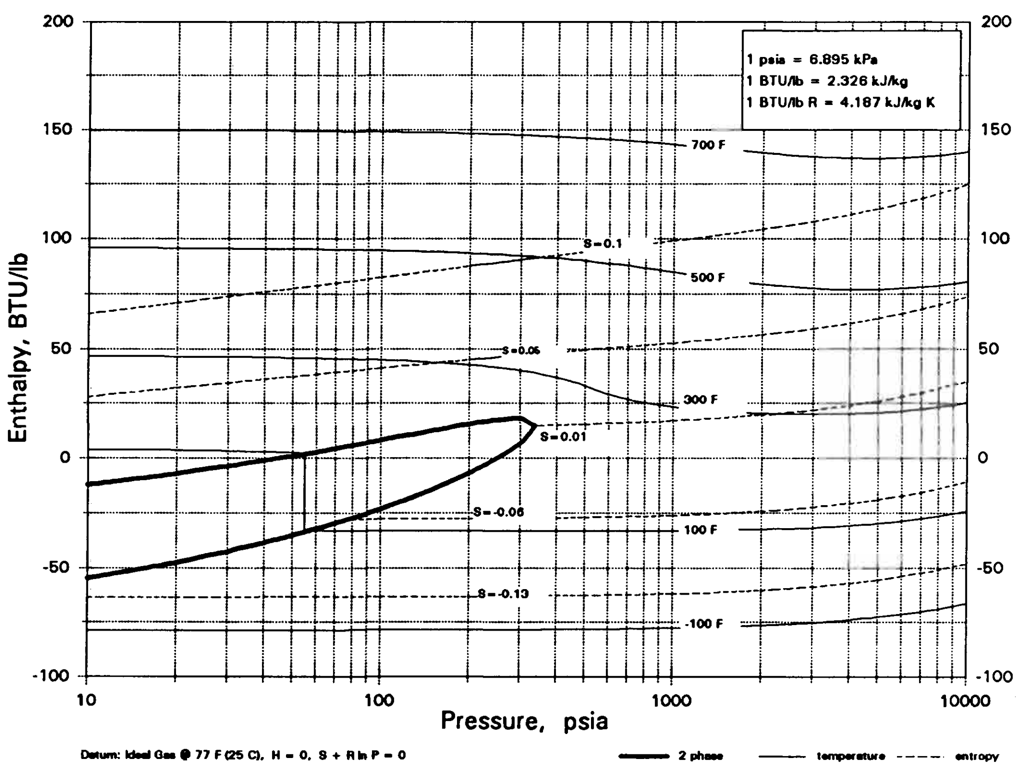
C4F8 OCTAFLUOROCYCLOBUTANE



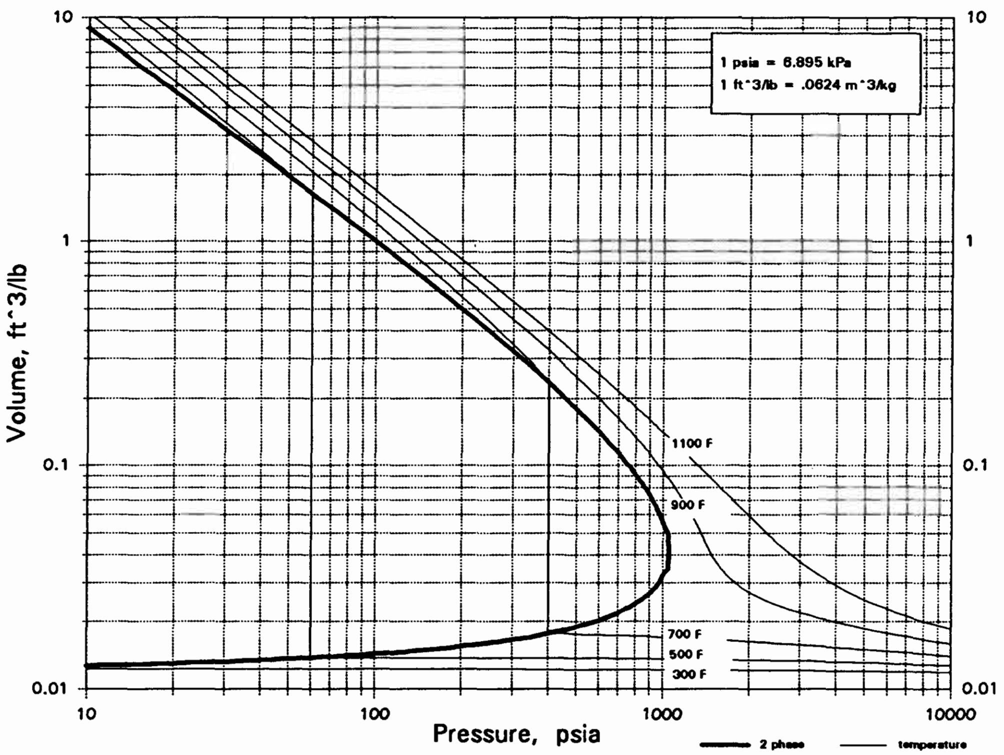


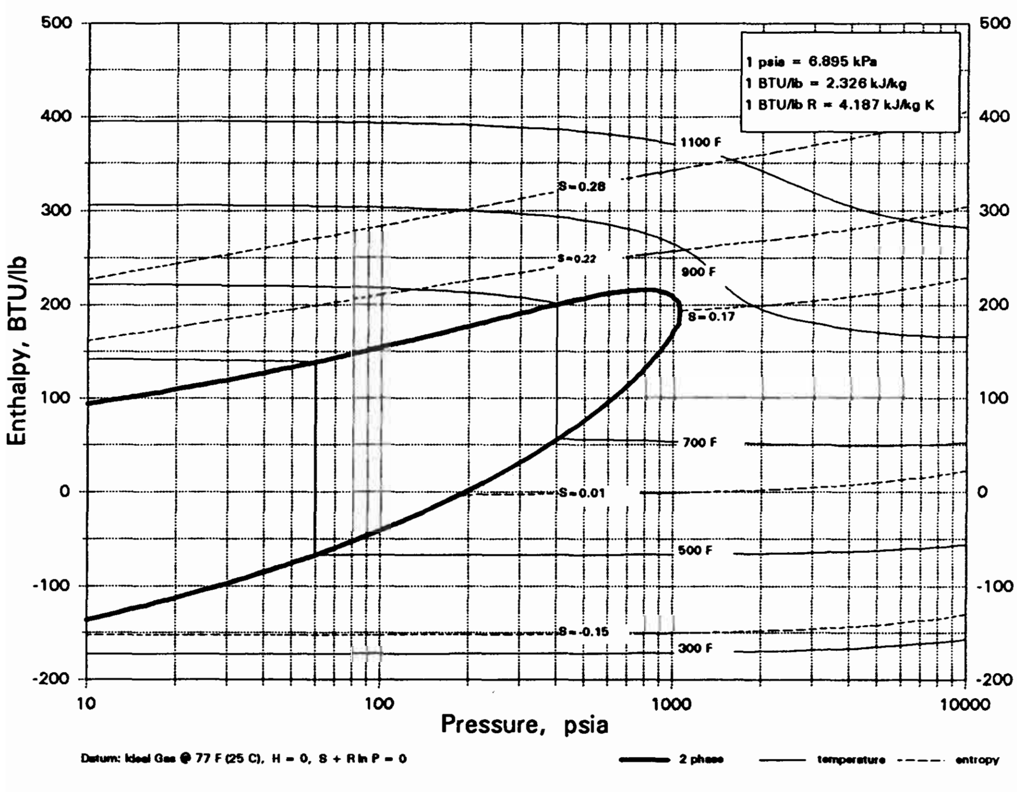
C4F10 DECAFLUOROBUTANE



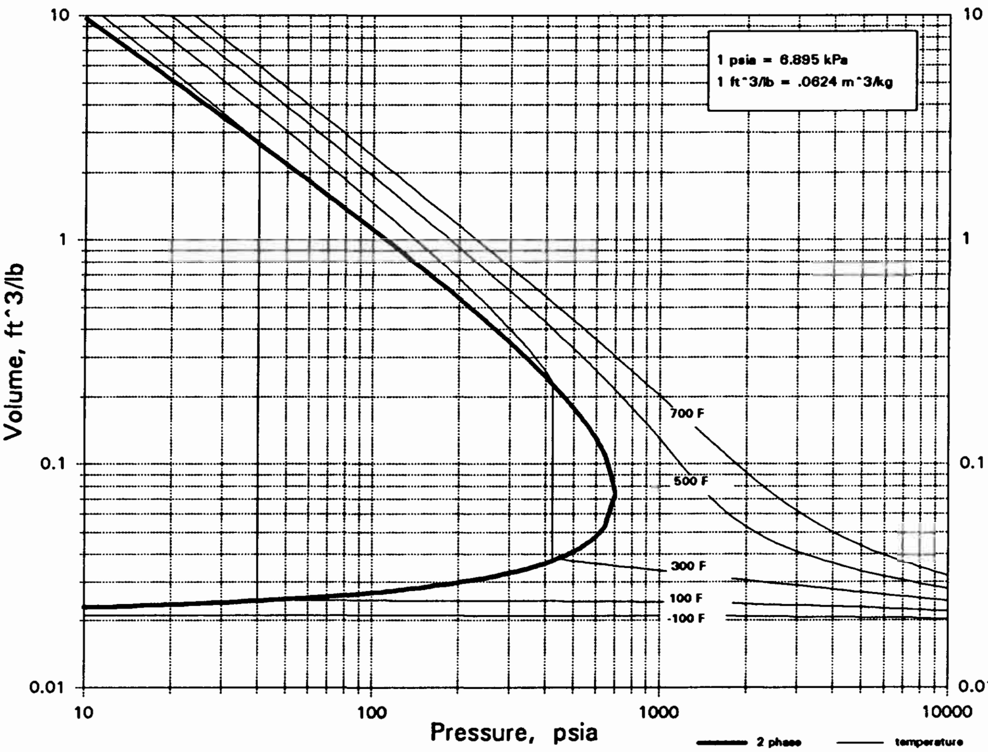


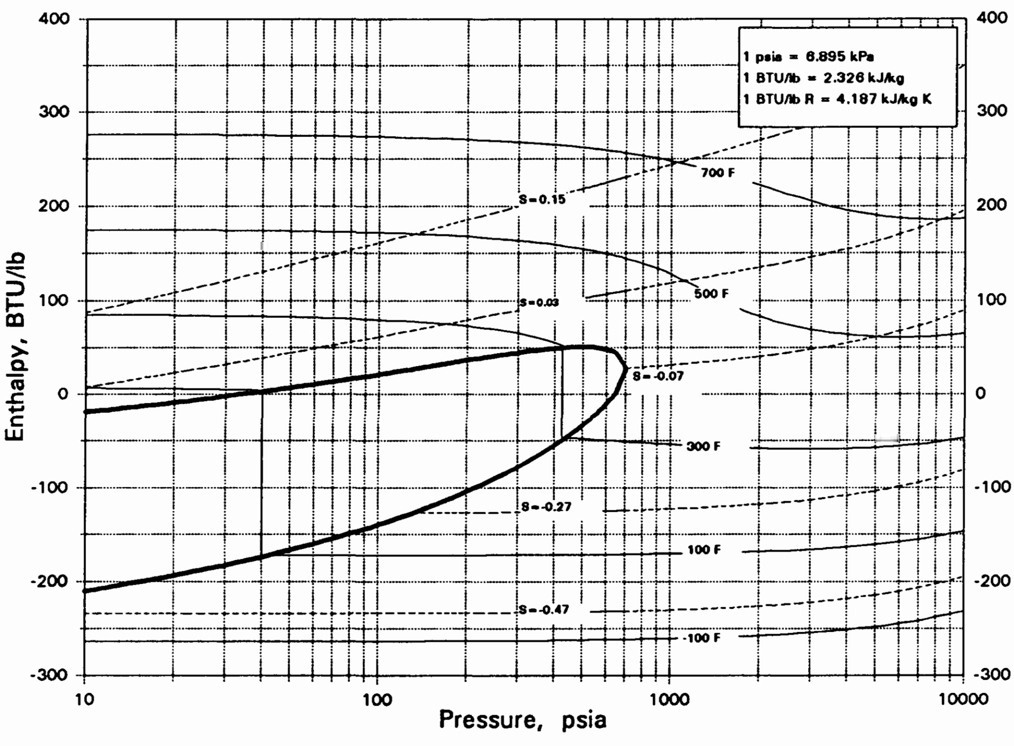
C4H2O3 MALEIC ANHYDRIDE



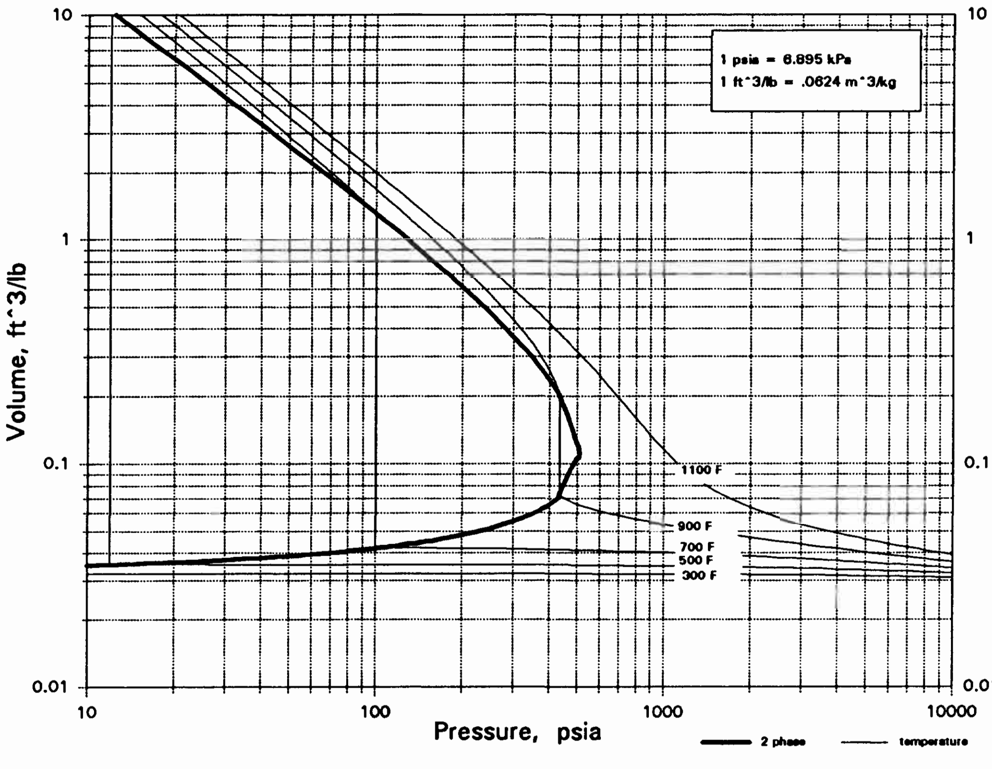


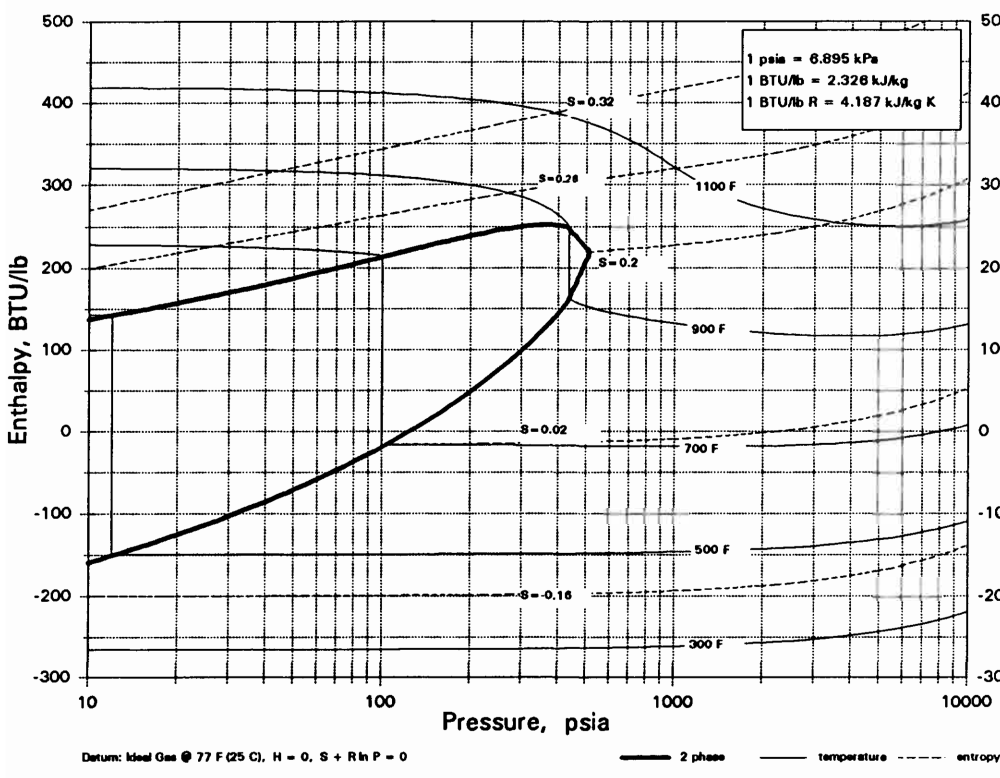
C4H4 VINYLACETYLENE



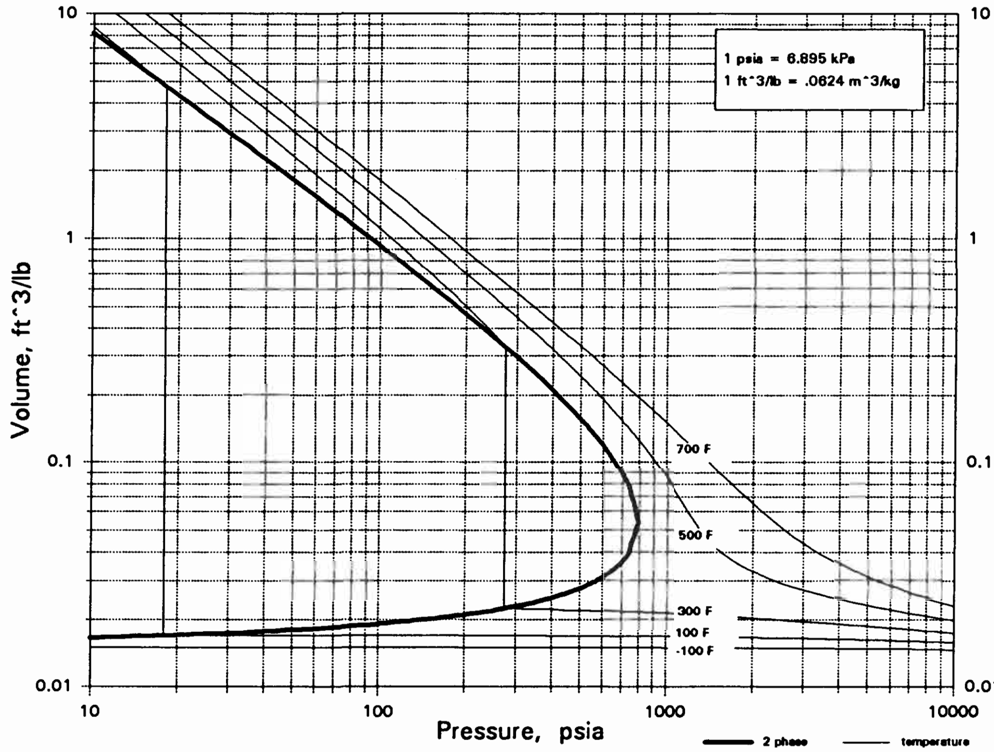


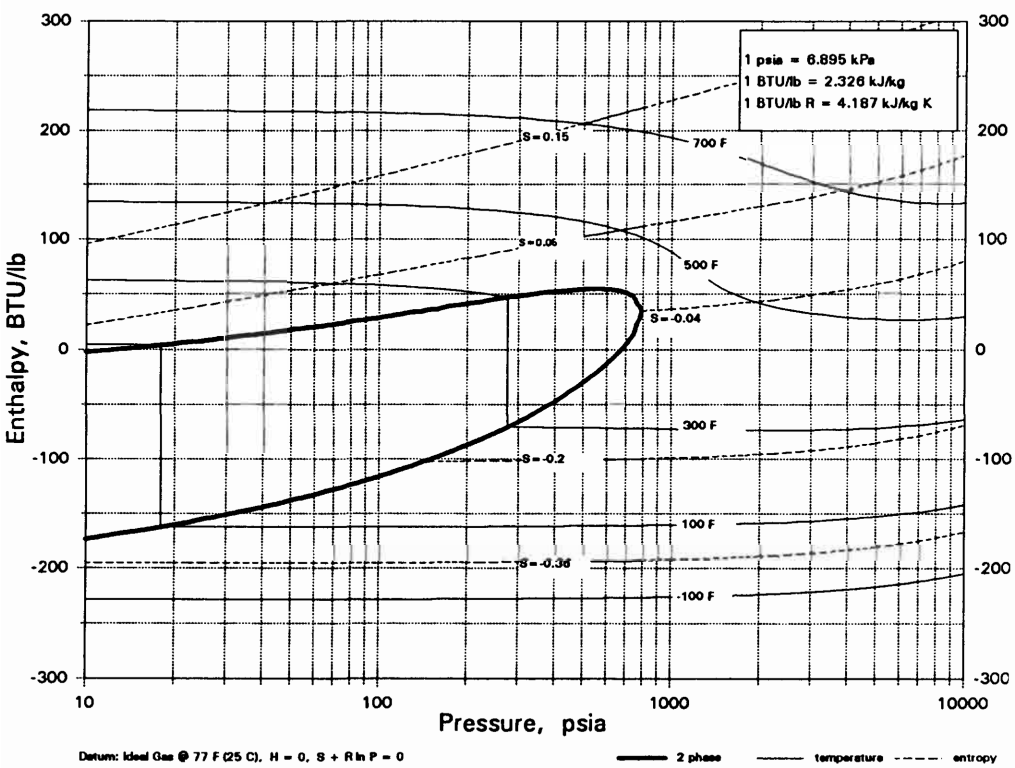
C4H4N2 SUCCINONITRILE





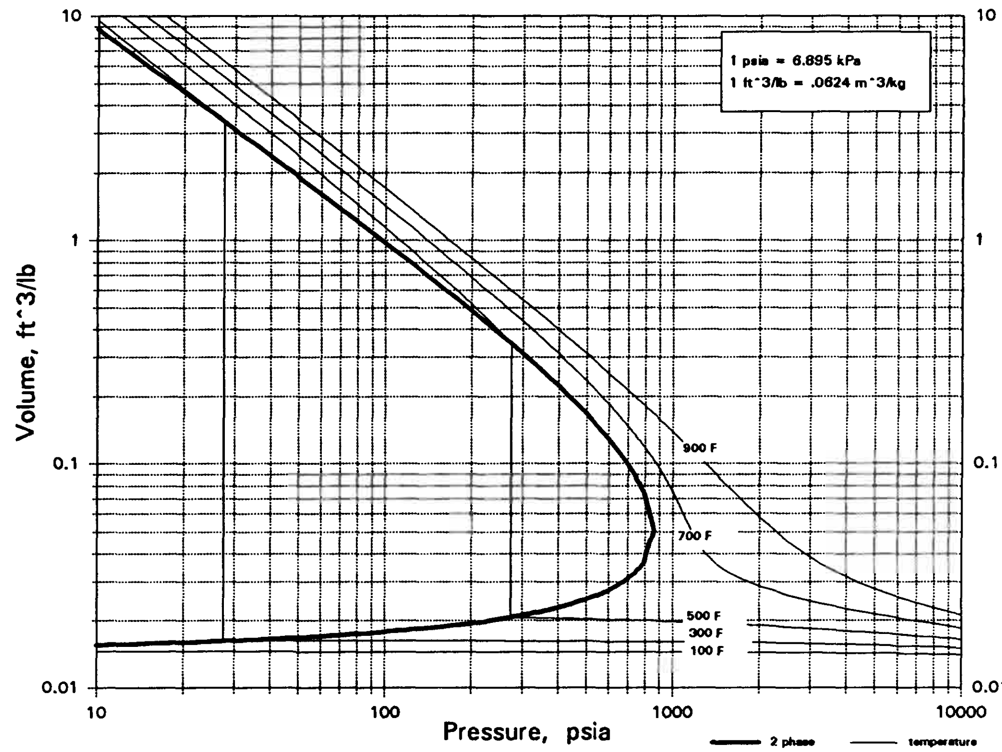
C4H4O FURAN

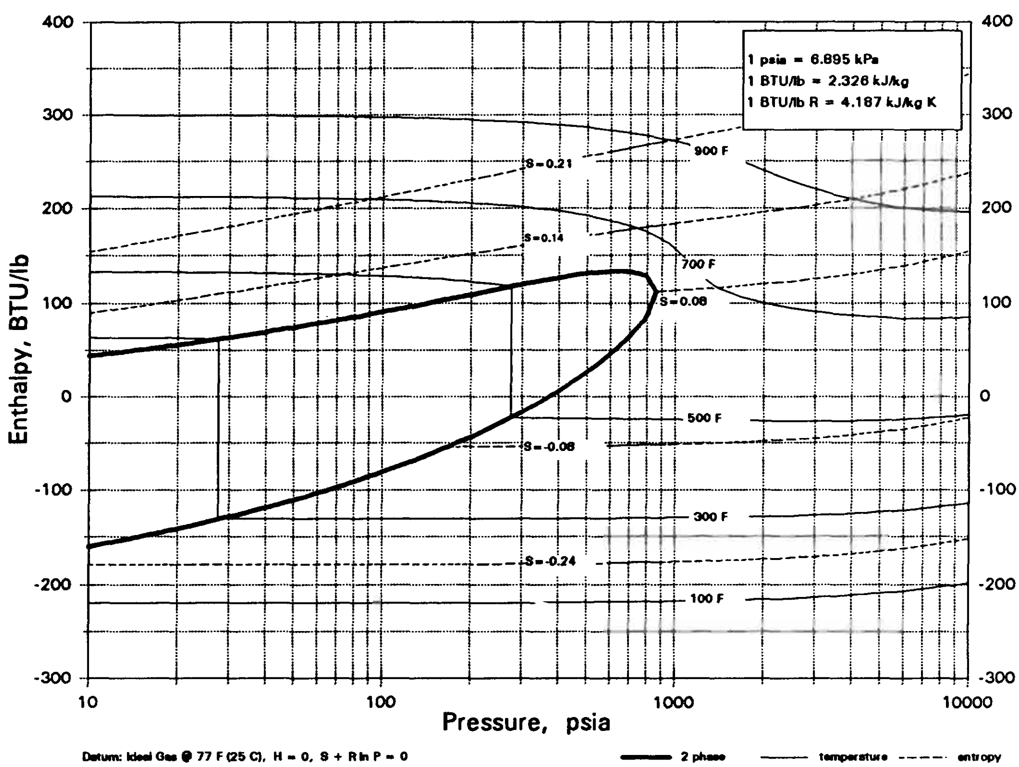




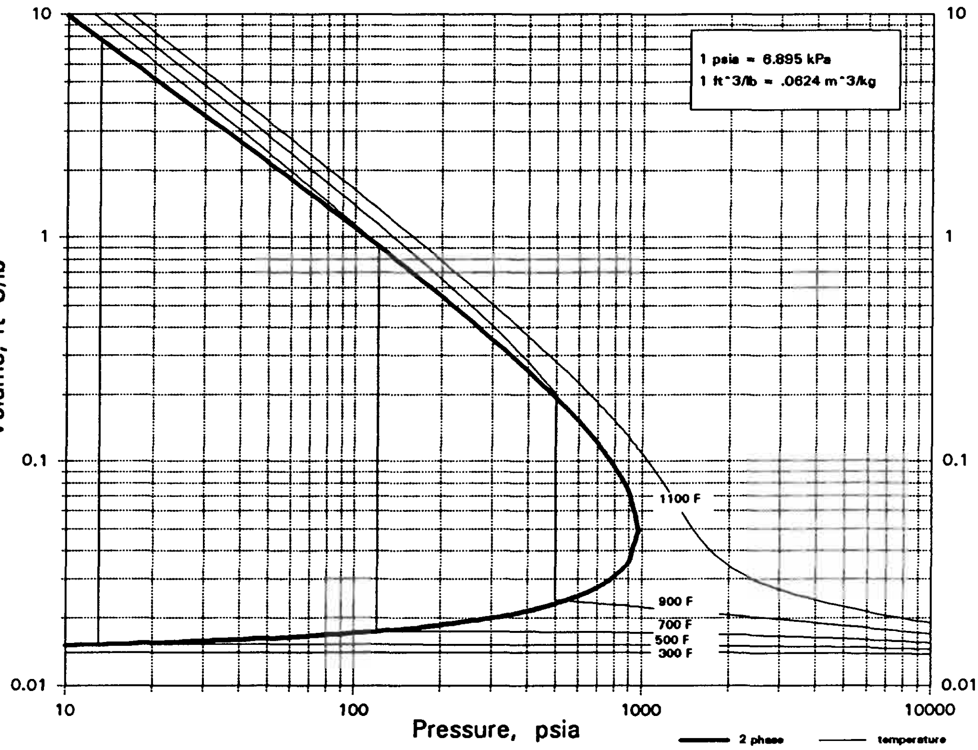
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

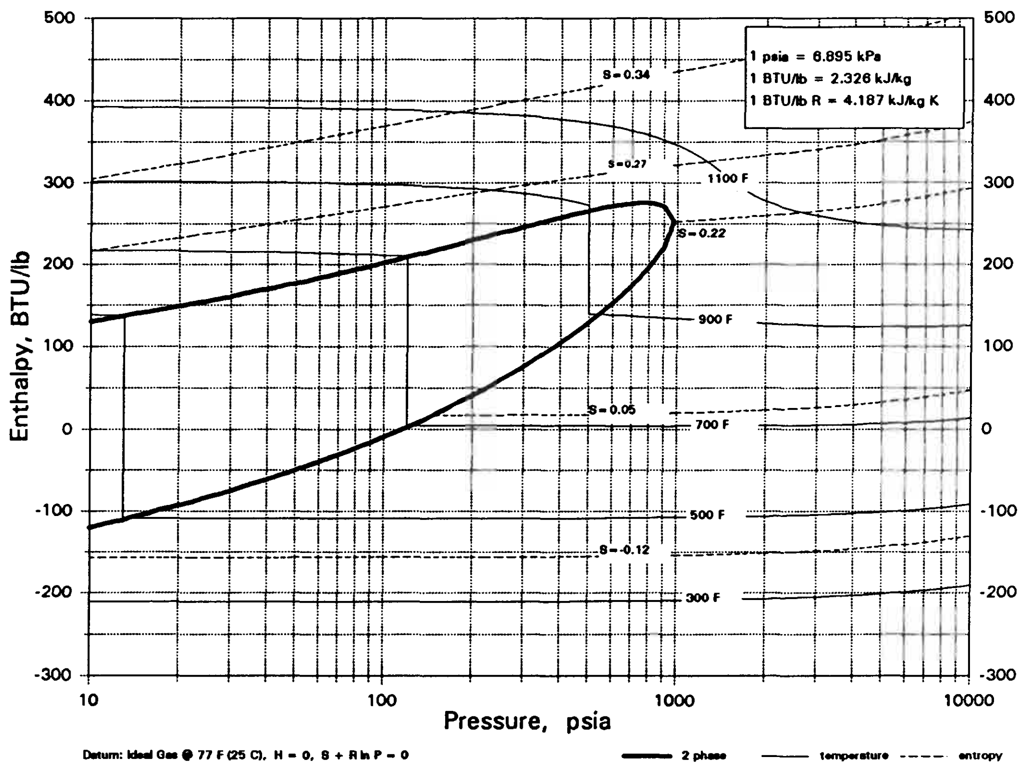
C4H4O2 DIKETENE



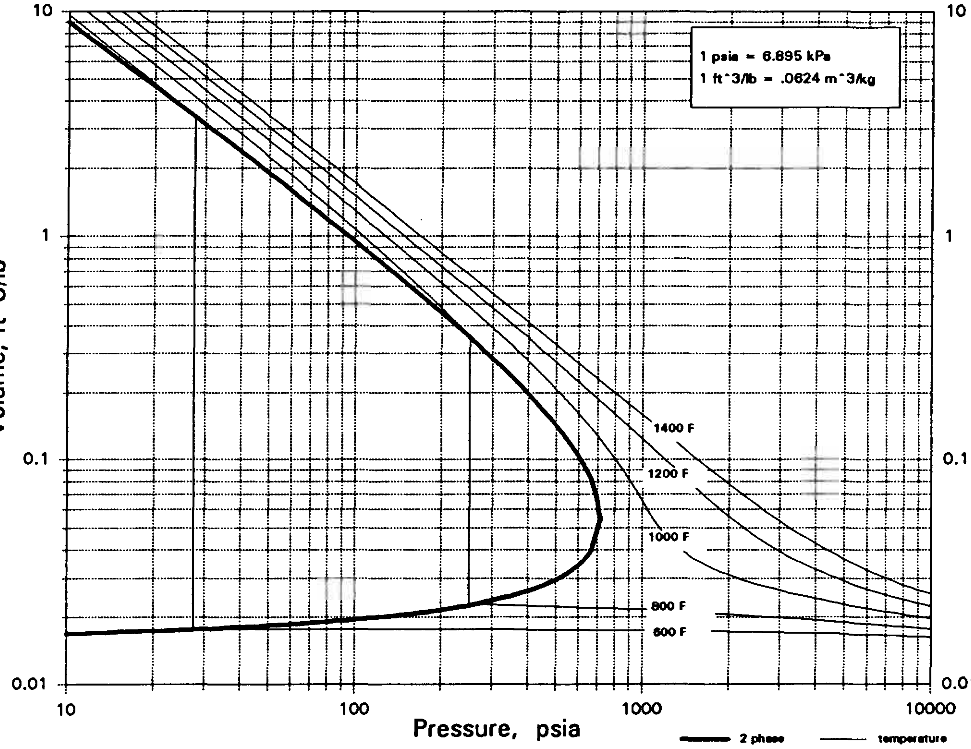


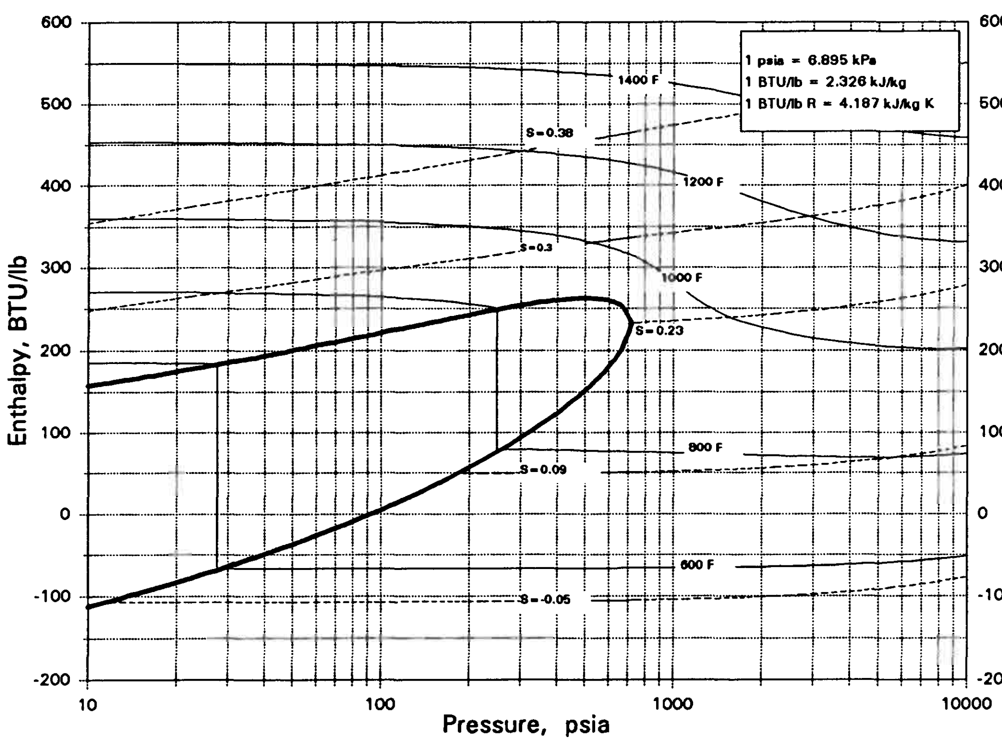
C4H4O3	SUCCINIC ANHYDRIDE



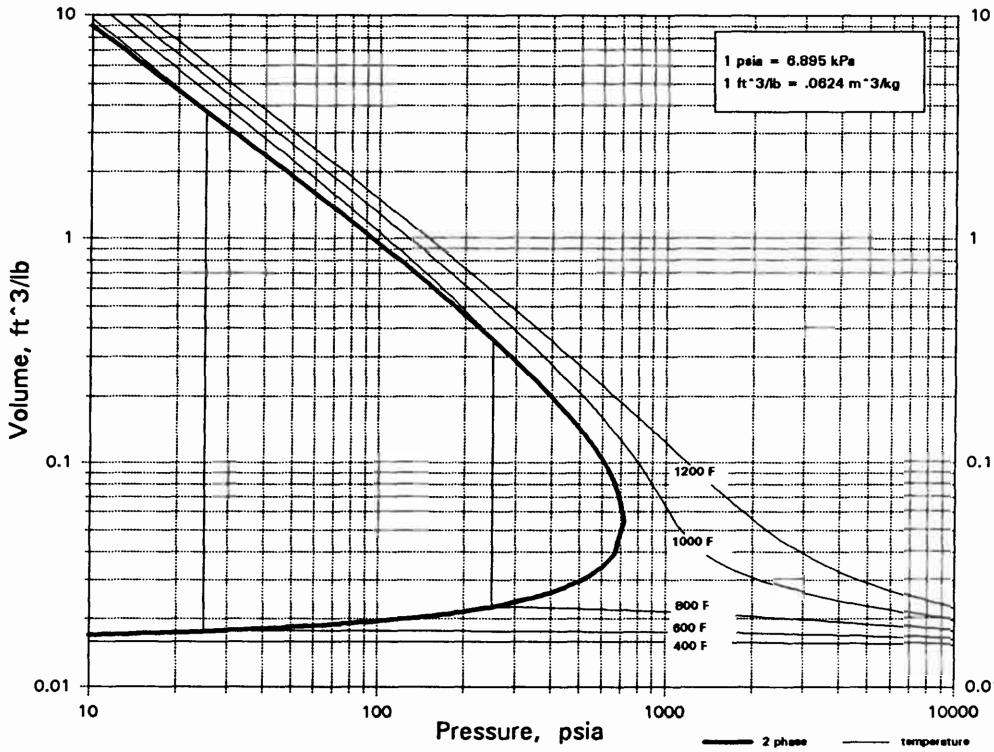


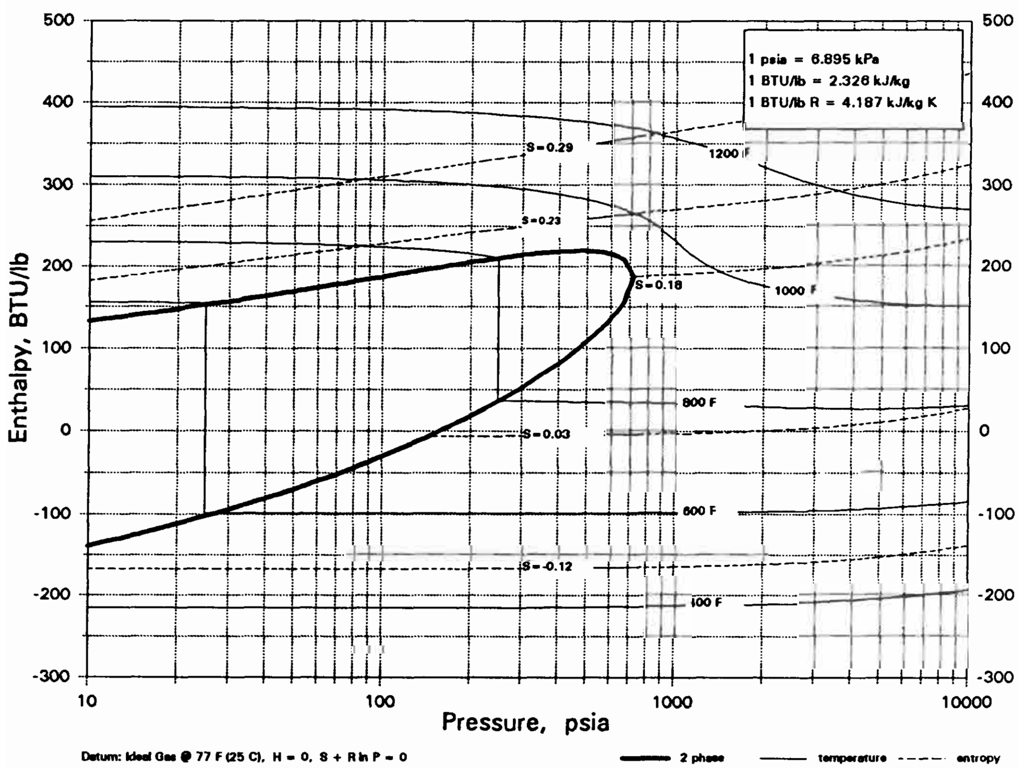
C4H4O4 FUMARIC ACID



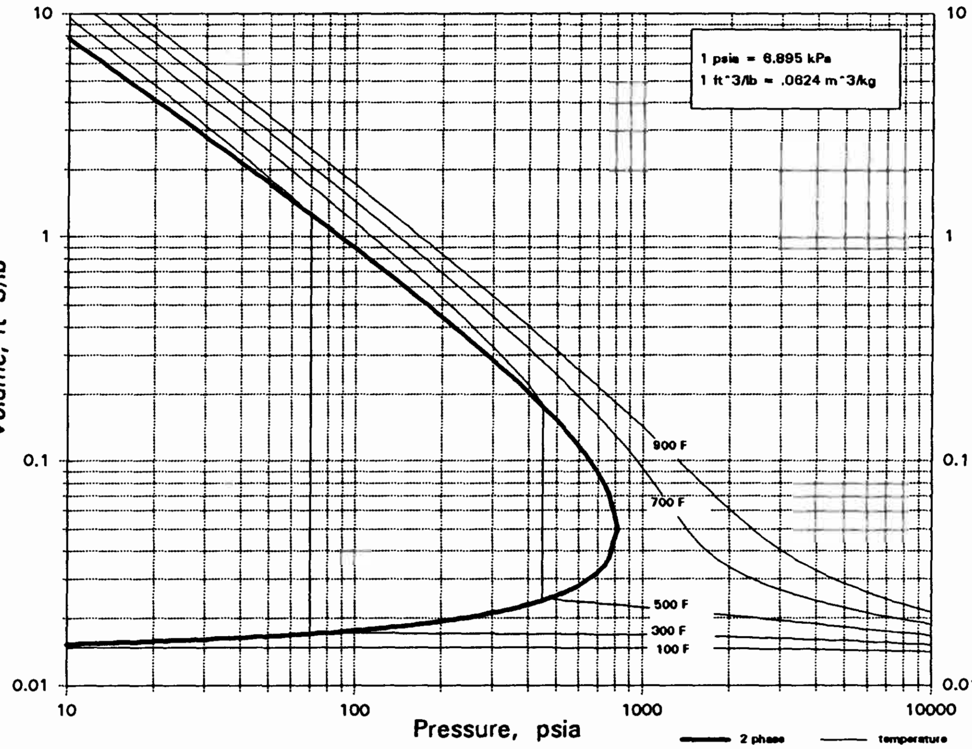


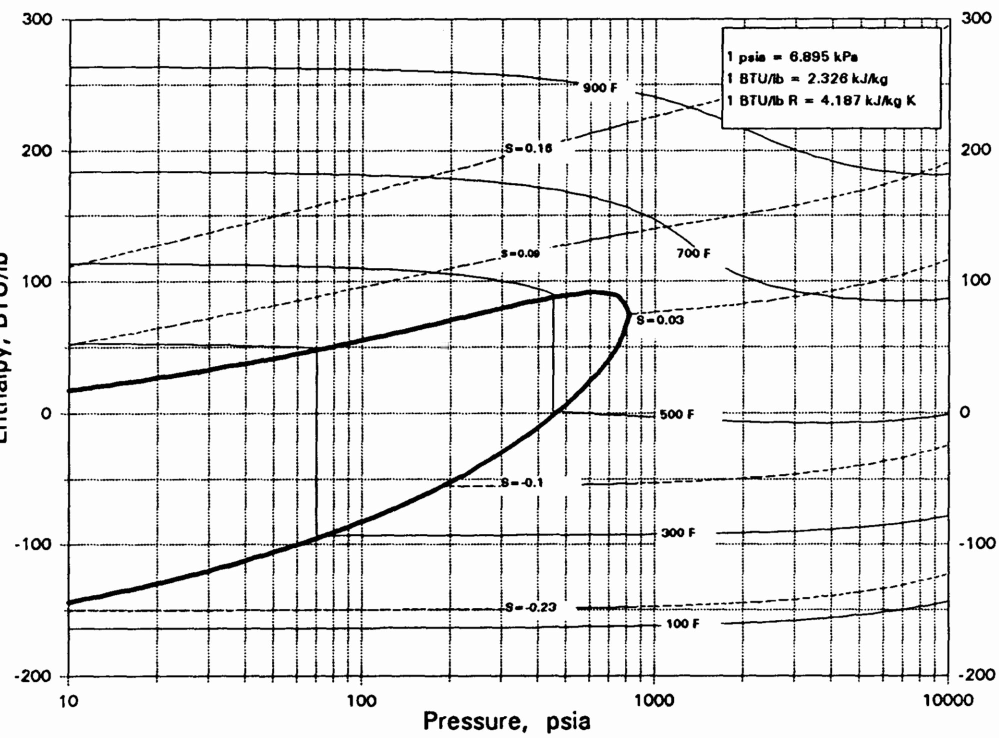
C4H4O4 MALEIC ACID





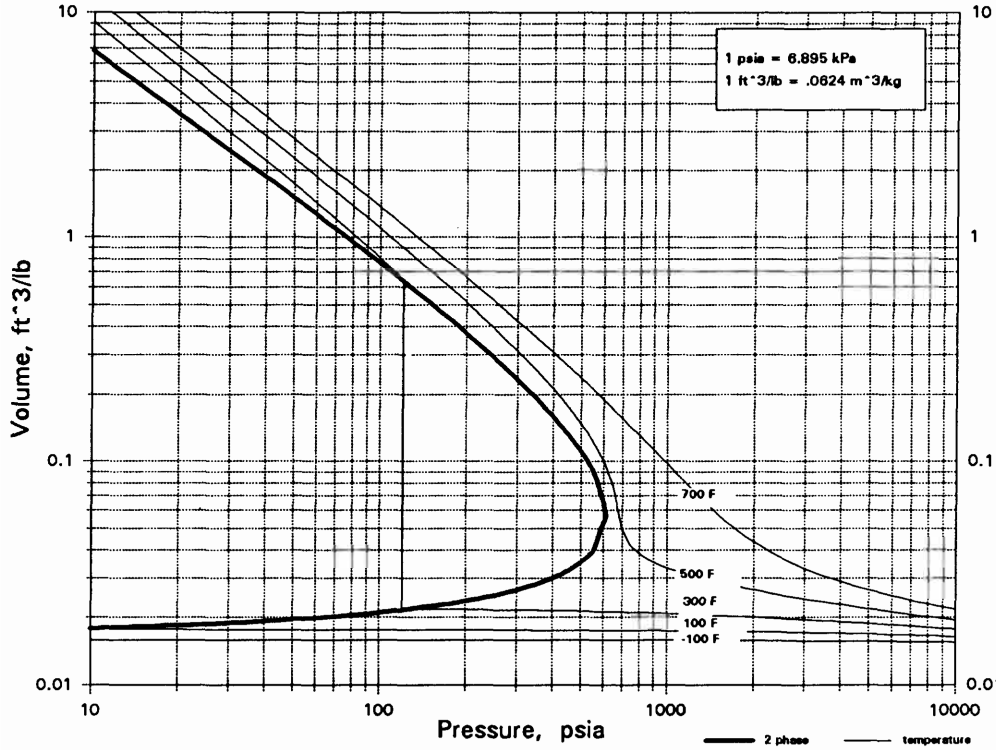
C4H4S THIOPHENE

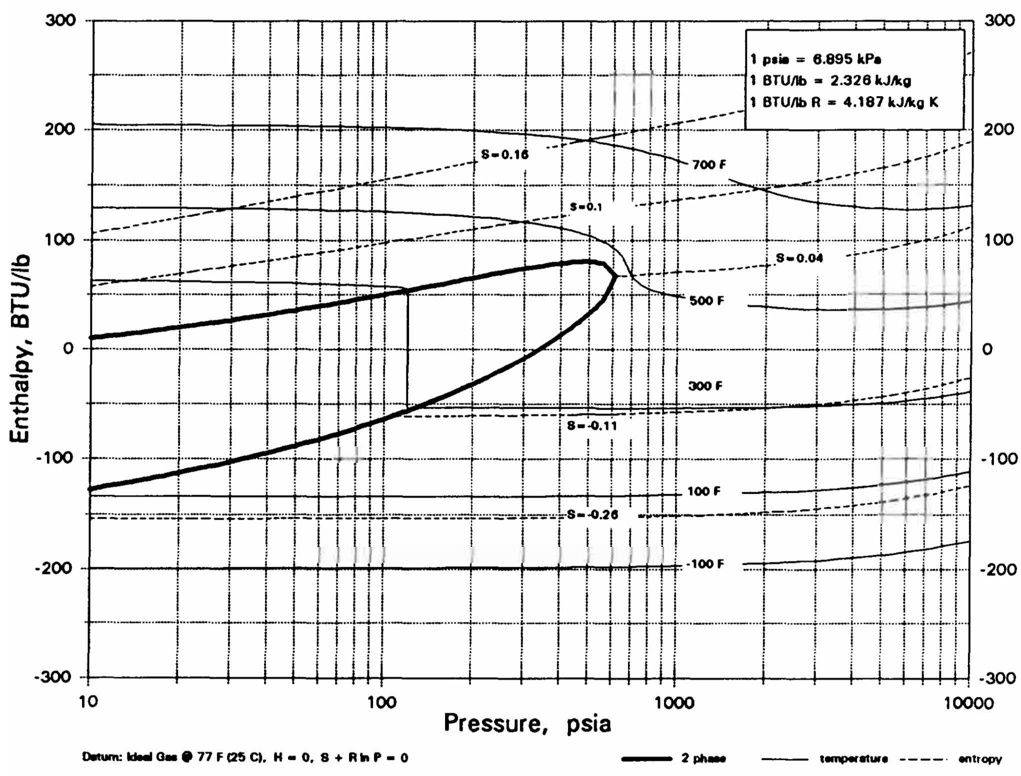




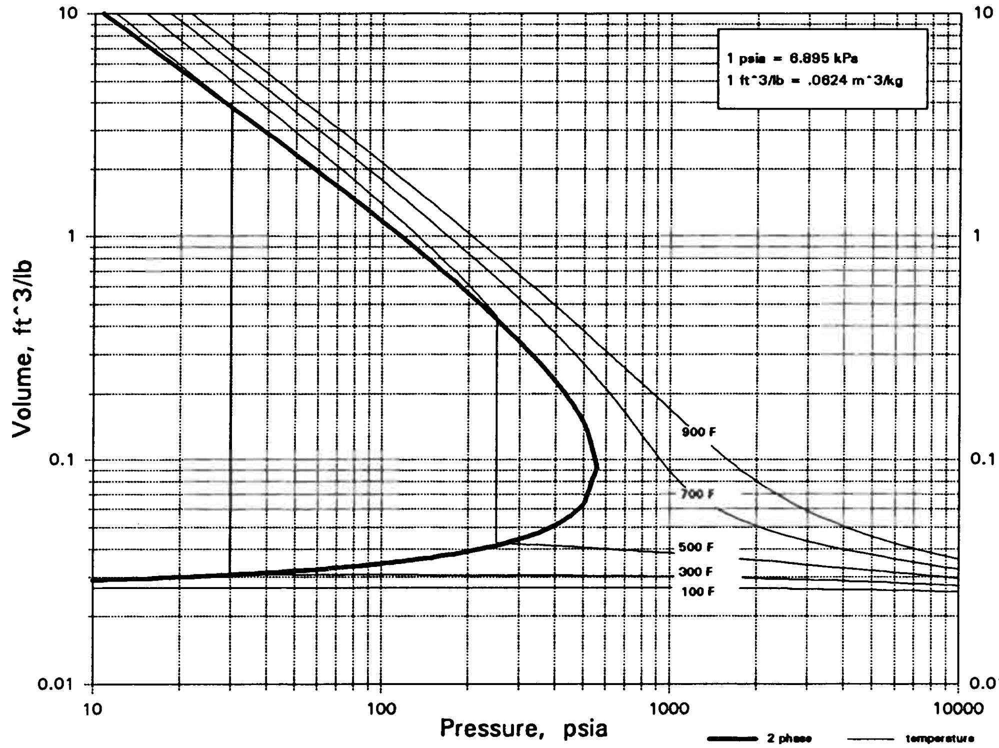
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

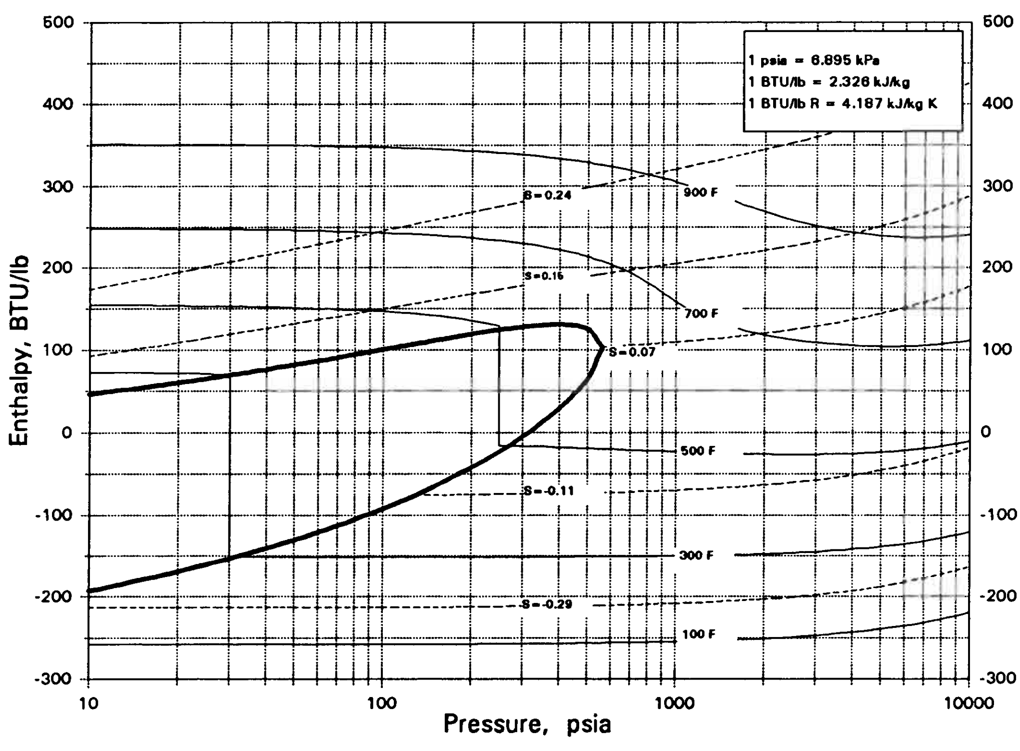
C_4H_5Cl	CHLOROPRENE



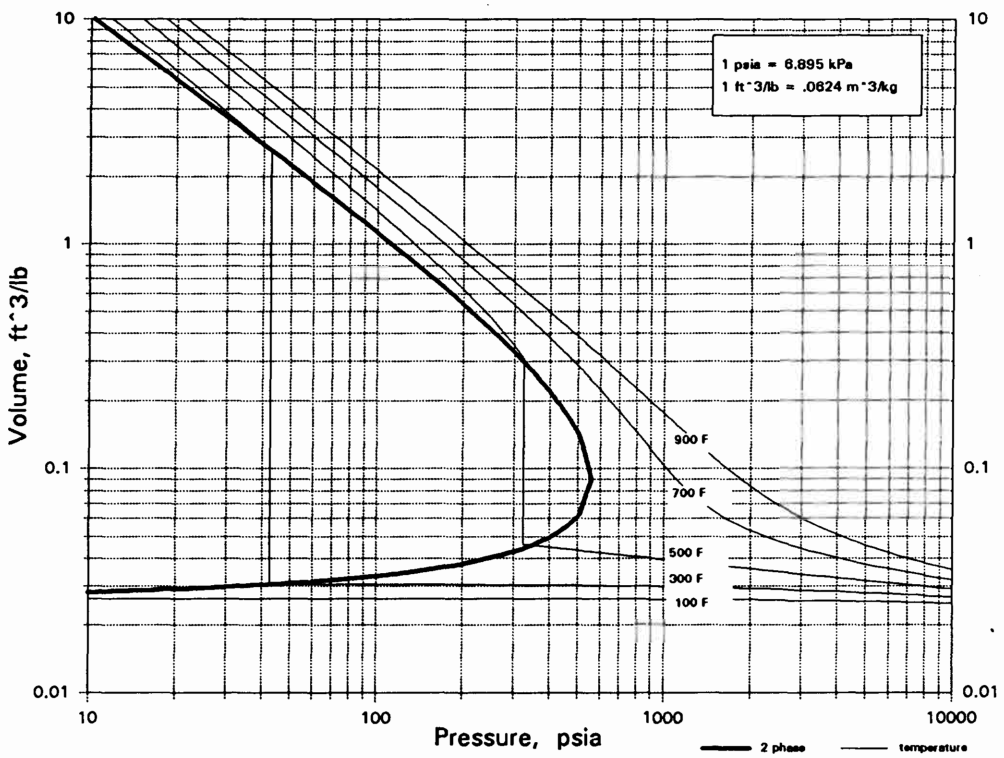


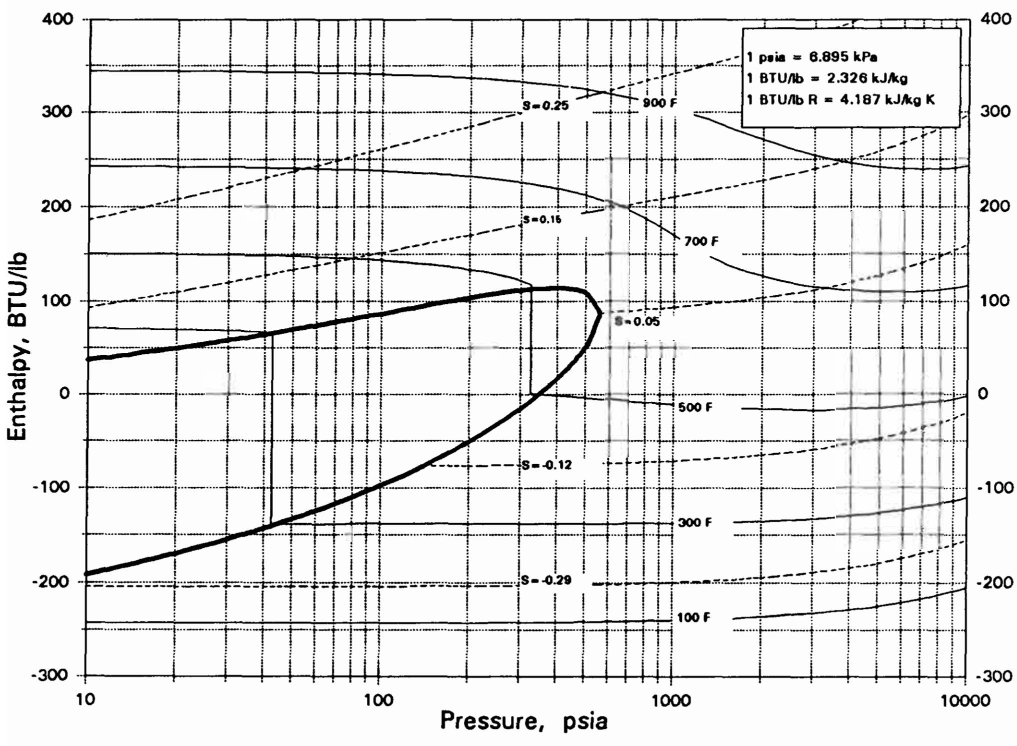
C4H5N trans-CROTONITRILE





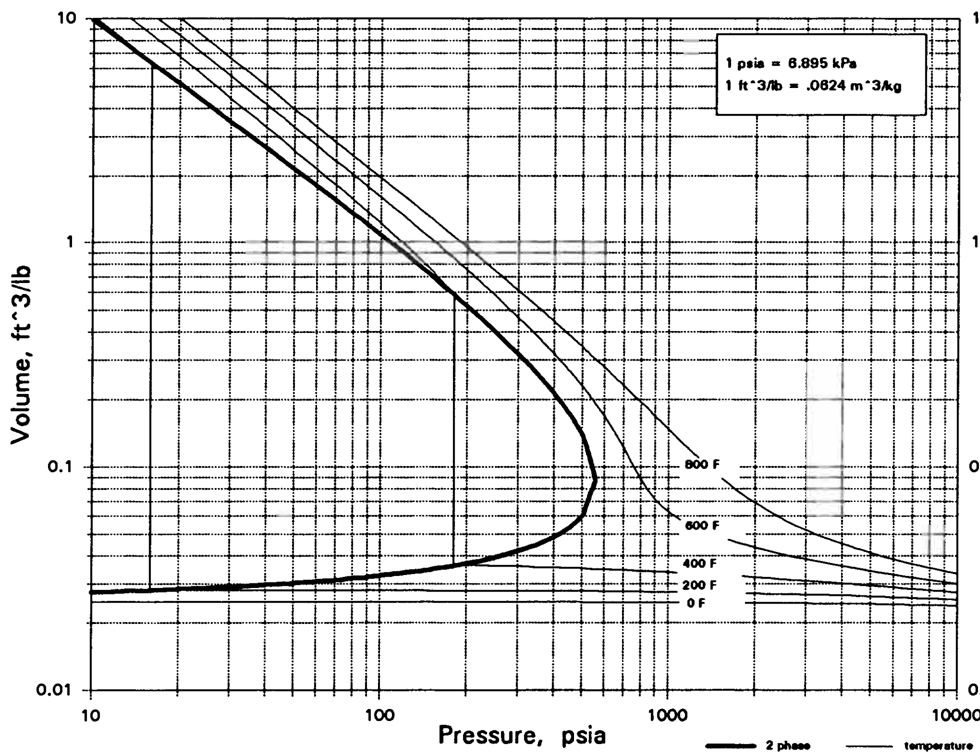
C4H5N cis-CROTONITRILE

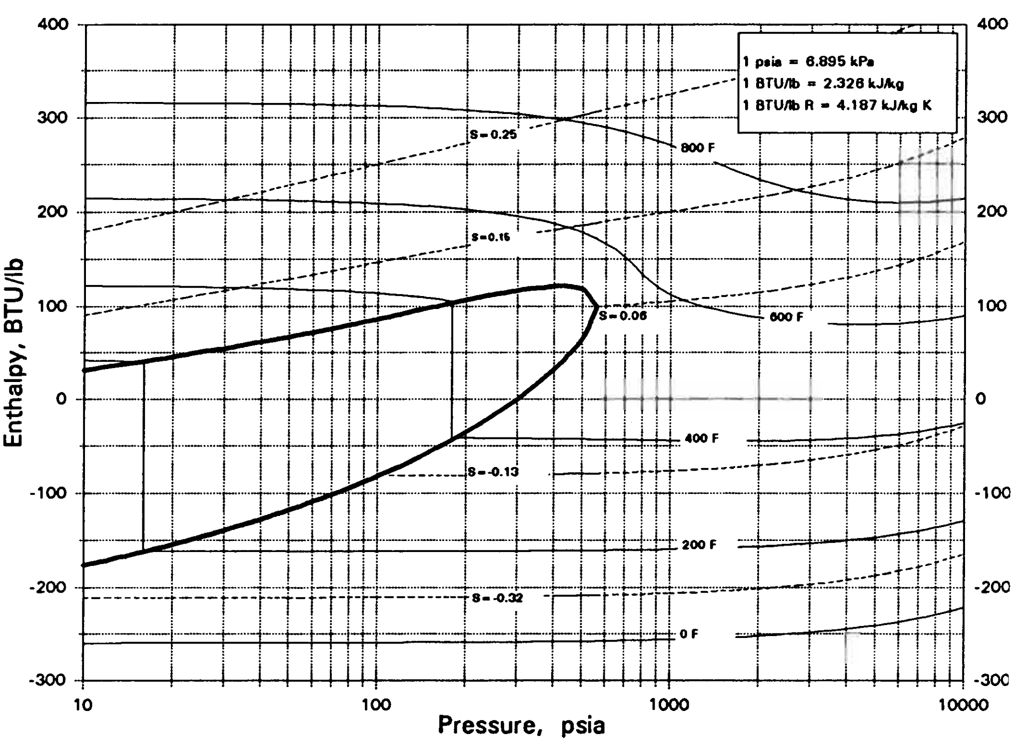




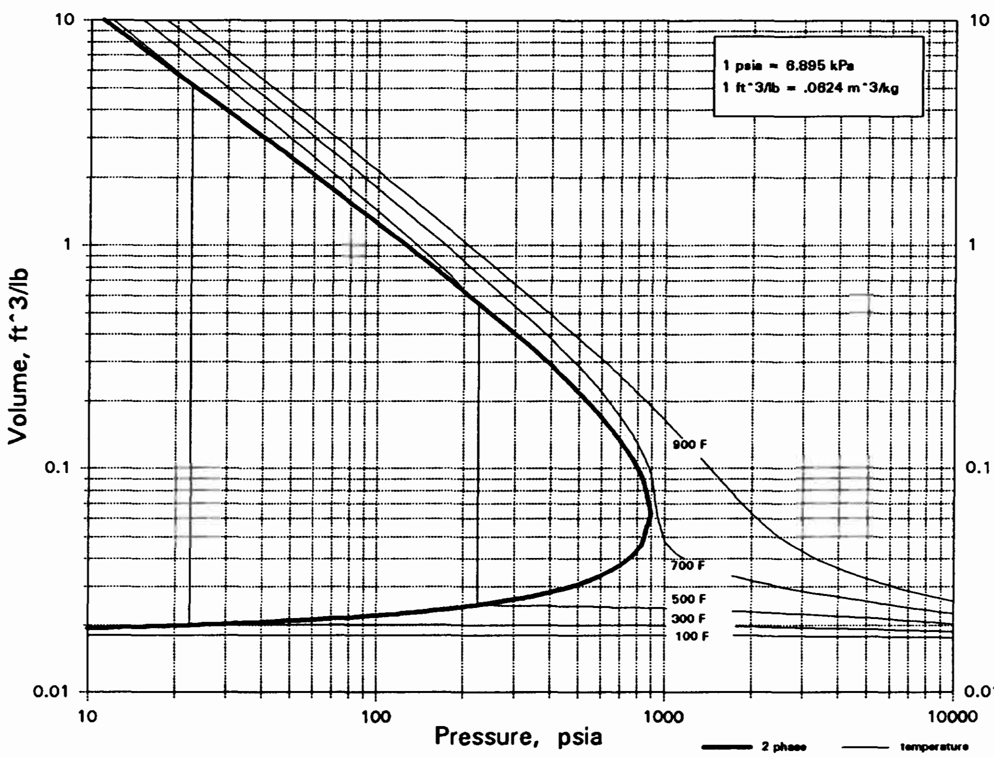
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

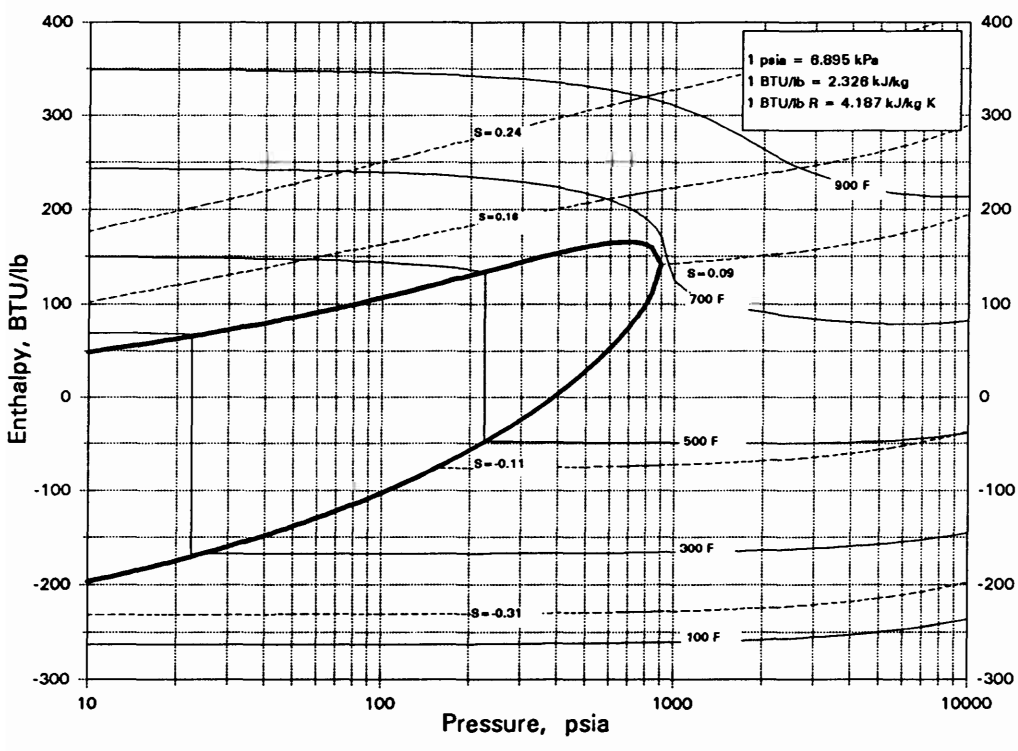
C4H5N METHACRYLONITRILE



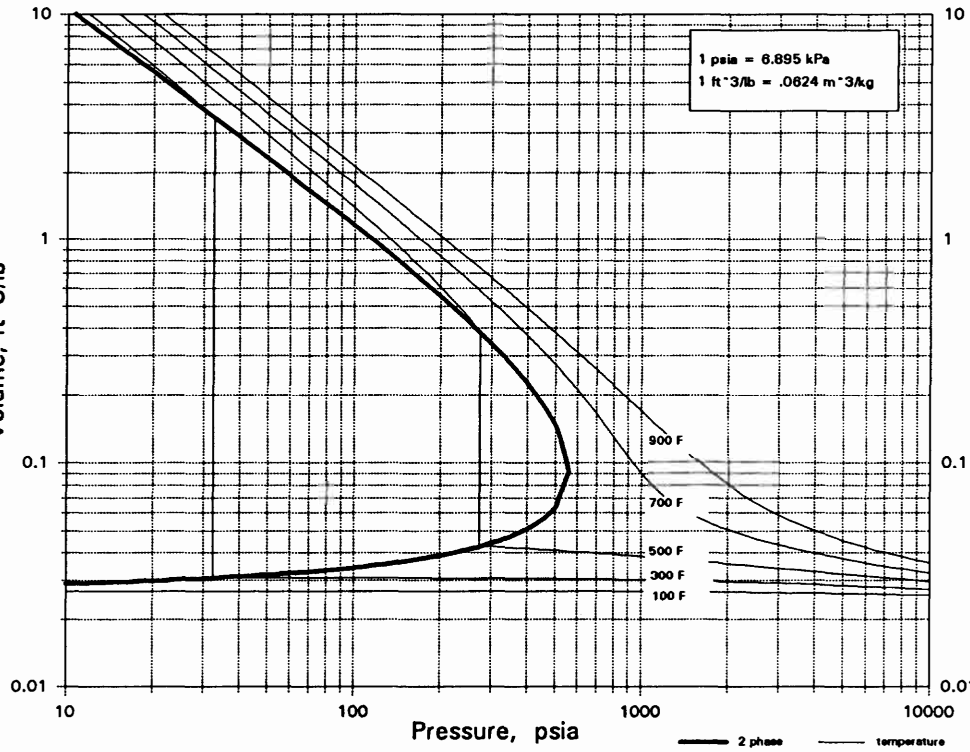


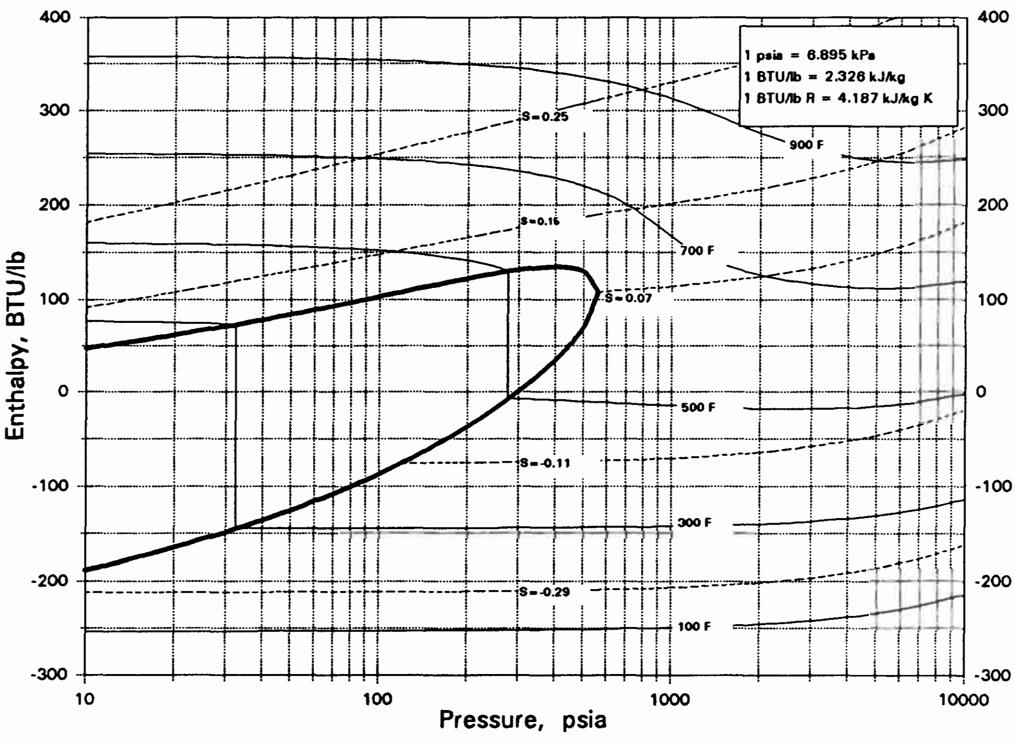
C4H5N PYRROLE



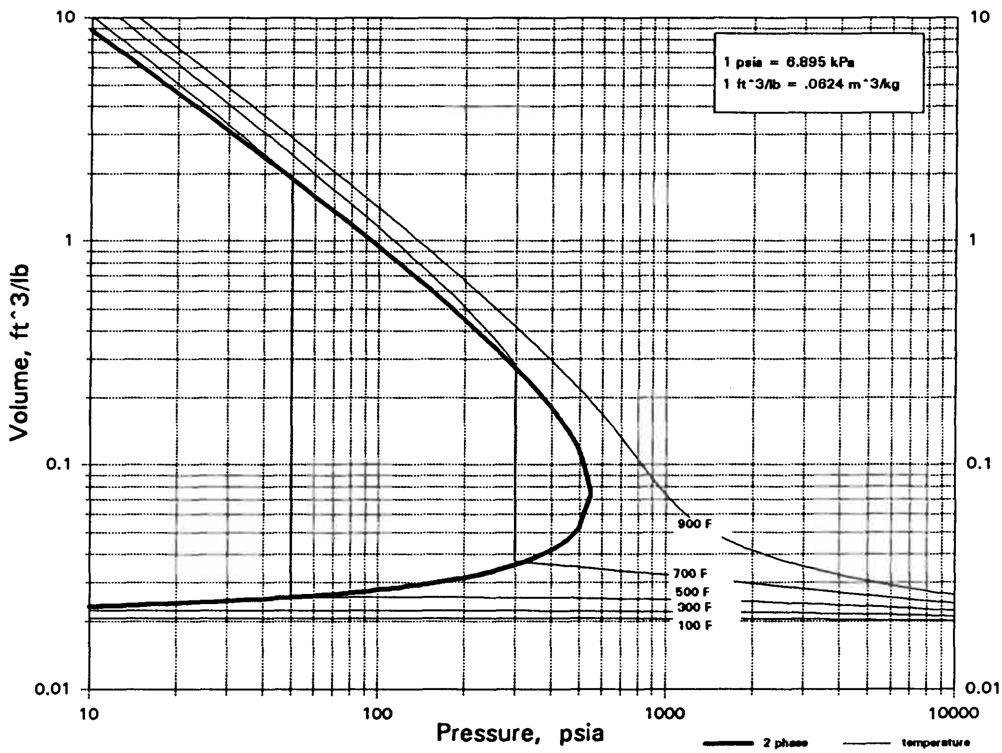


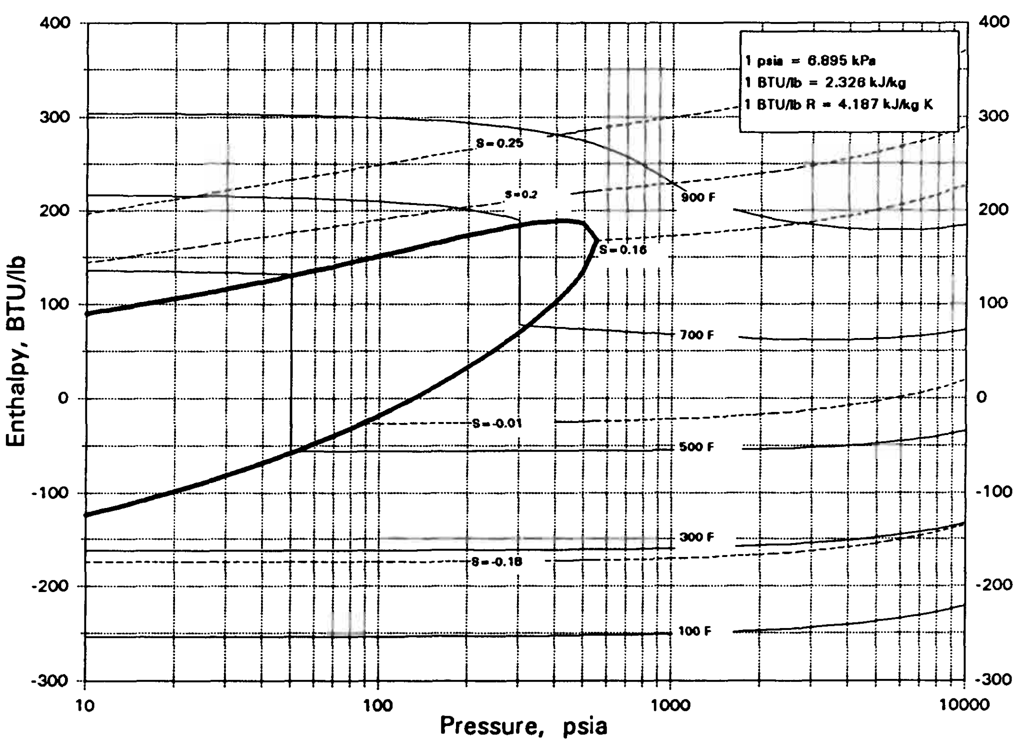
C4H5N VINYLACETONITRILE



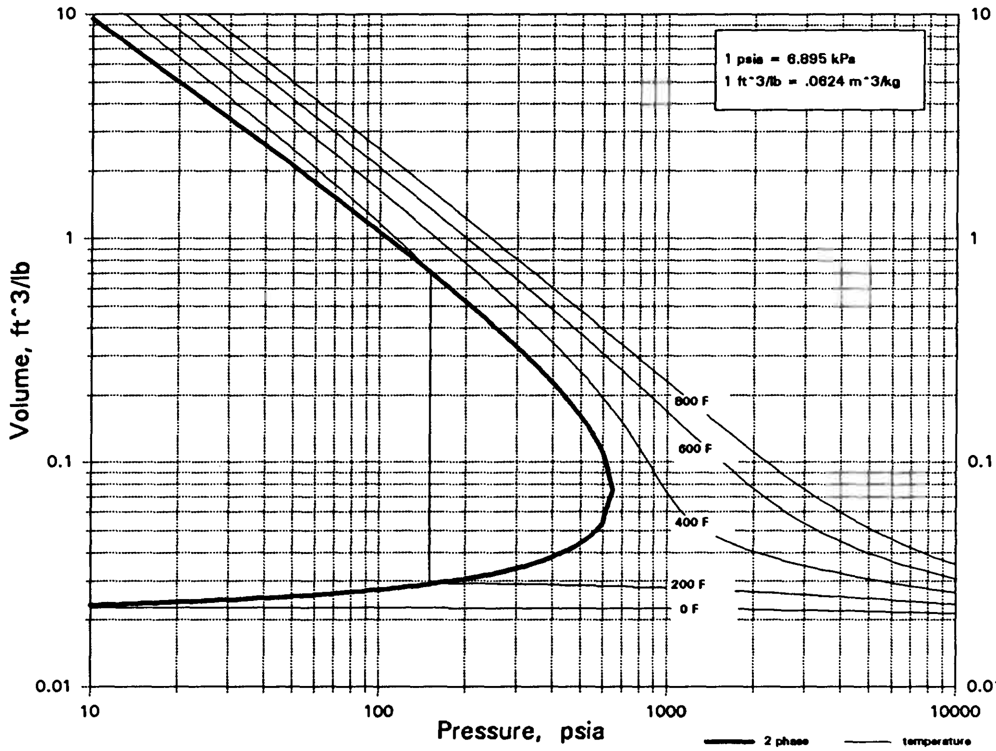


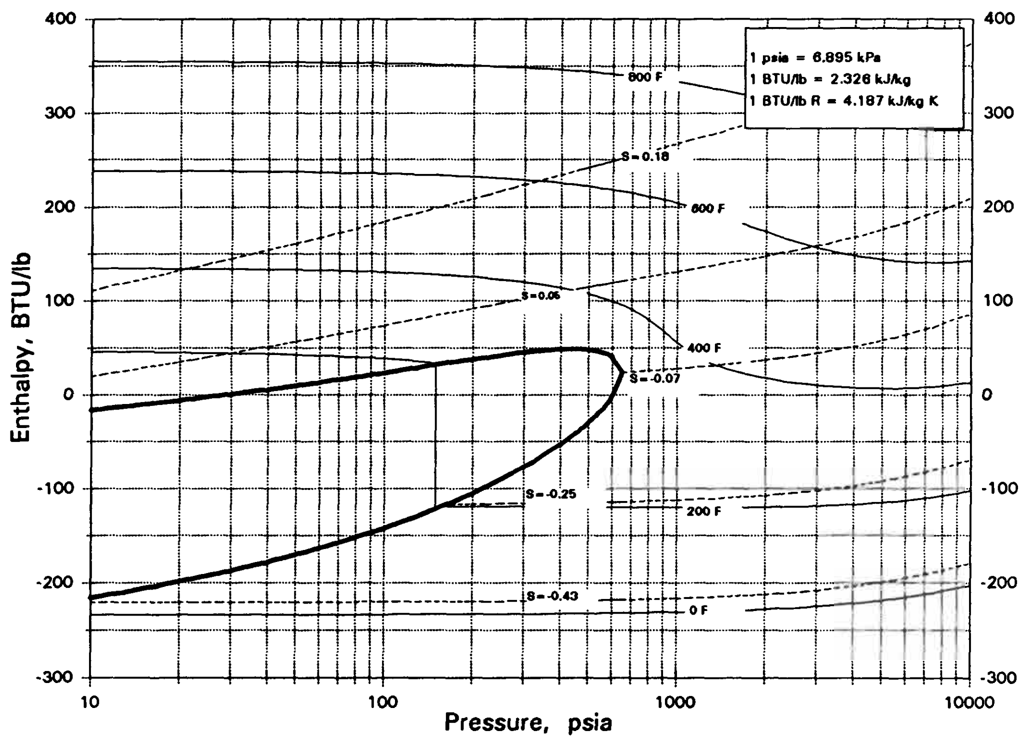
C4H5NO2 METHYL CYANOACETATE



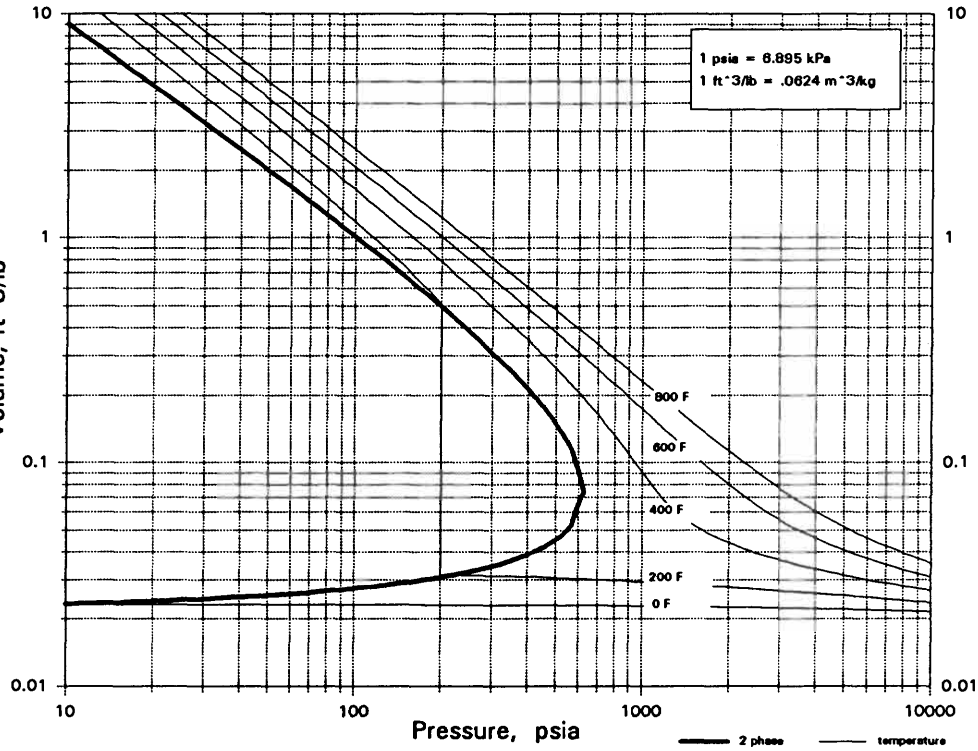


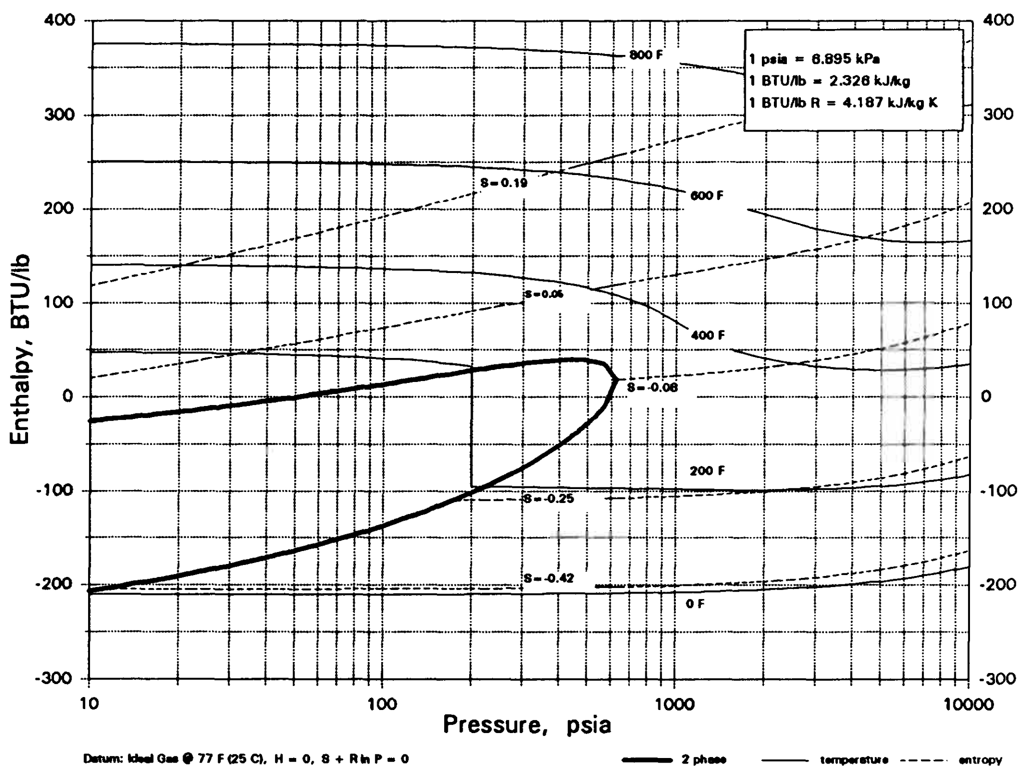
C4H6 1-2-BUTADIENE



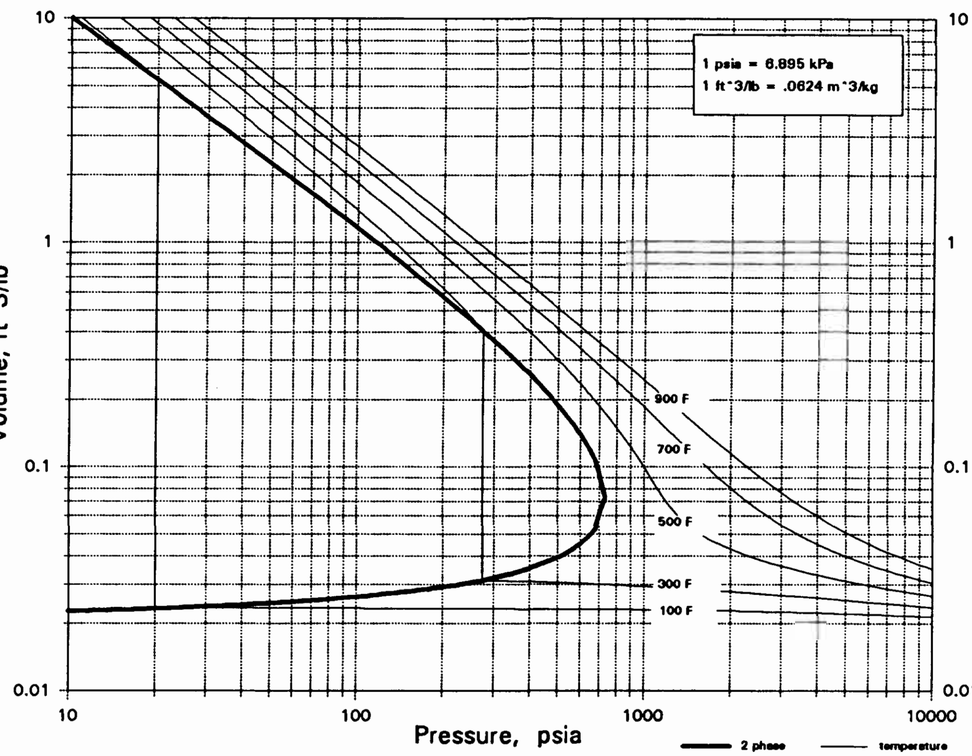


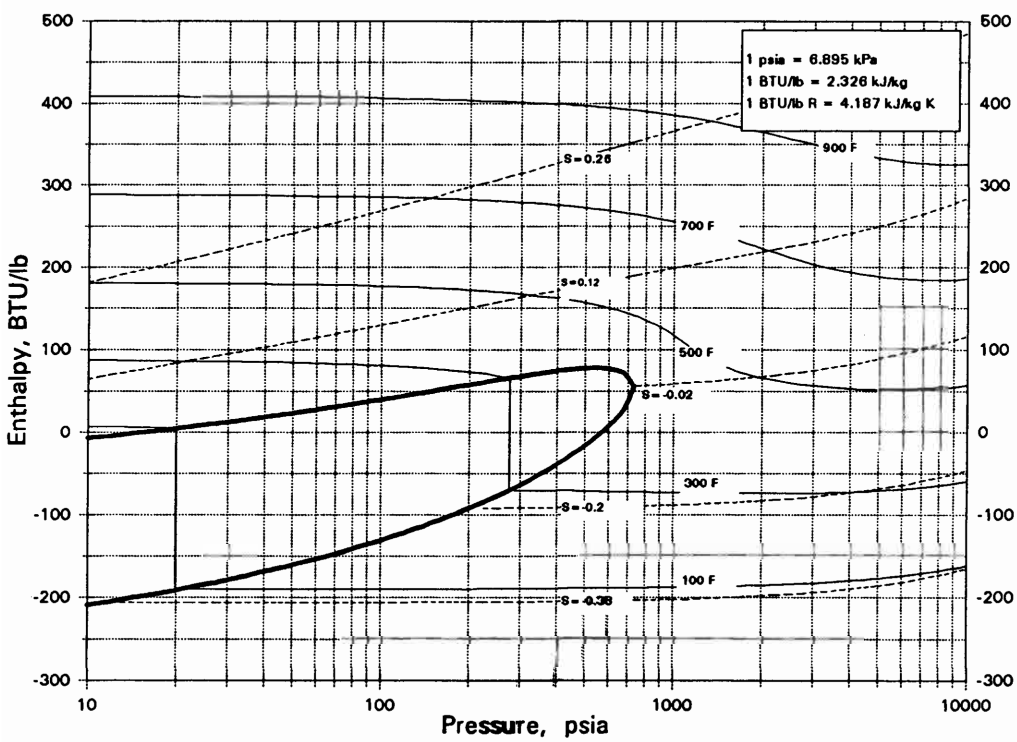
C4H6	1-3-BUTADIENE





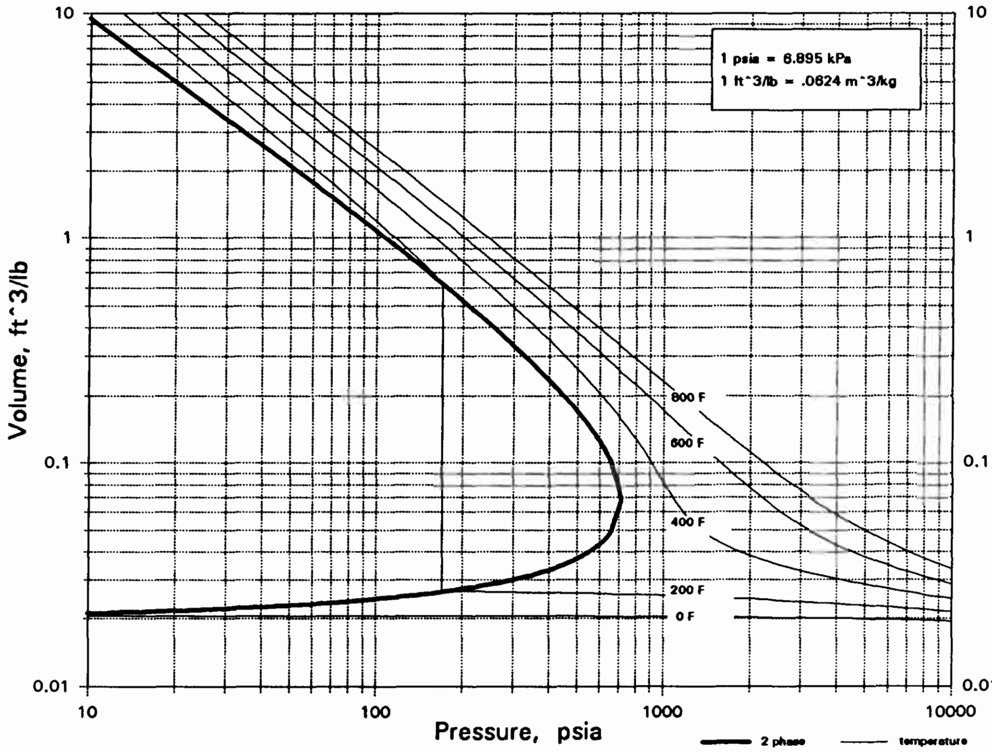
C4H6 DIMETHYLACETYLENE

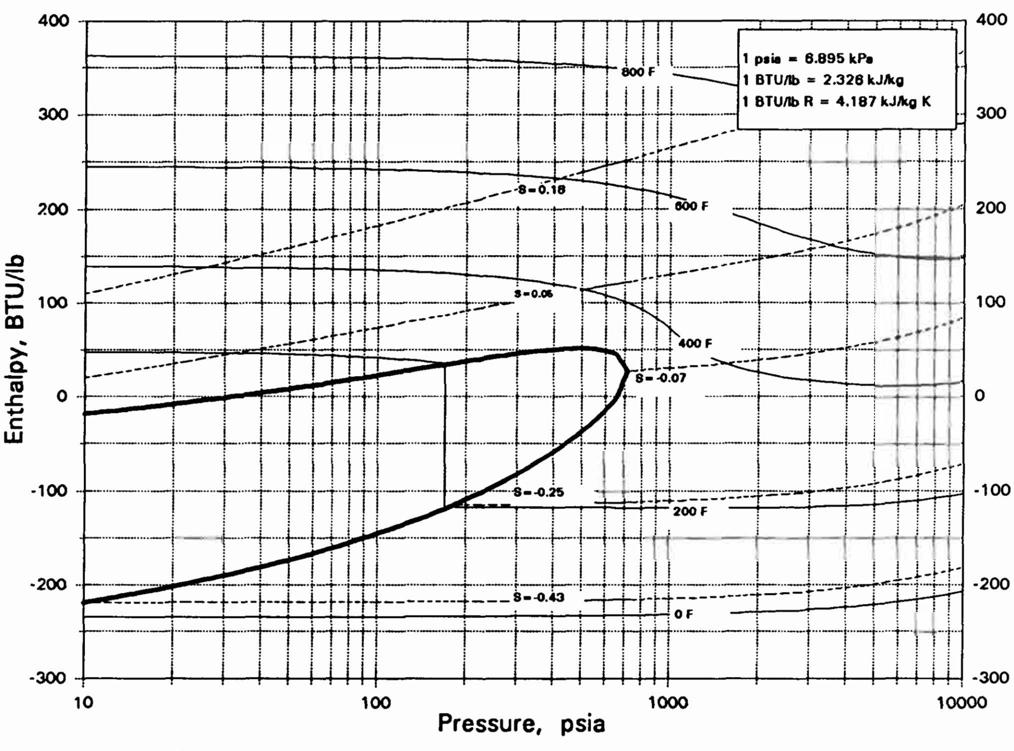




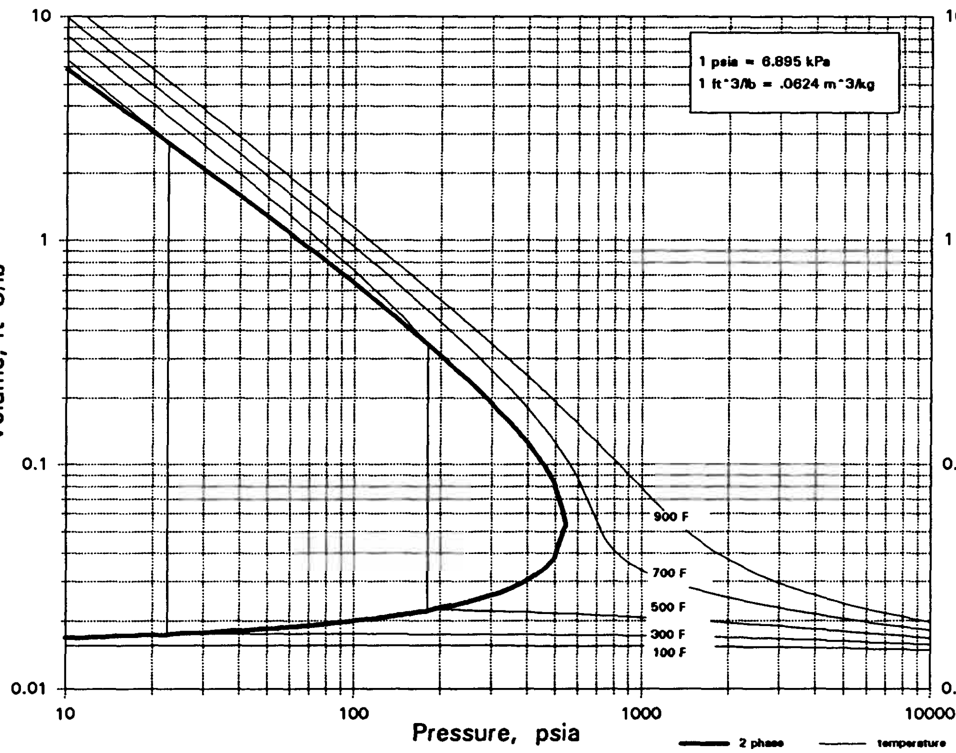
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

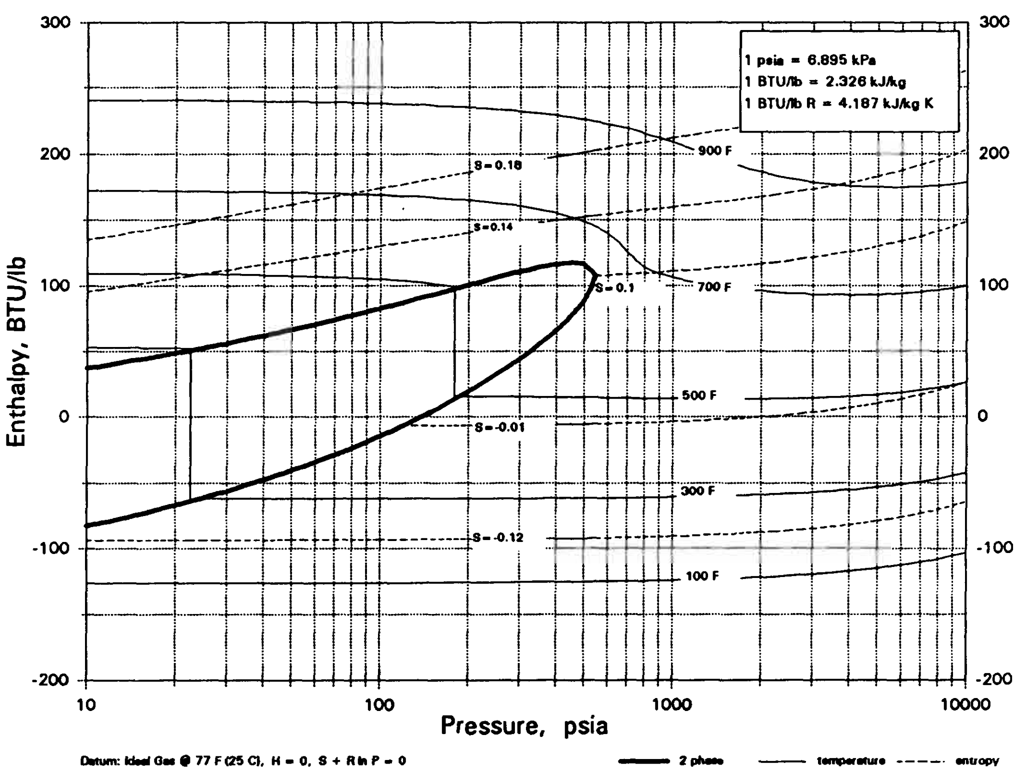
C4H6 ETHYLACETYLENE



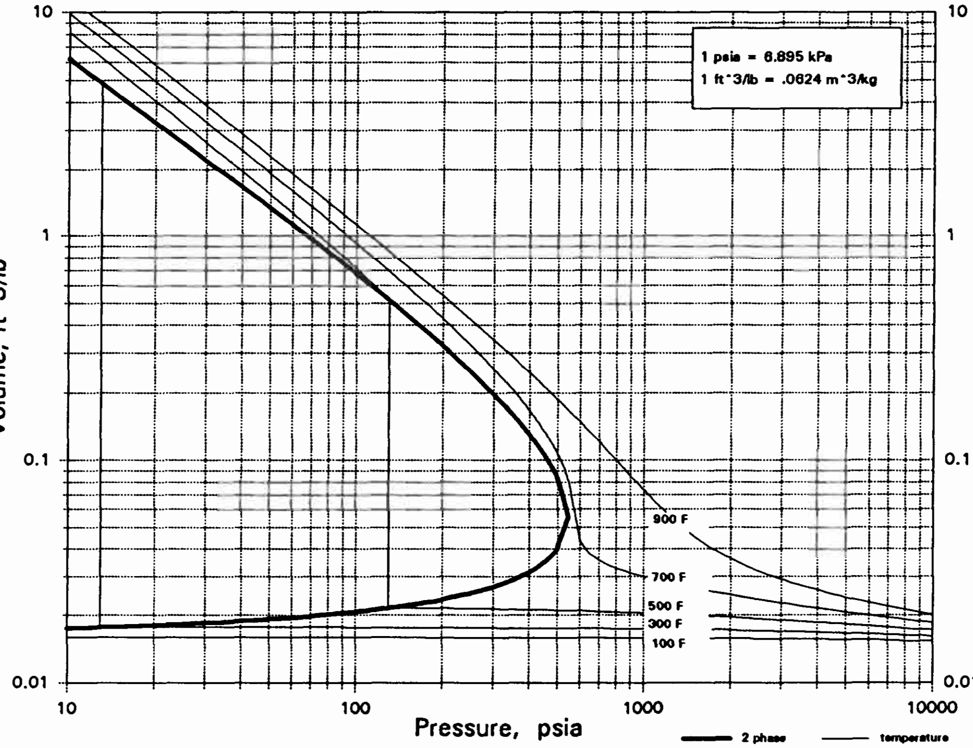


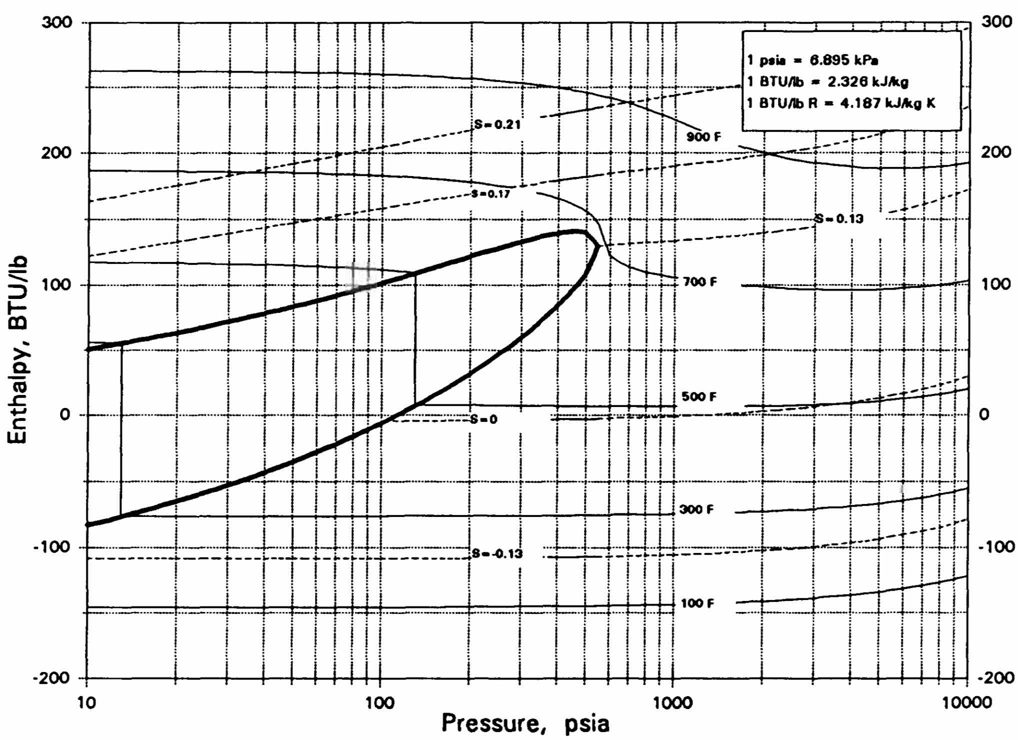
C4H6Cl2 1-3-DICHLORO-trans-2-BUTENE





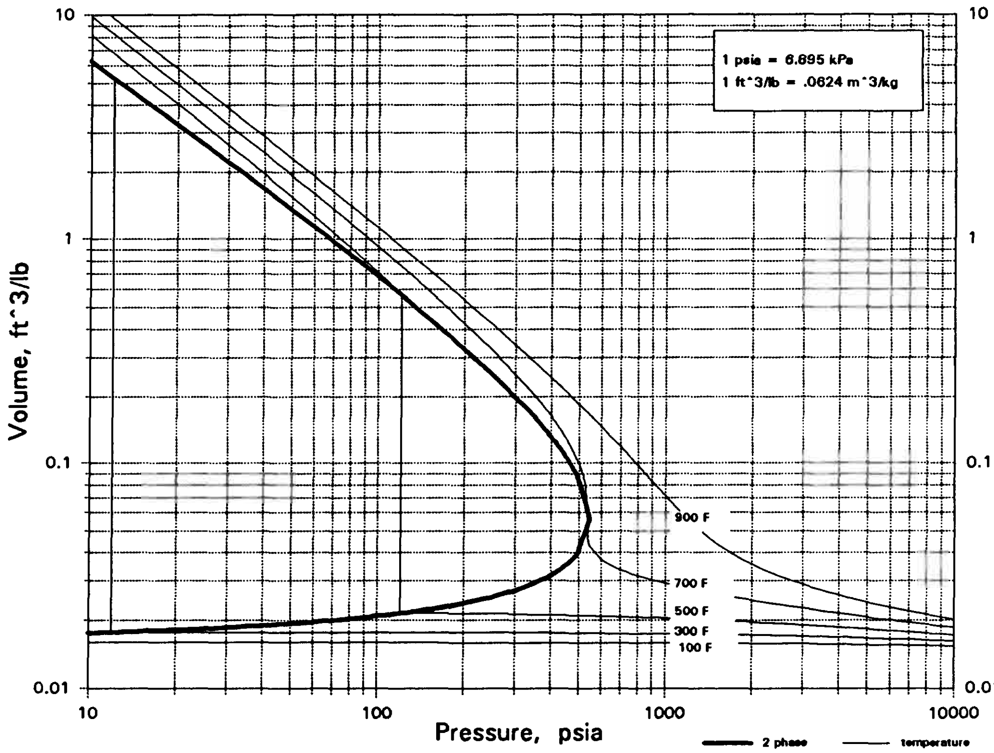
C4H6Cl2	1-4-DICHLORO-cis-2-BUTENE

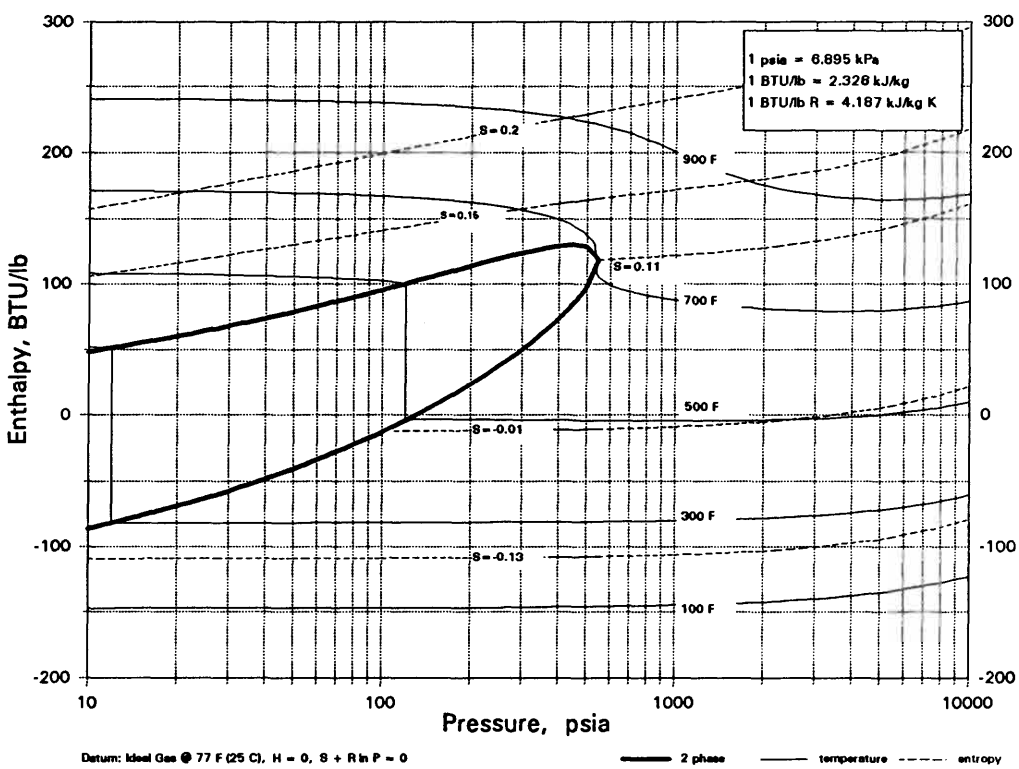




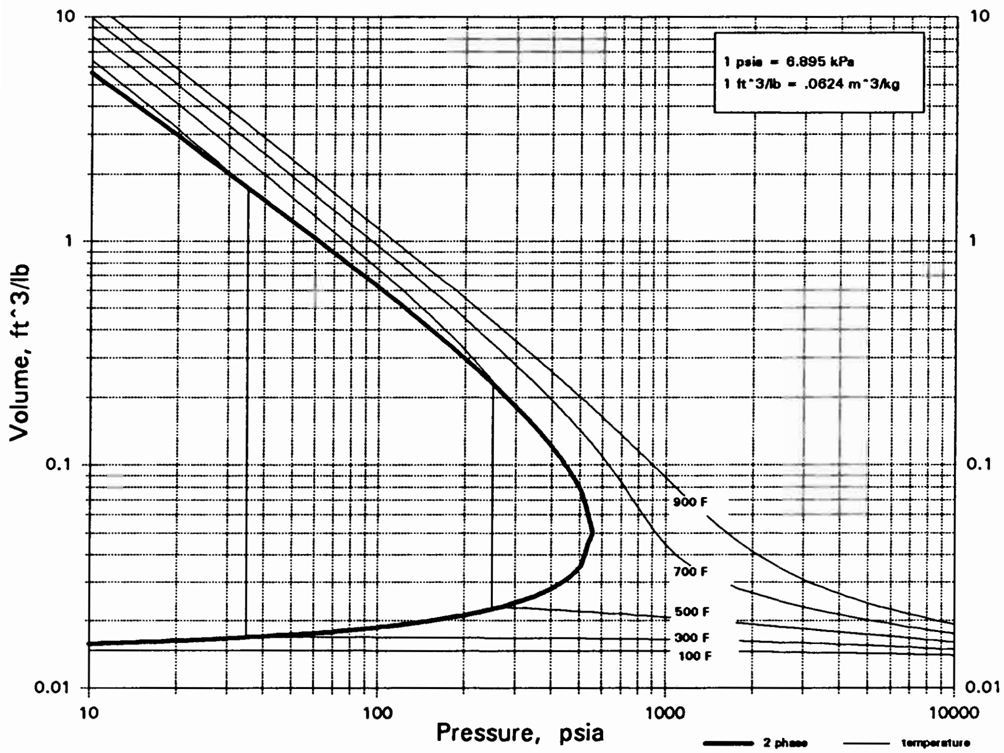
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

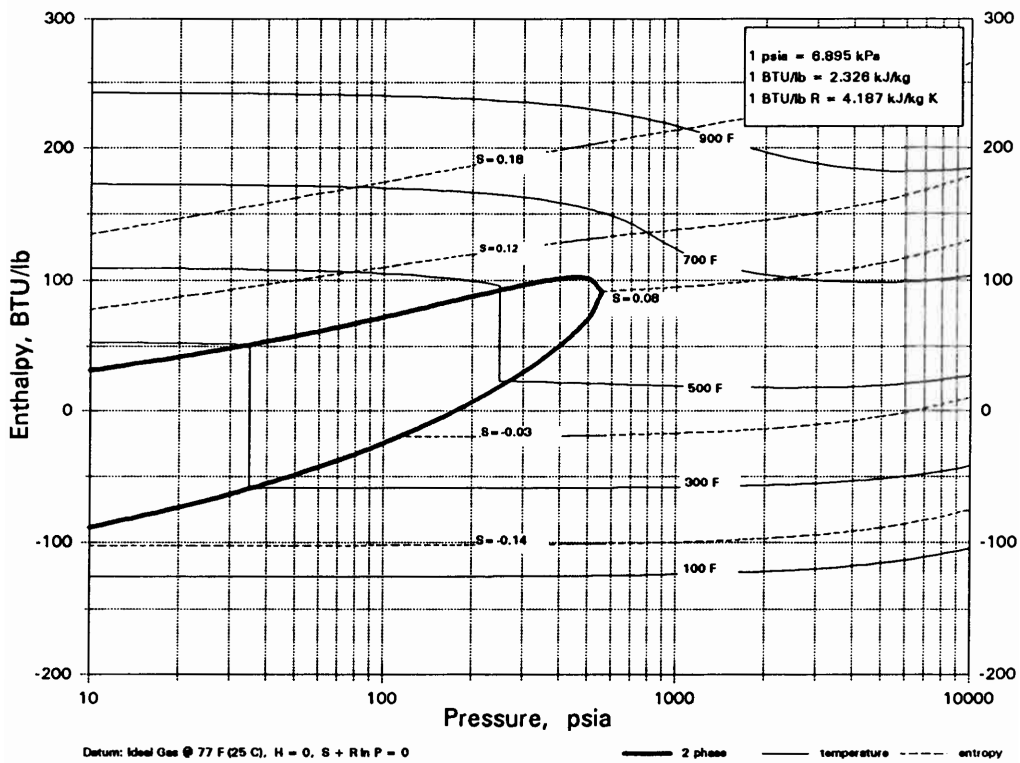
C4H6Cl2 1-4-DICHLORO-trans-2-BUTENE



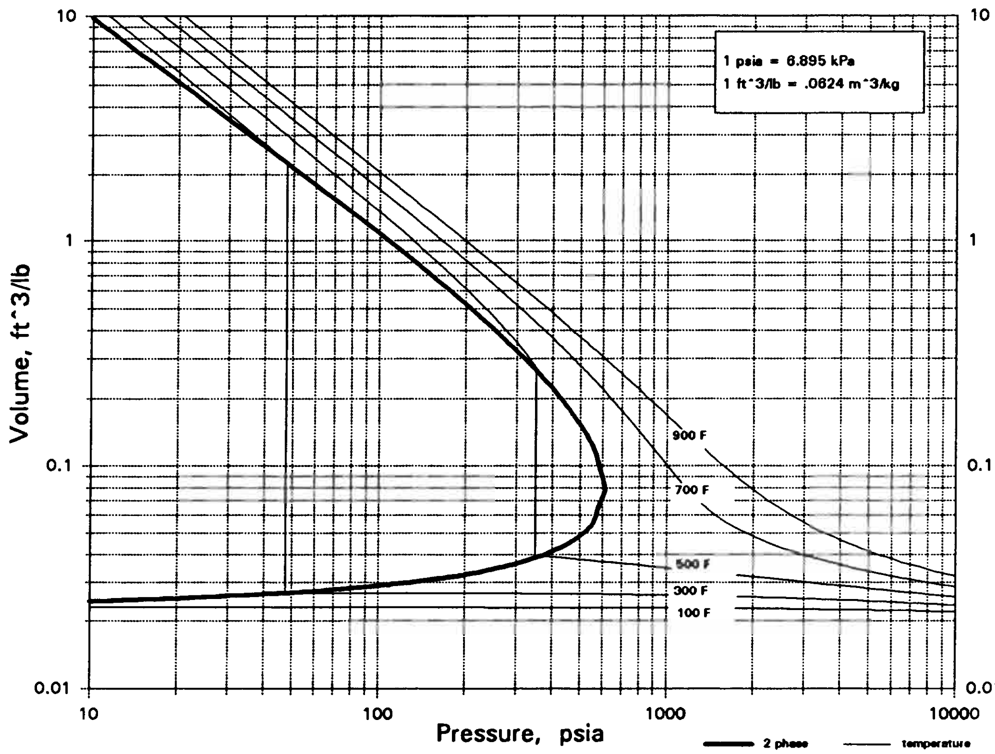


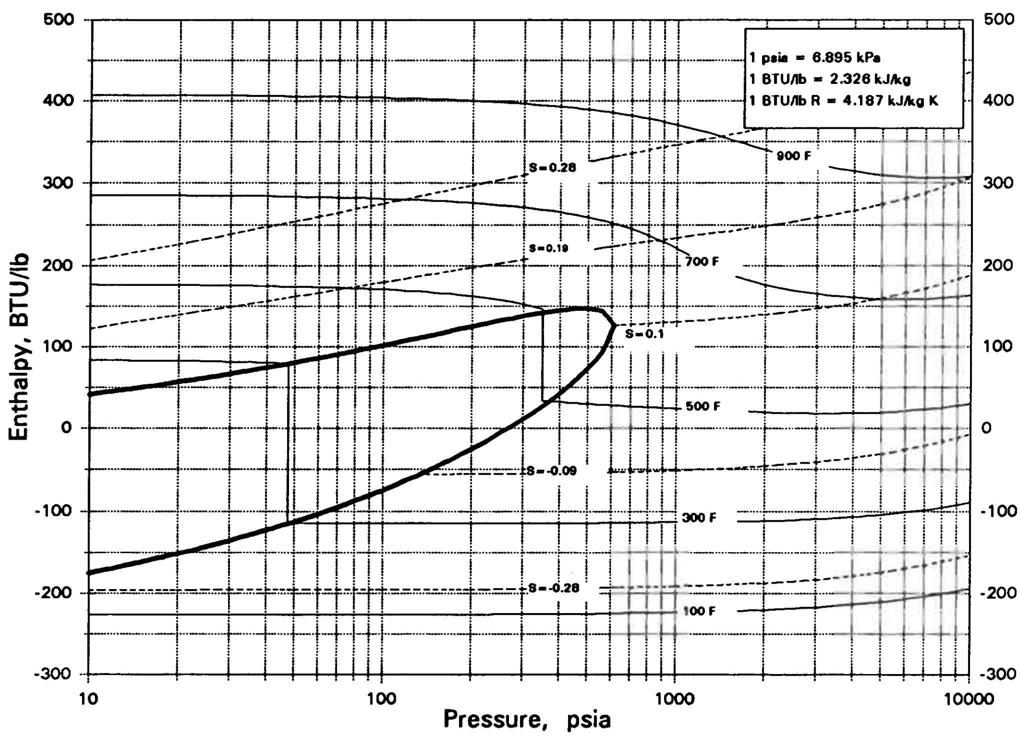
C4H6Cl2 3-4-DICHLORO-1-BUTENE





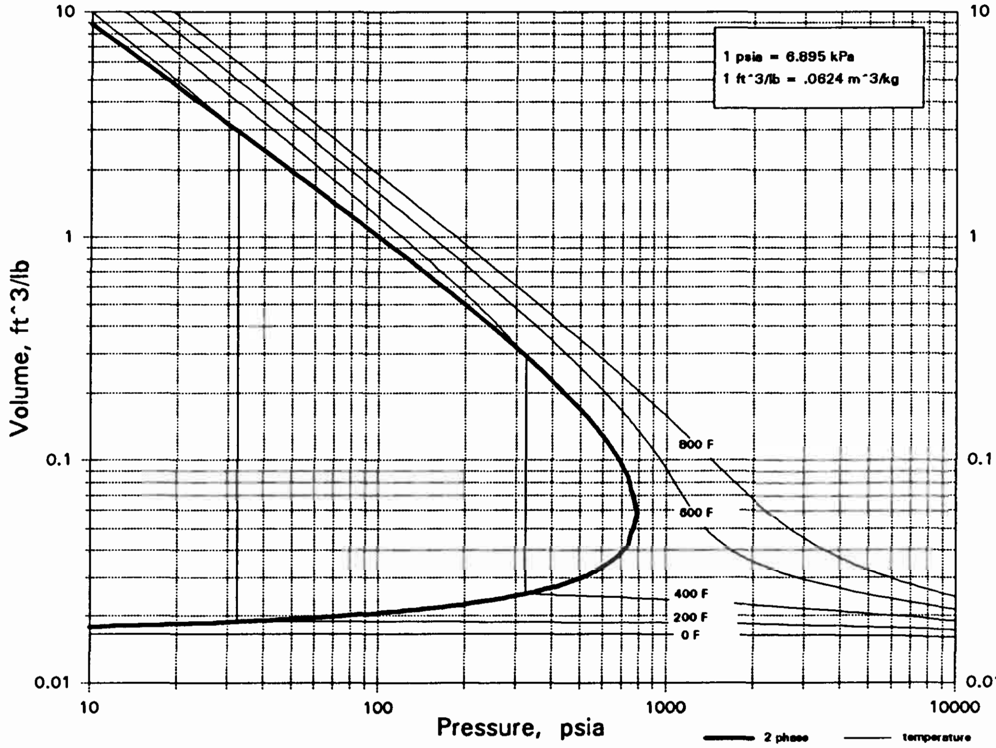
C4H6O trans-CROTONALDEHYDE

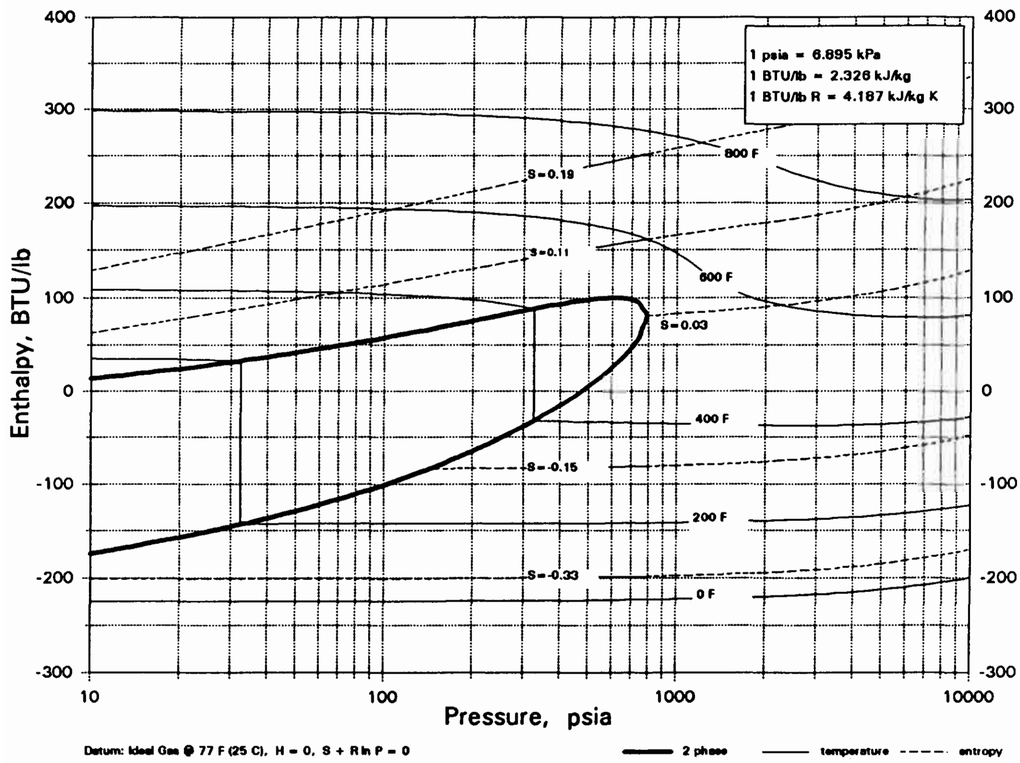




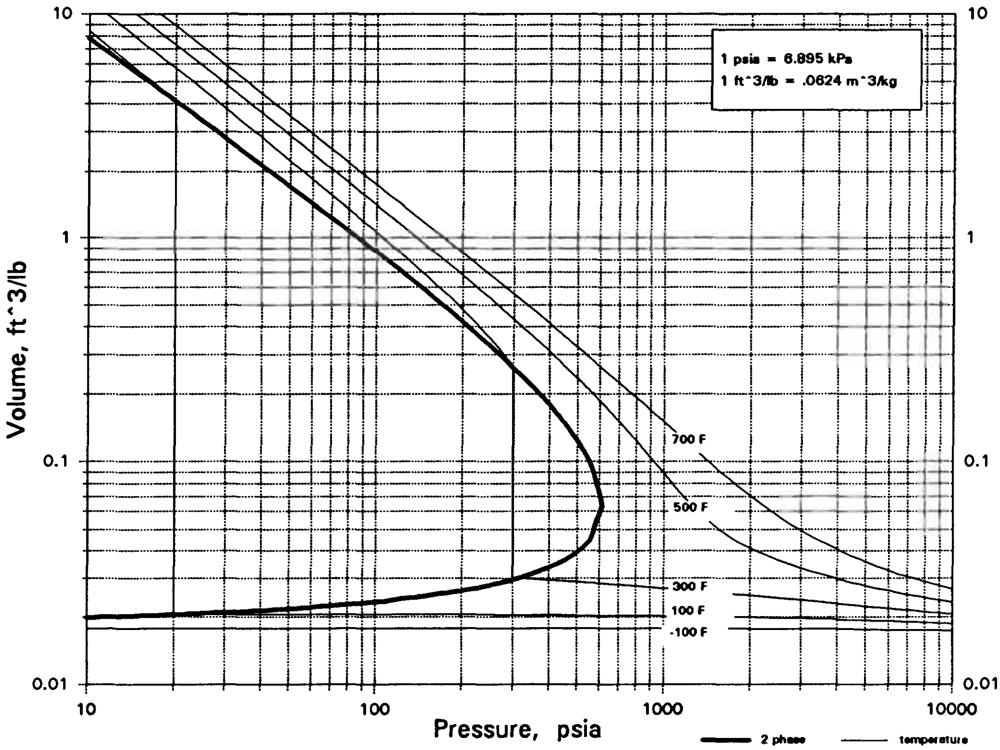
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

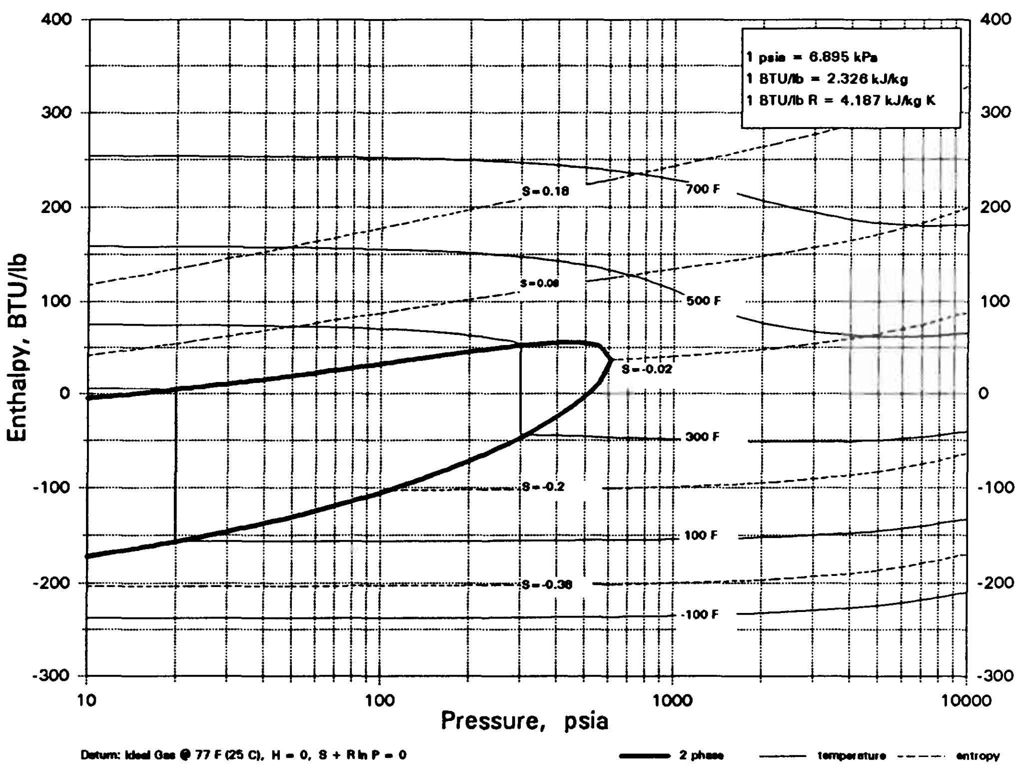
C4H6O 2-5-DIHYDROFURAN



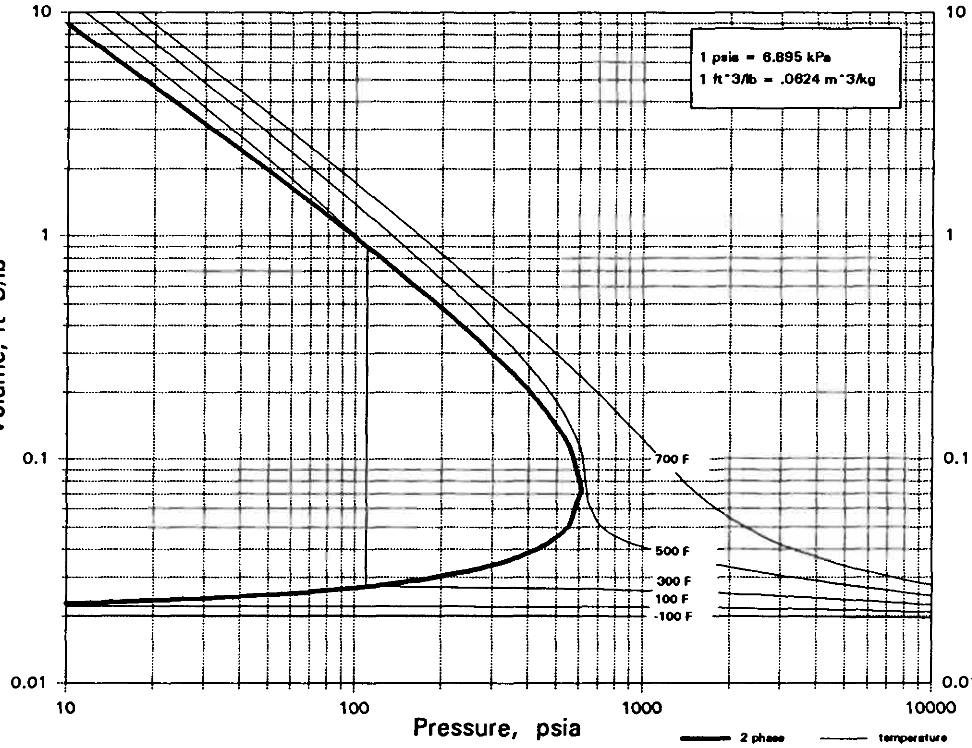


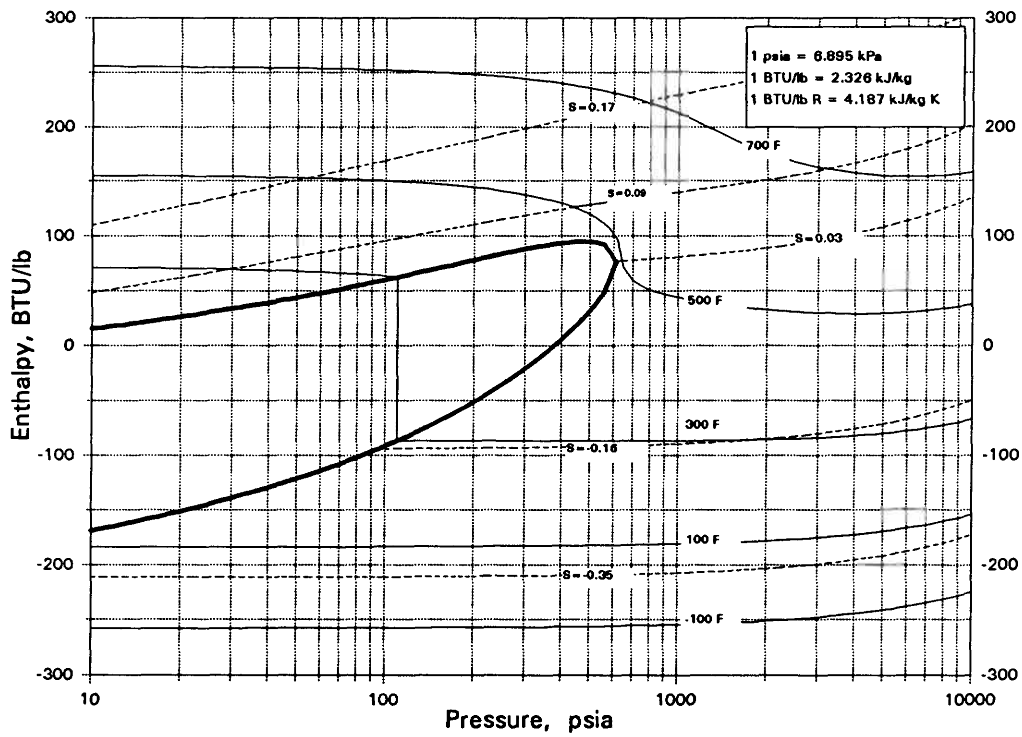
C4H6O DIVINYL ETHER





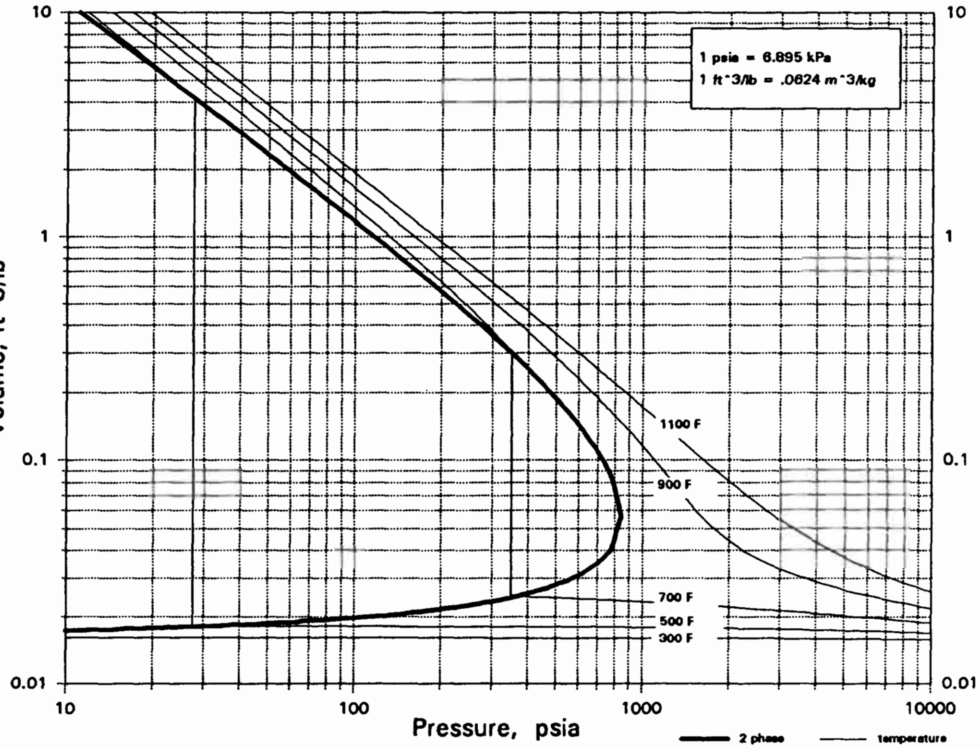
C4H6O METHACROLEIN

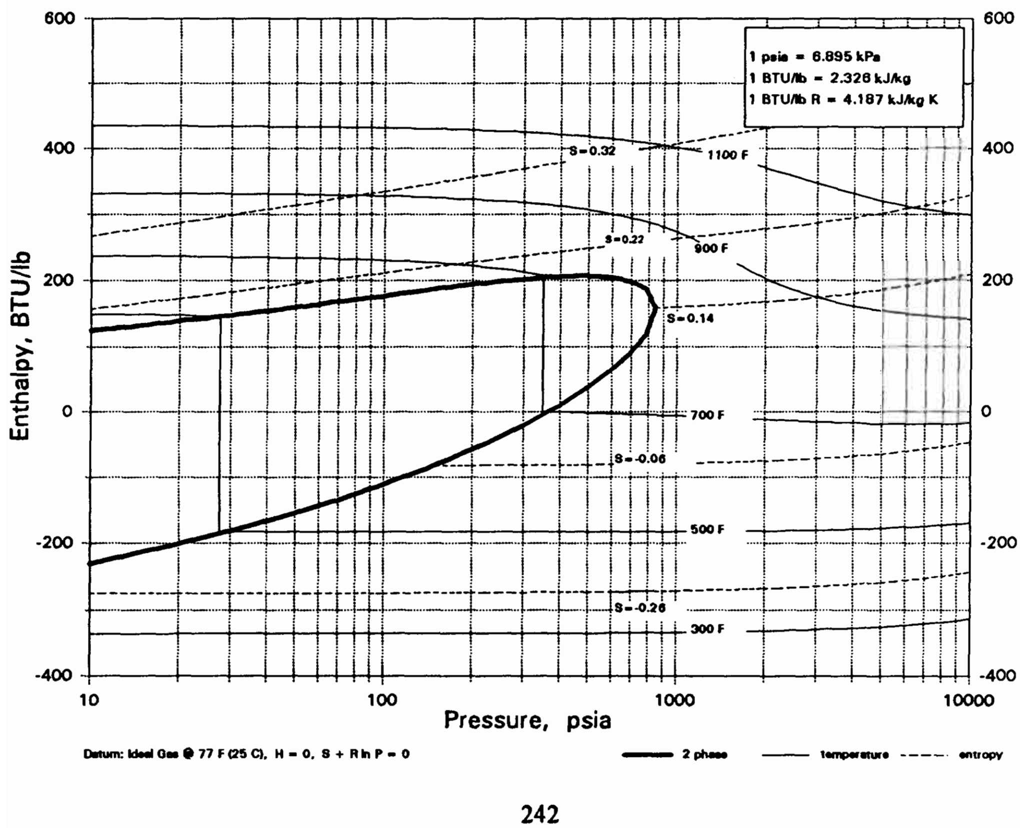




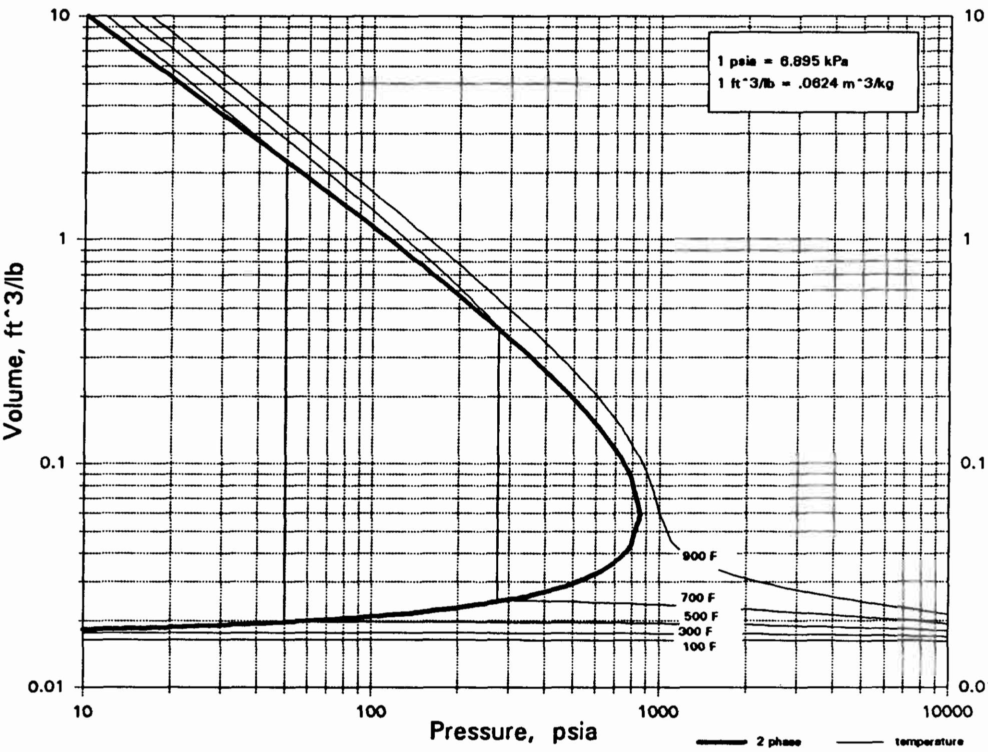
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

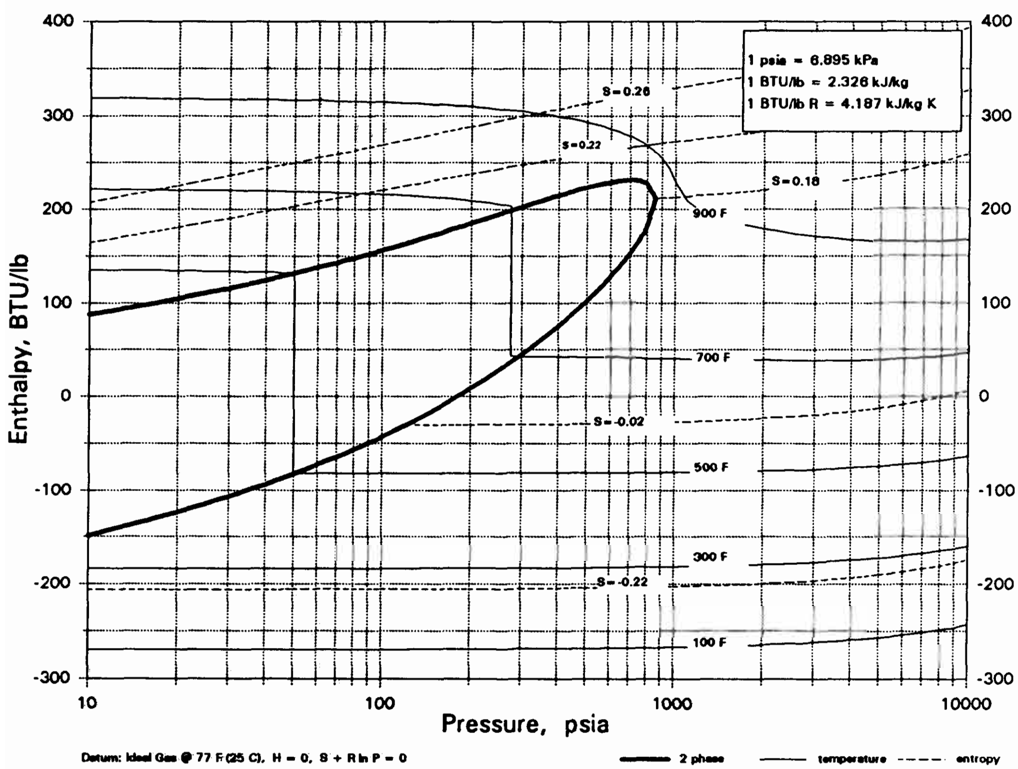
C4H6O2 2-BUTYNE-1-4-DIOL



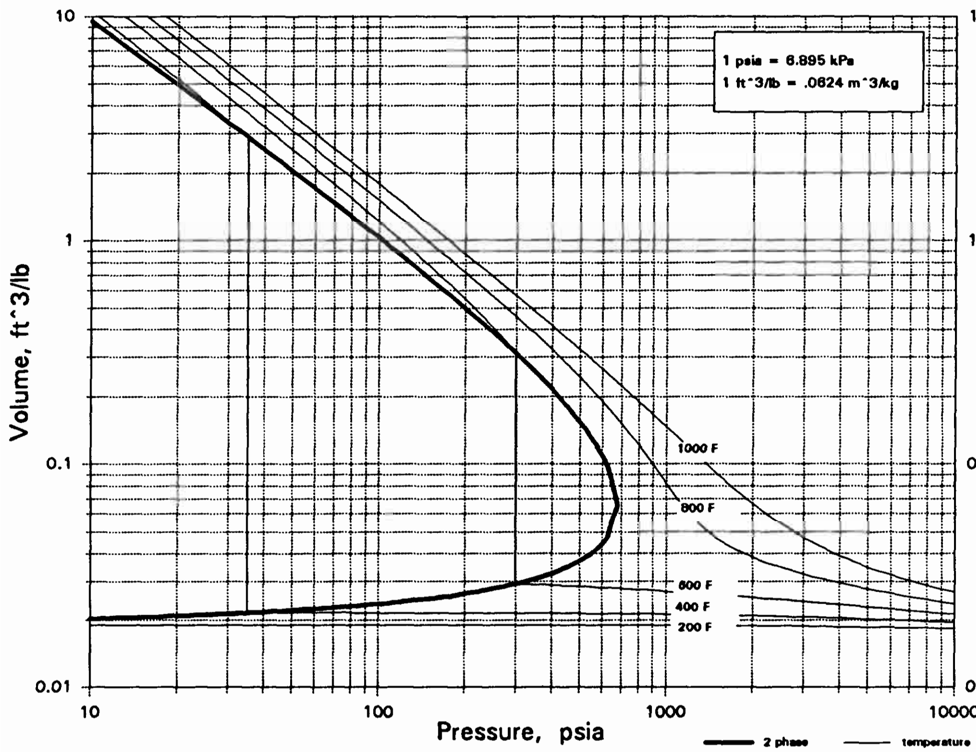


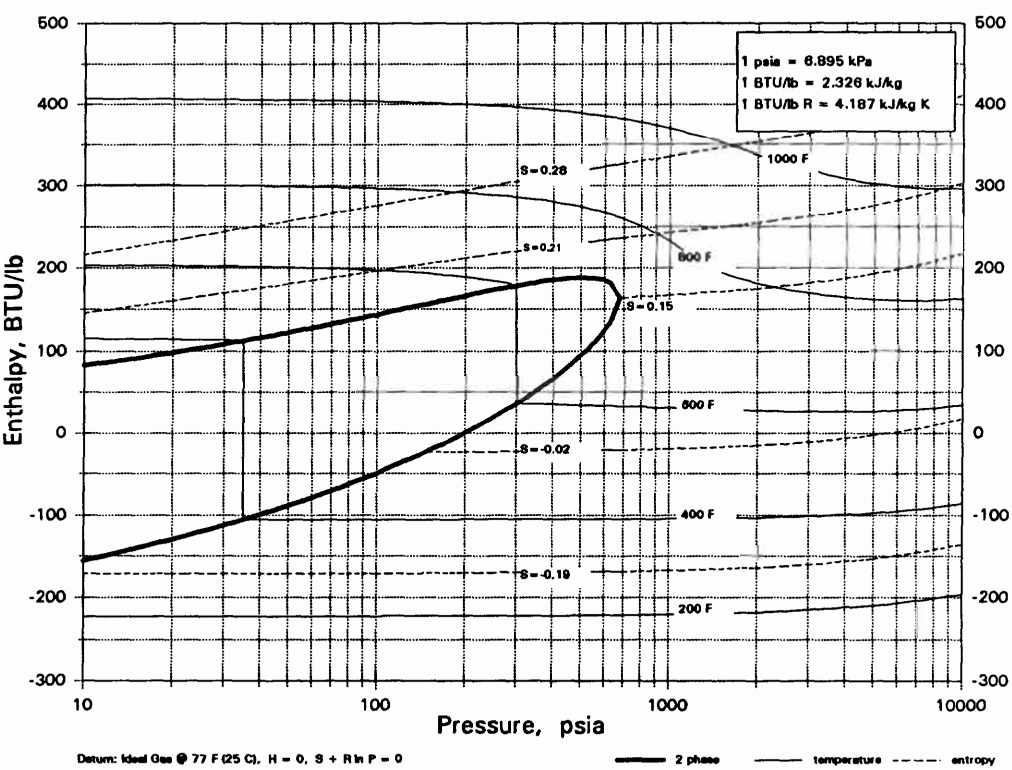
C4H6O2 gamma-BUTYROLACTONE



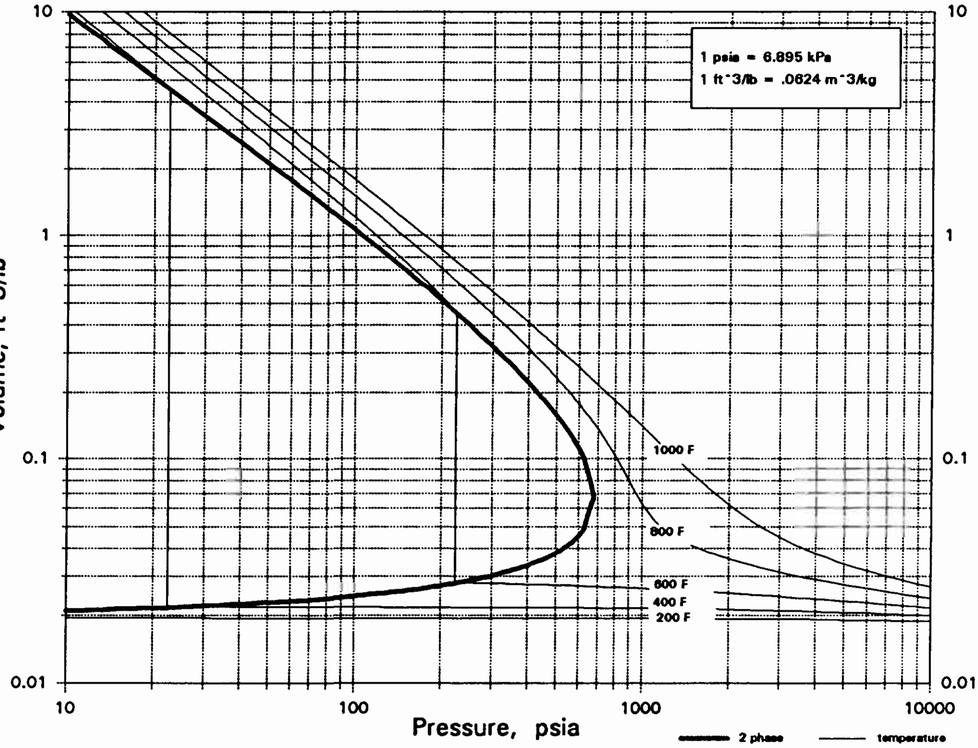


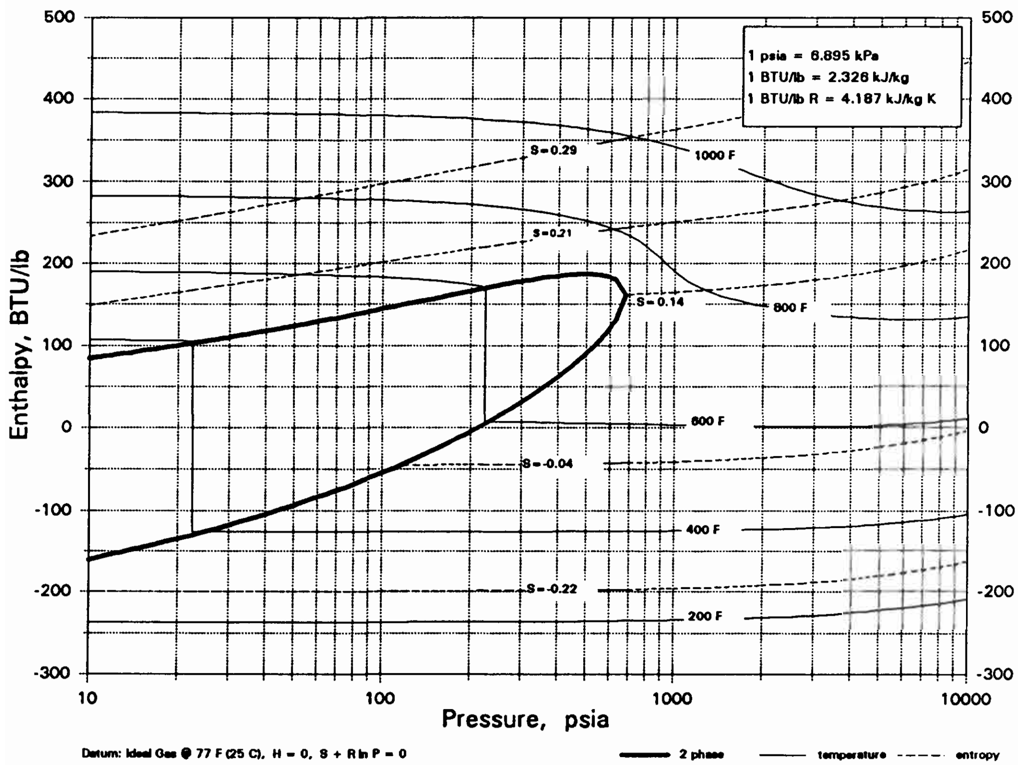
C4H6O2 cis-CROTONIC ACID



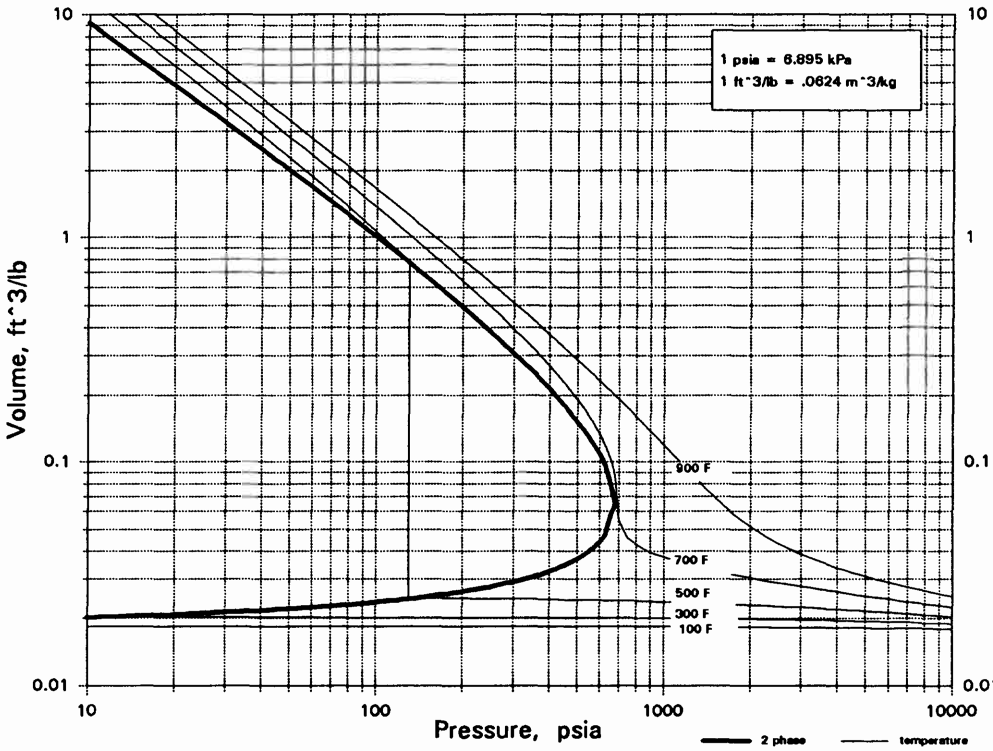


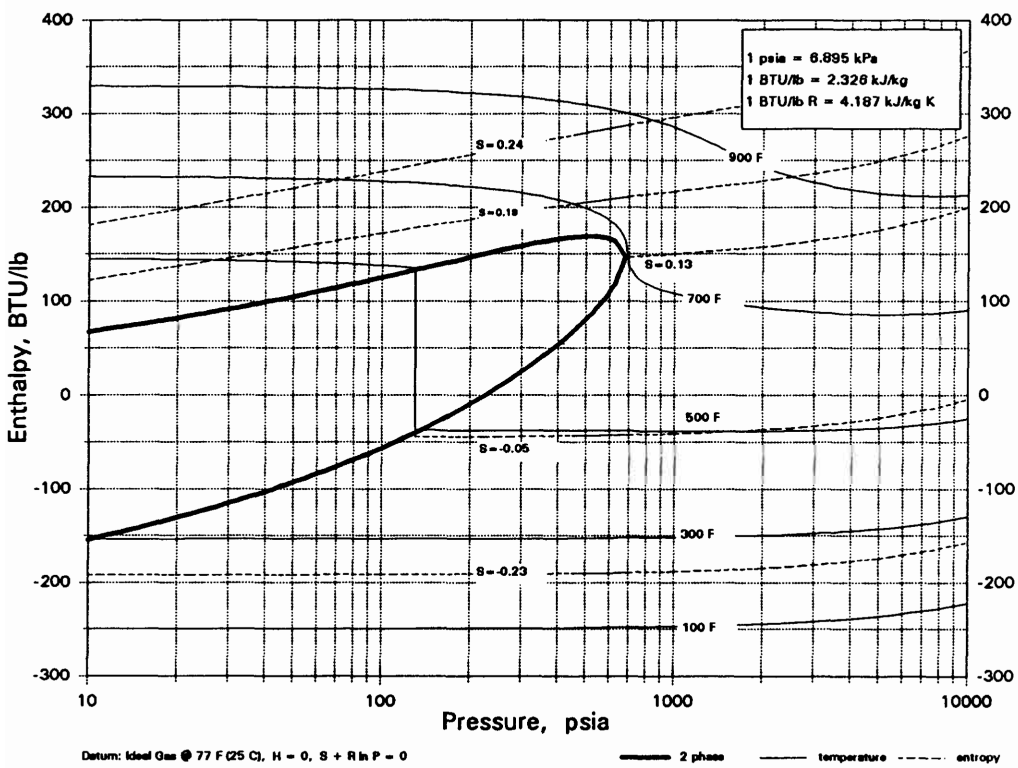
C4H6O2 trans-CROTONIC ACID



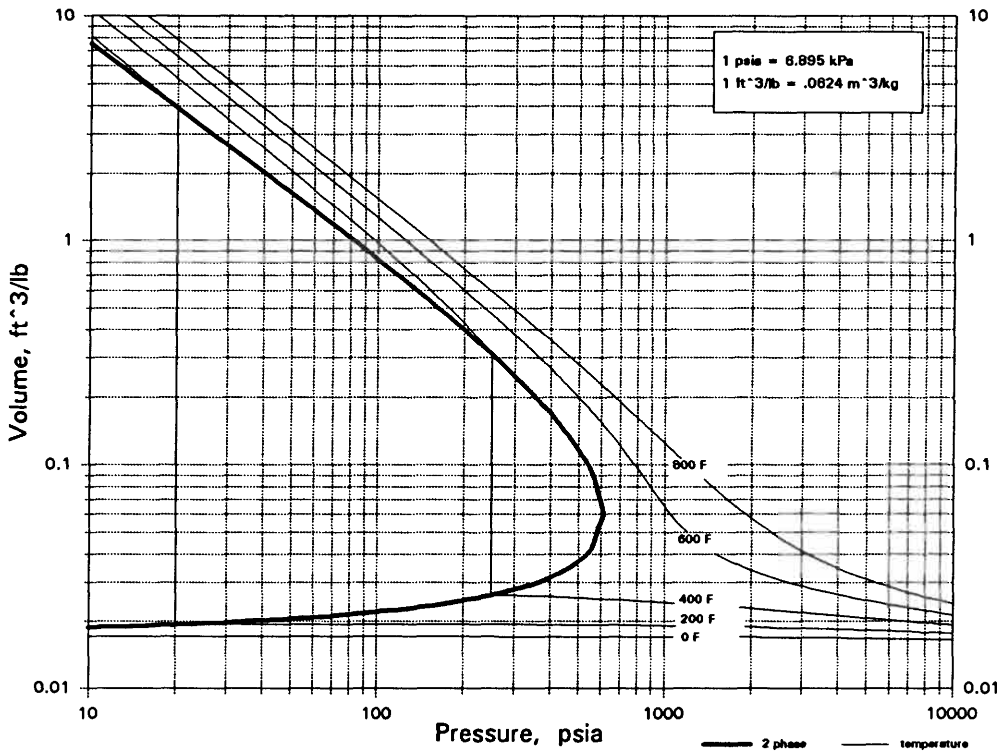


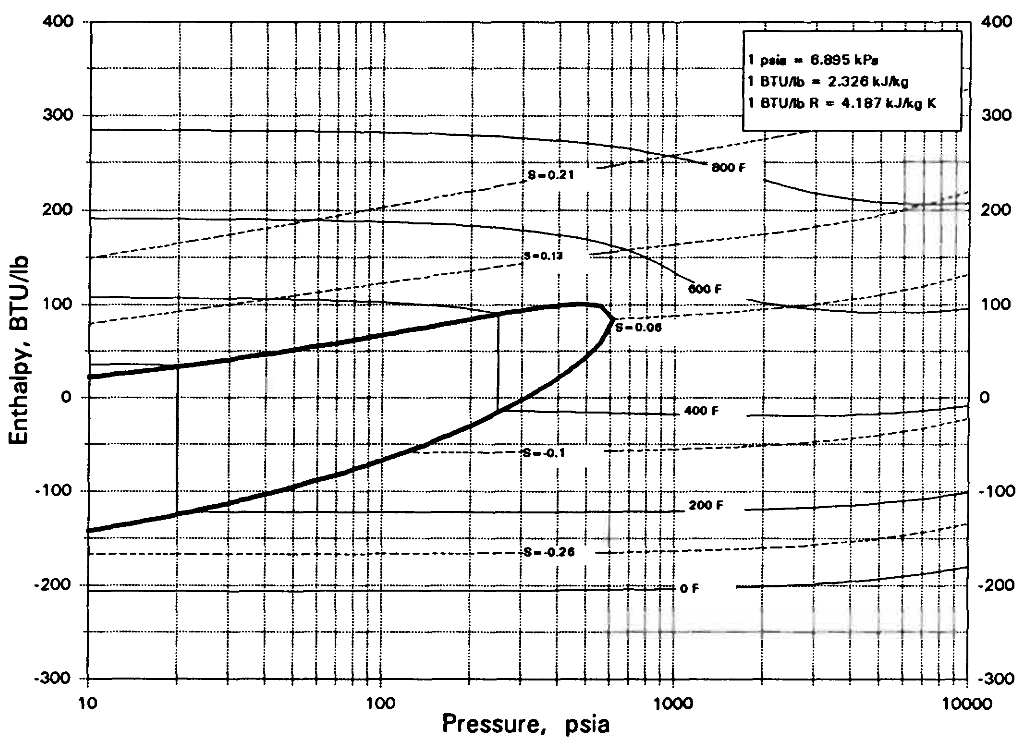
C4H6O2 METHACRYLIC ACID



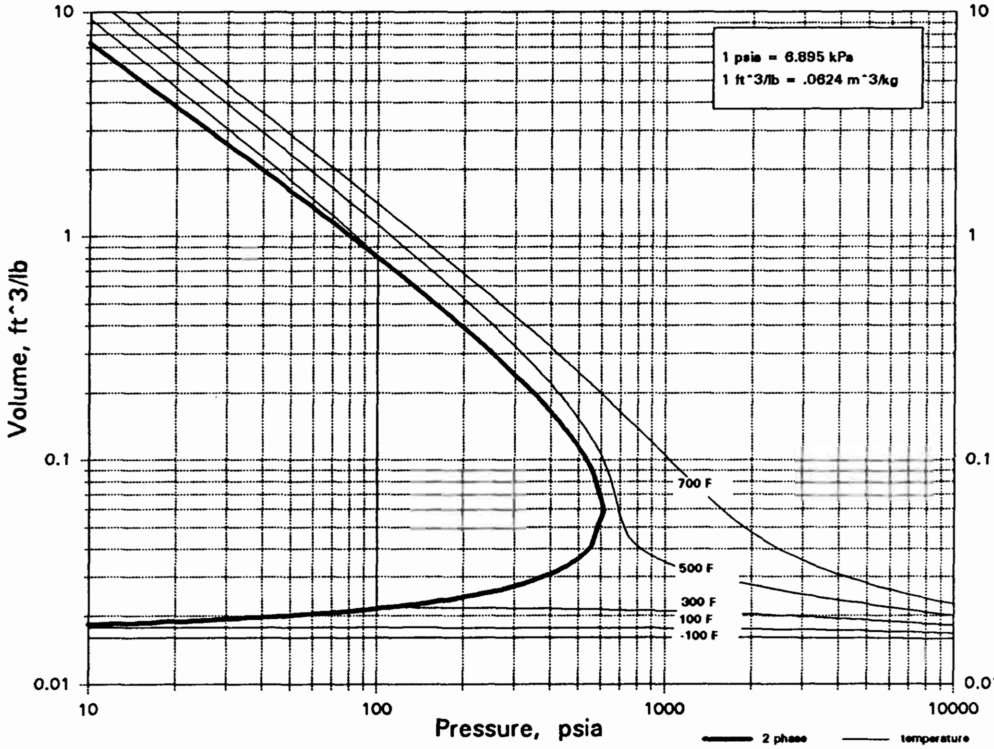


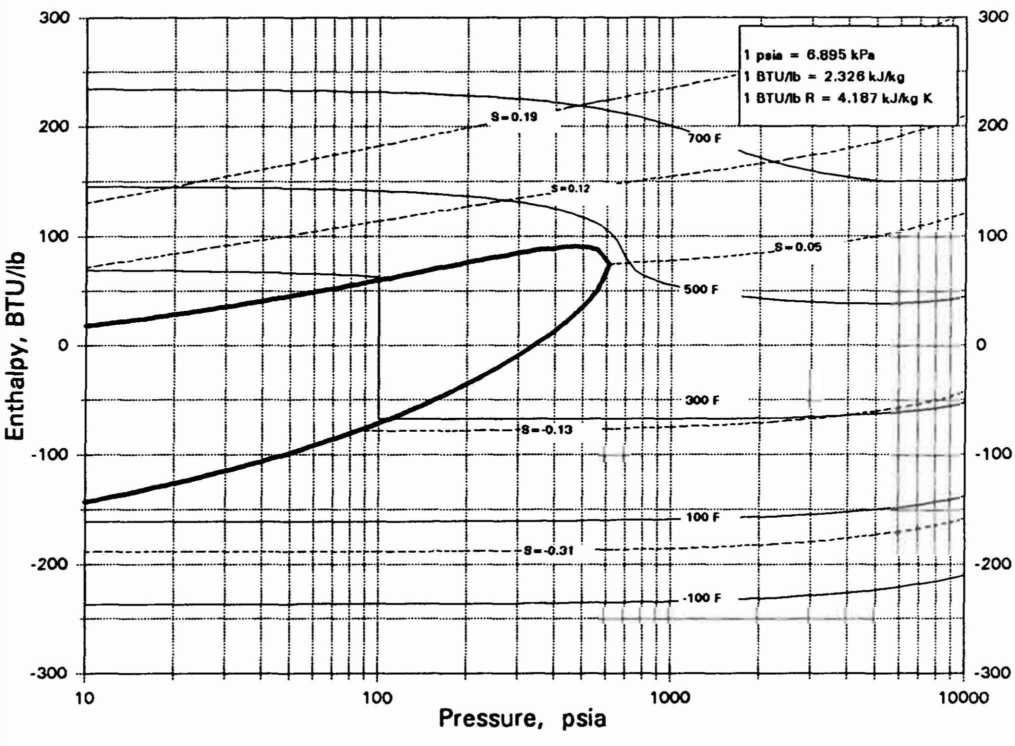
C4H6O2 METHYL ACRYLATE



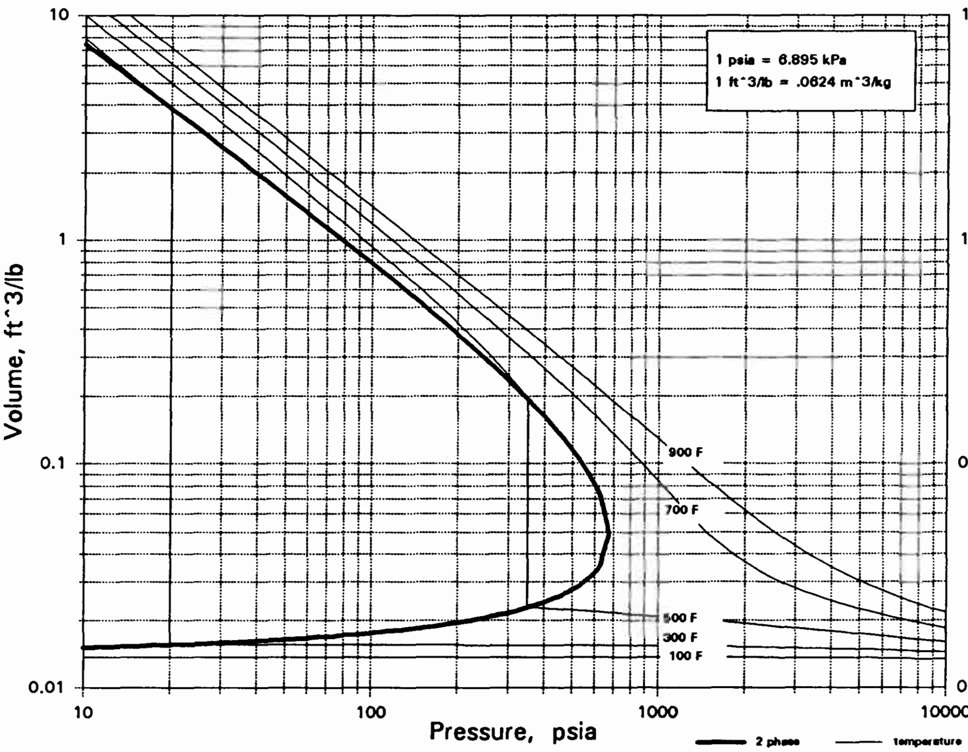


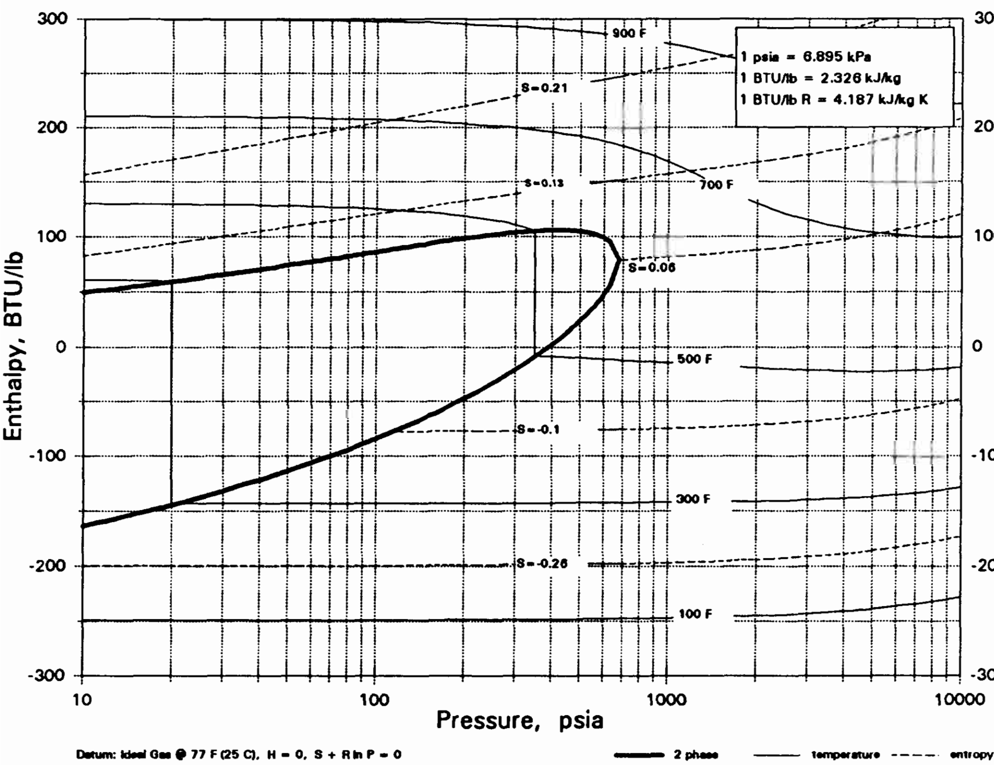
C4H6O2 VINYL ACETATE



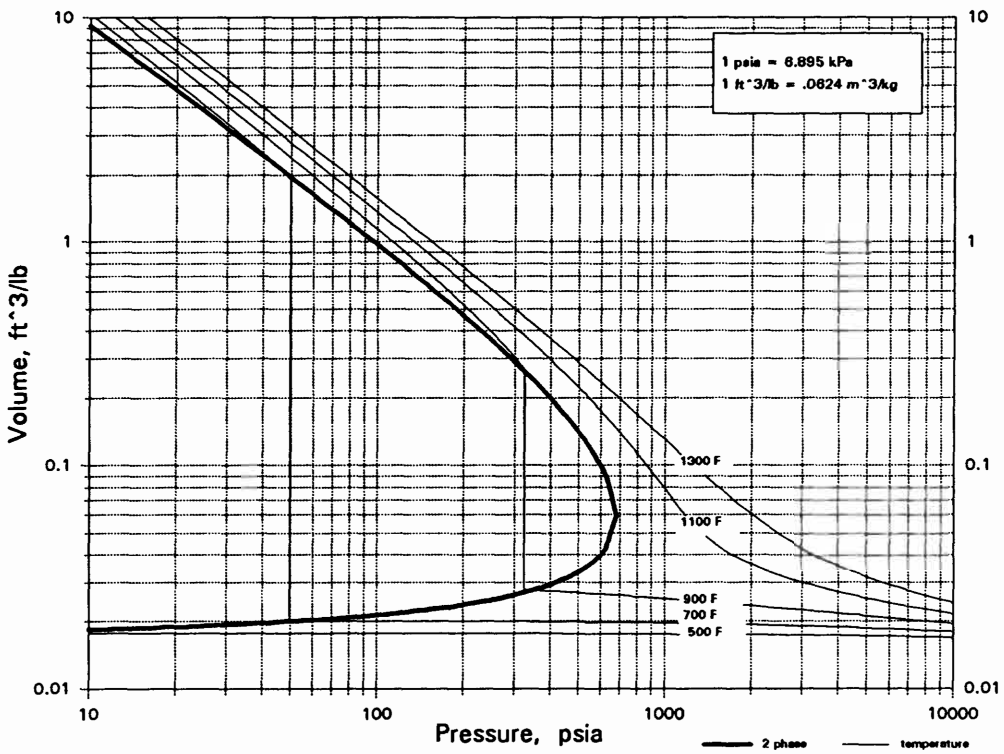


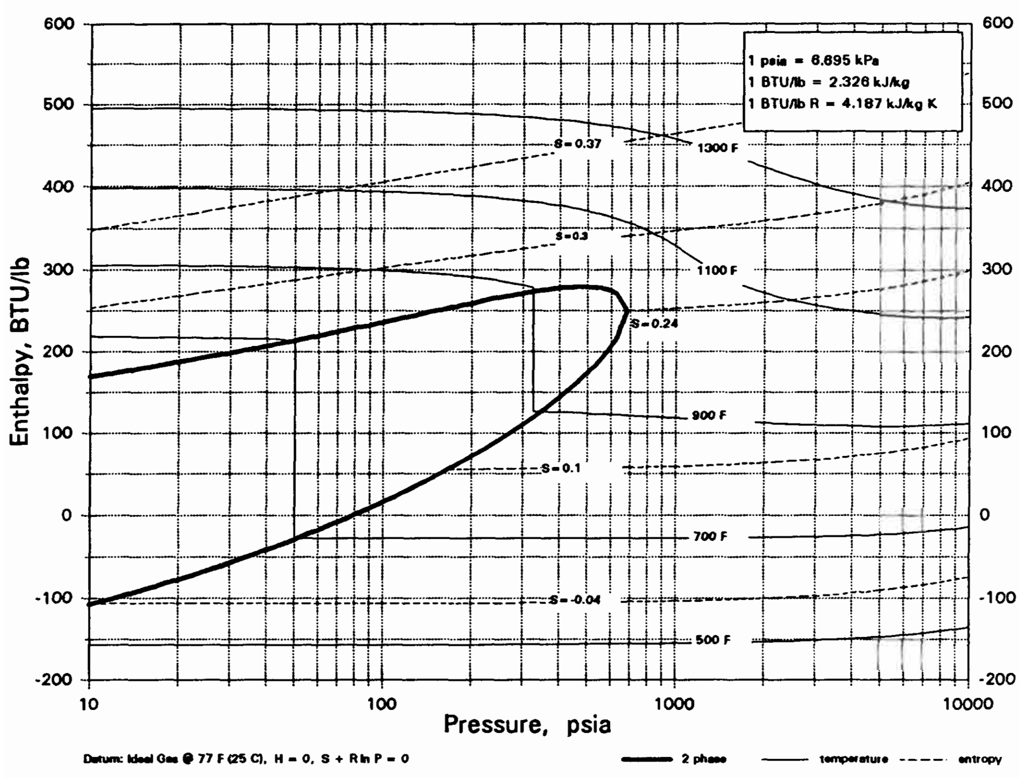
C4H6O3 ACETIC ANHYDRIDE



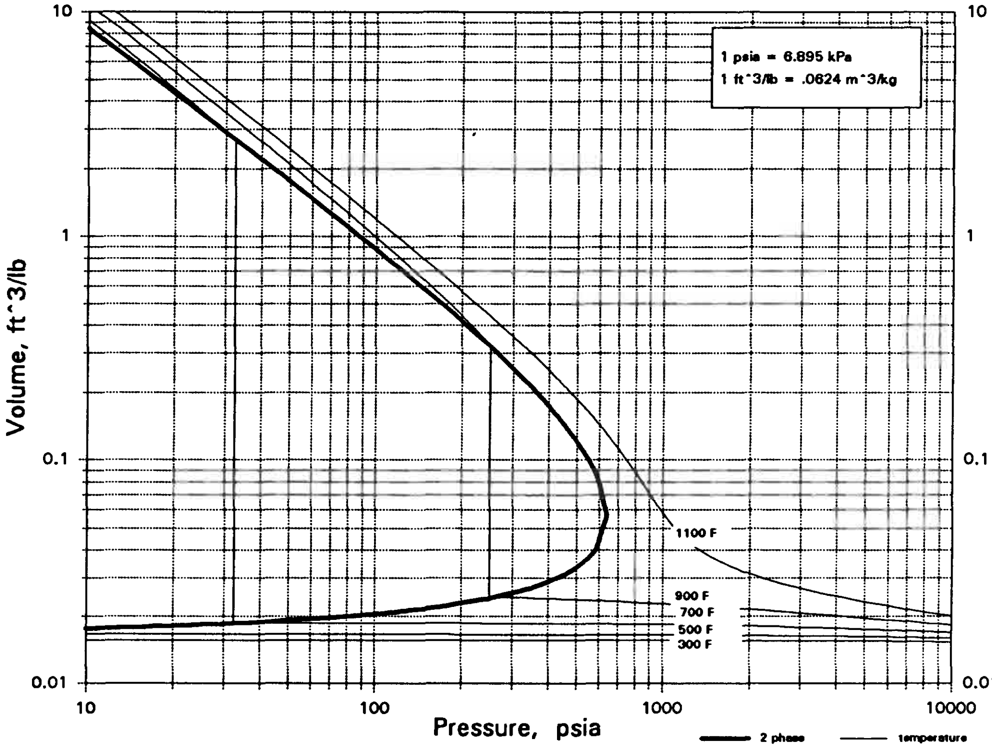


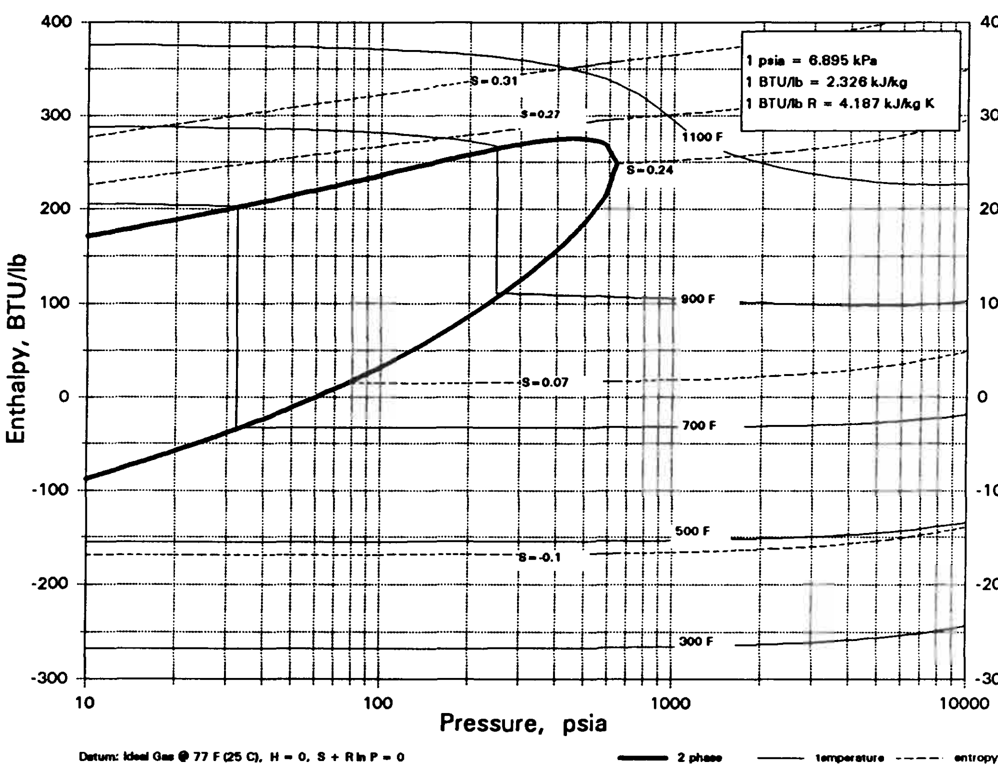
C4H6O4 SUCCINIC ACID





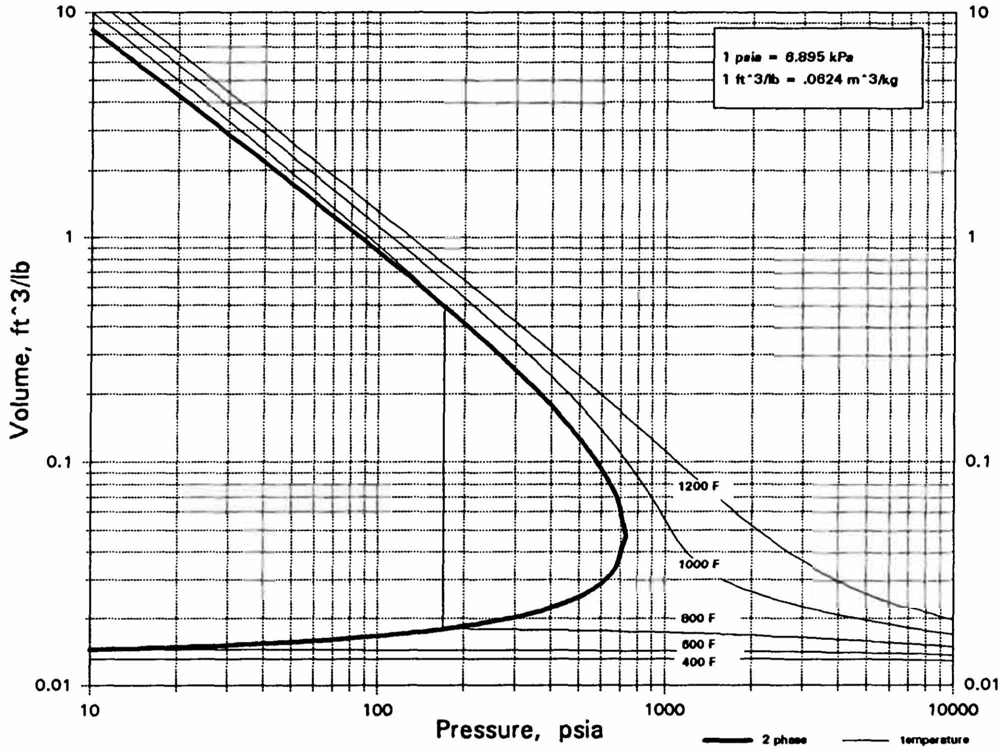
C4H6O5	DIGLYCOLIC ACID

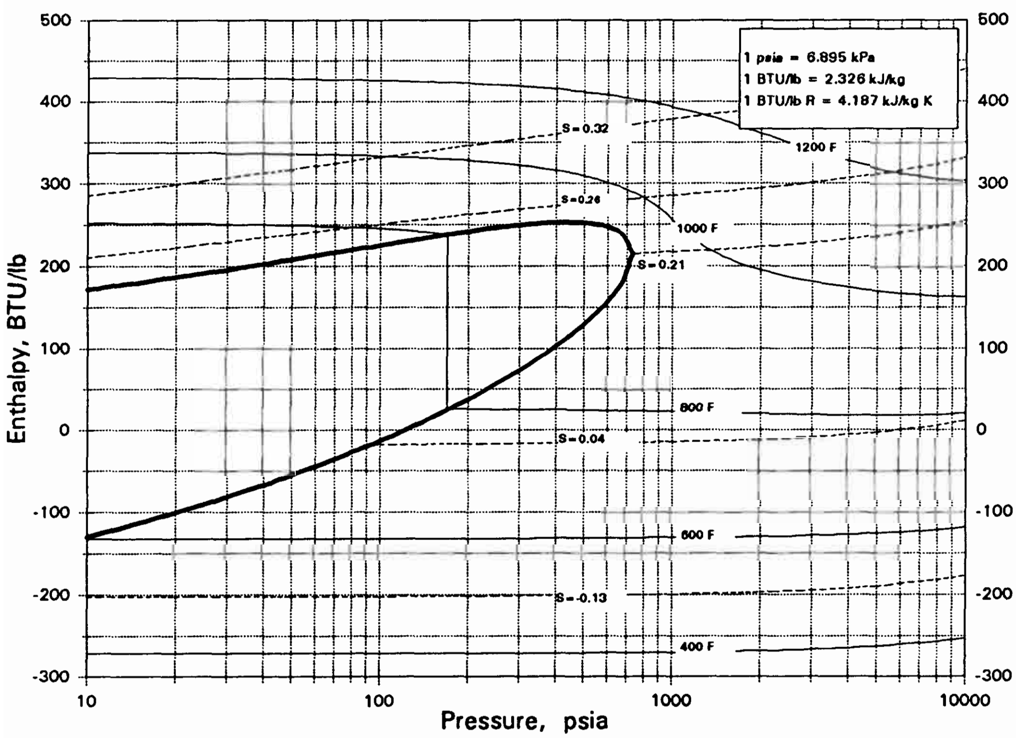




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

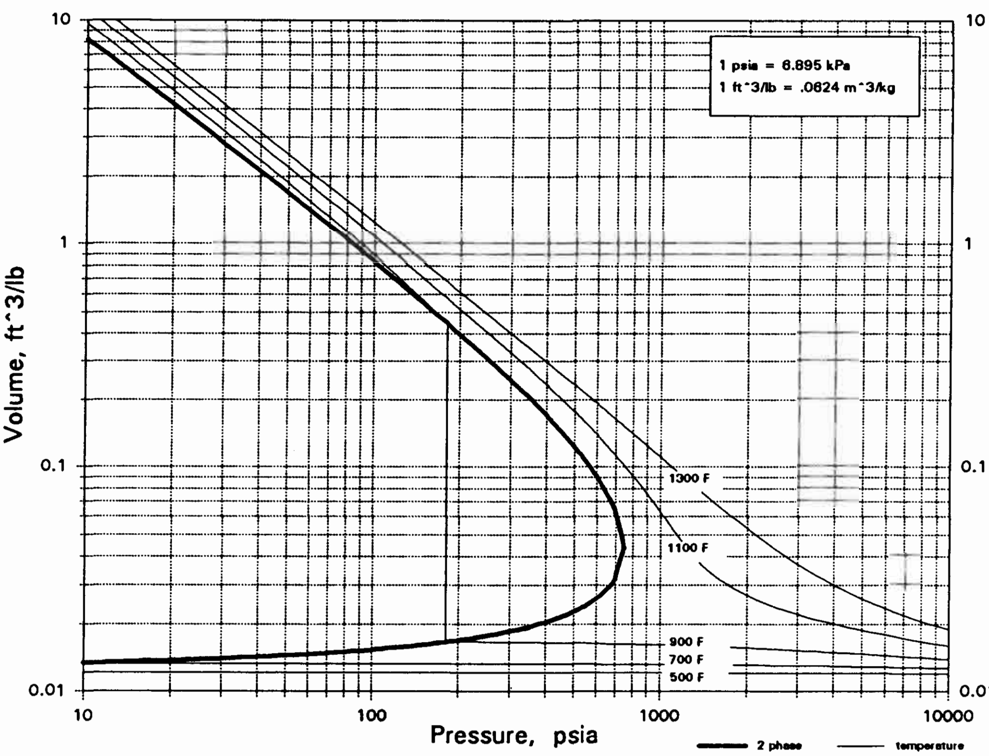
C4H6O5 MALIC ACID

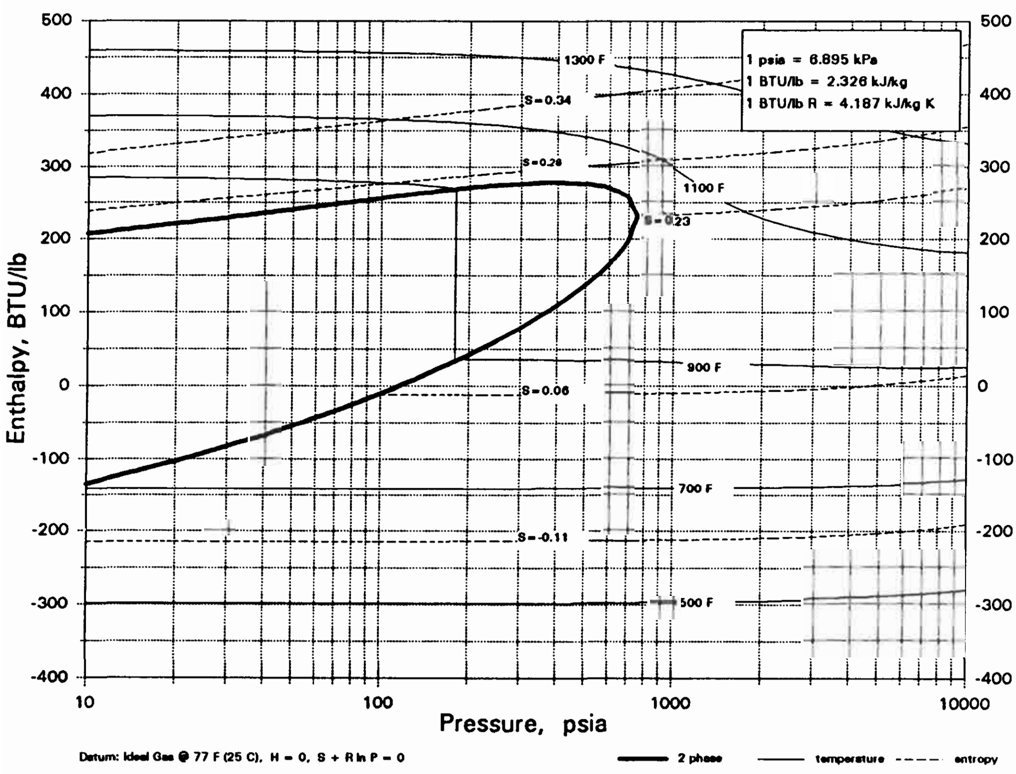




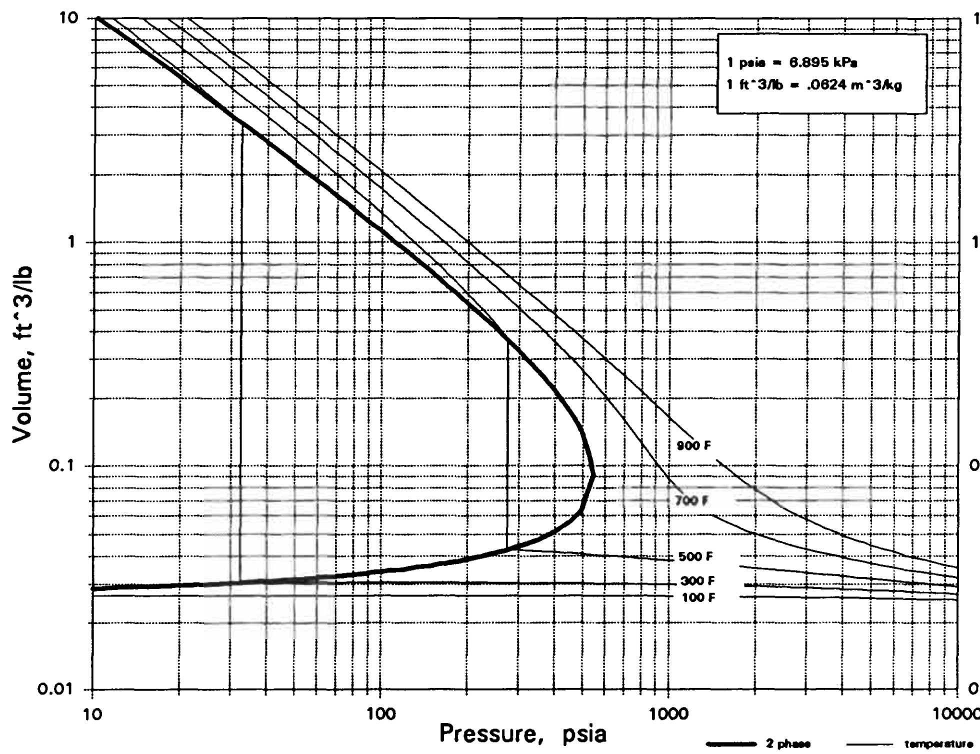
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

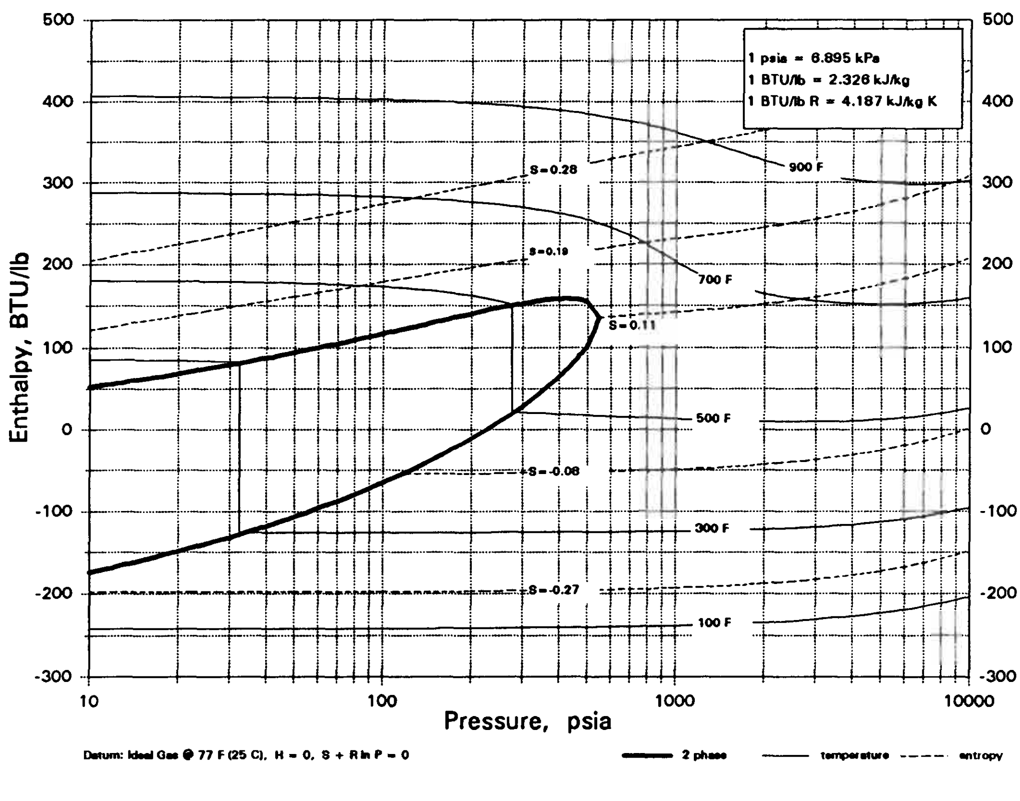
C4H6O6 TARTARIC ACID



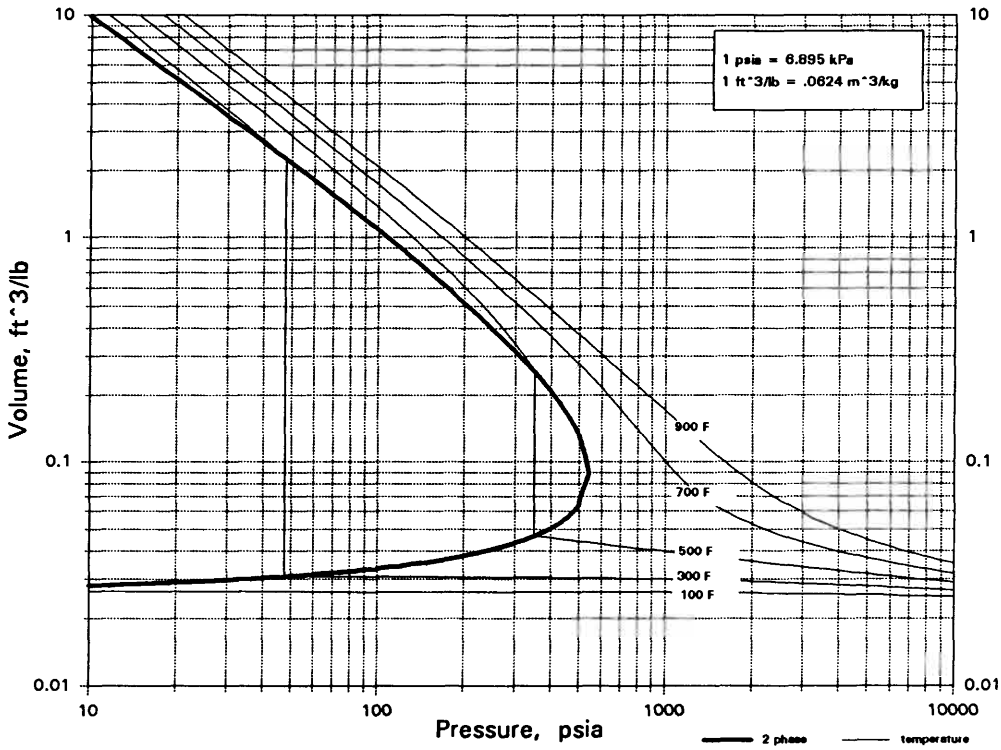


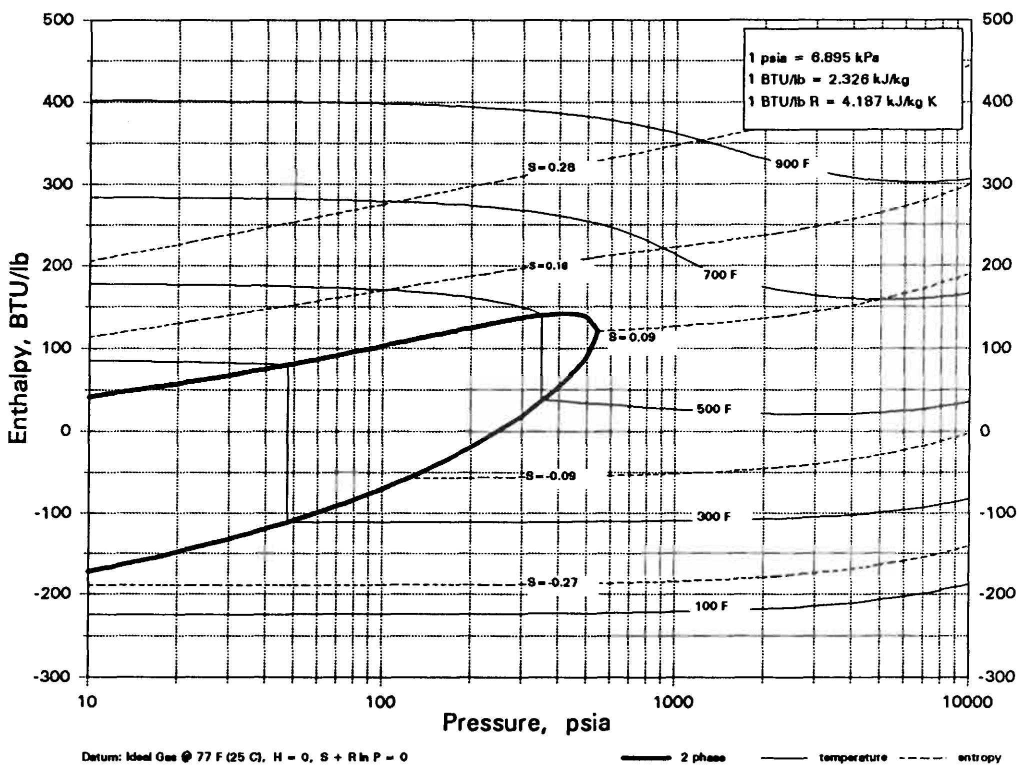
C4H7N n-BUTYRONITRILE



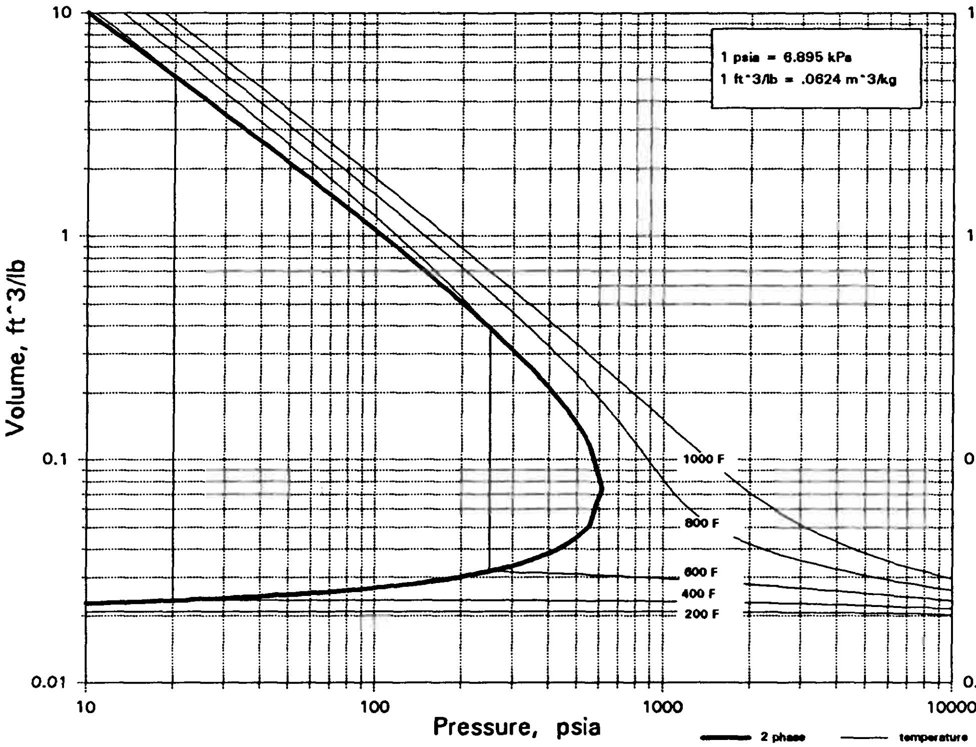


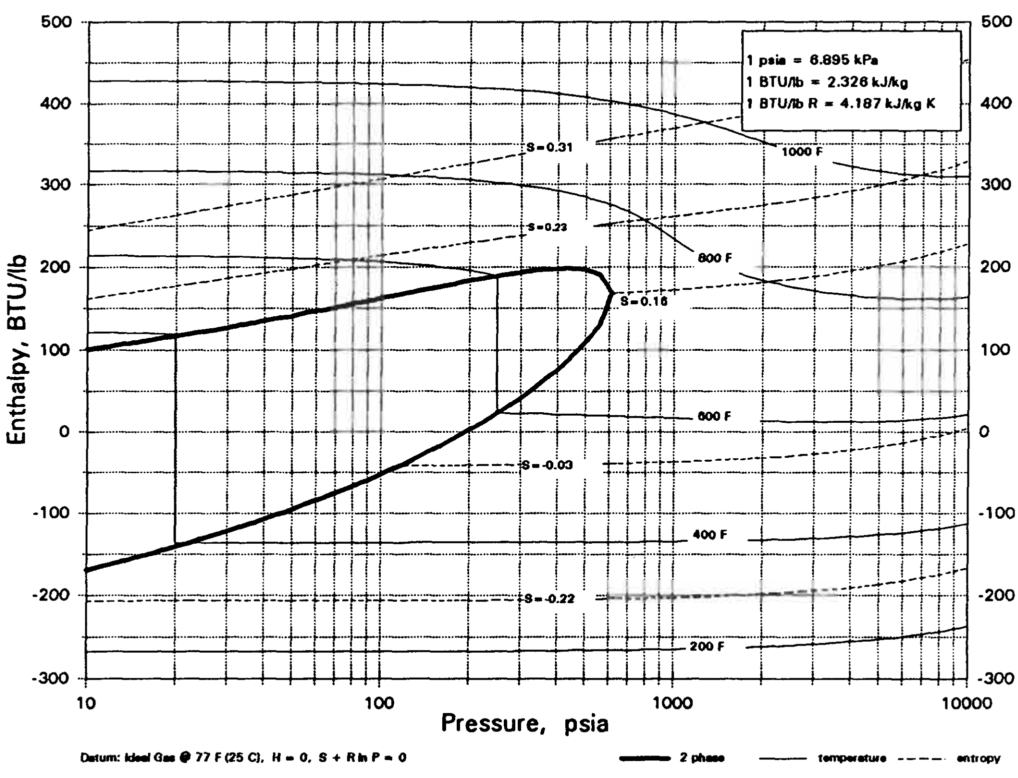
C4H7N ISOBUTYRONITRILE



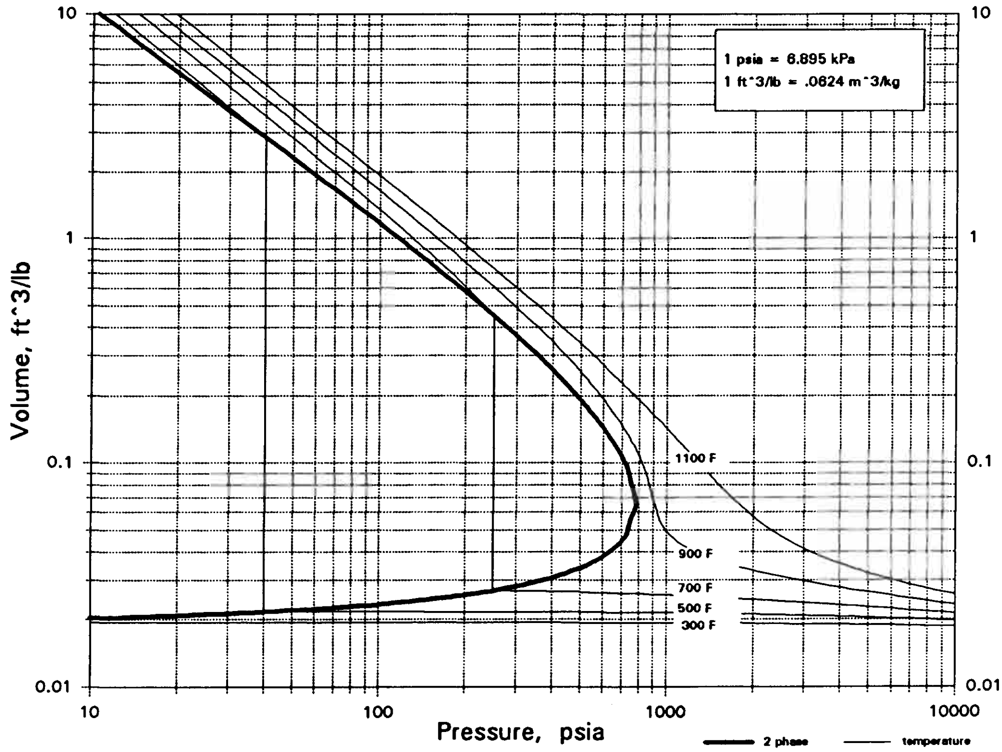


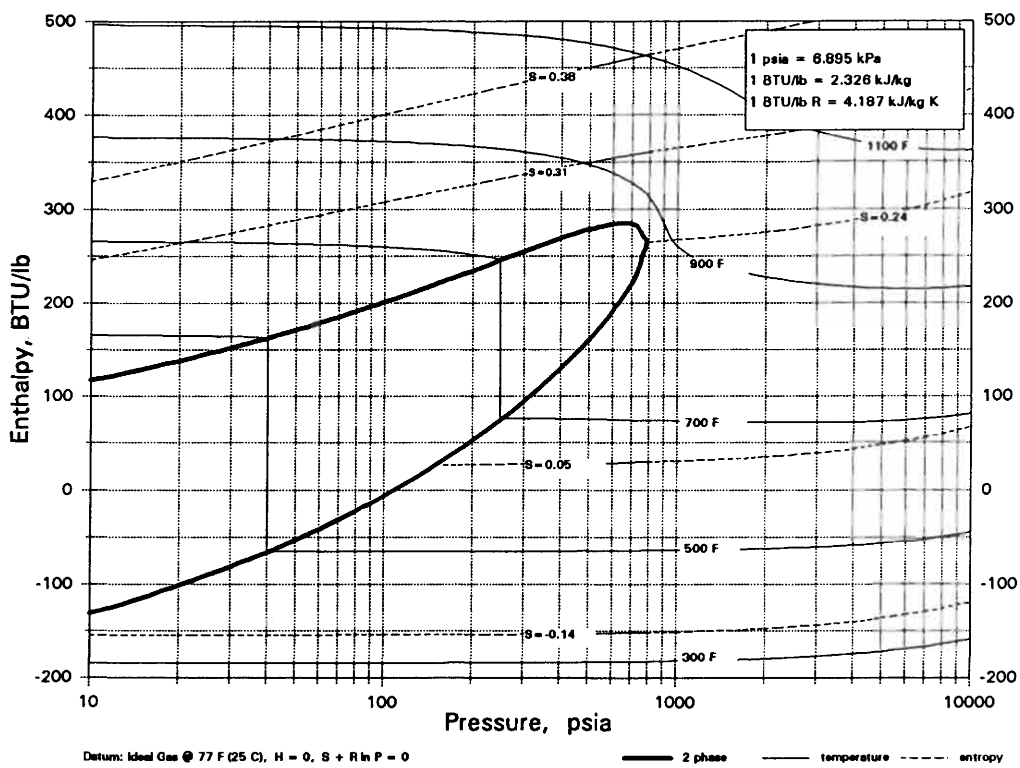
C4H7NO ACETONE CYANOHYDRIN



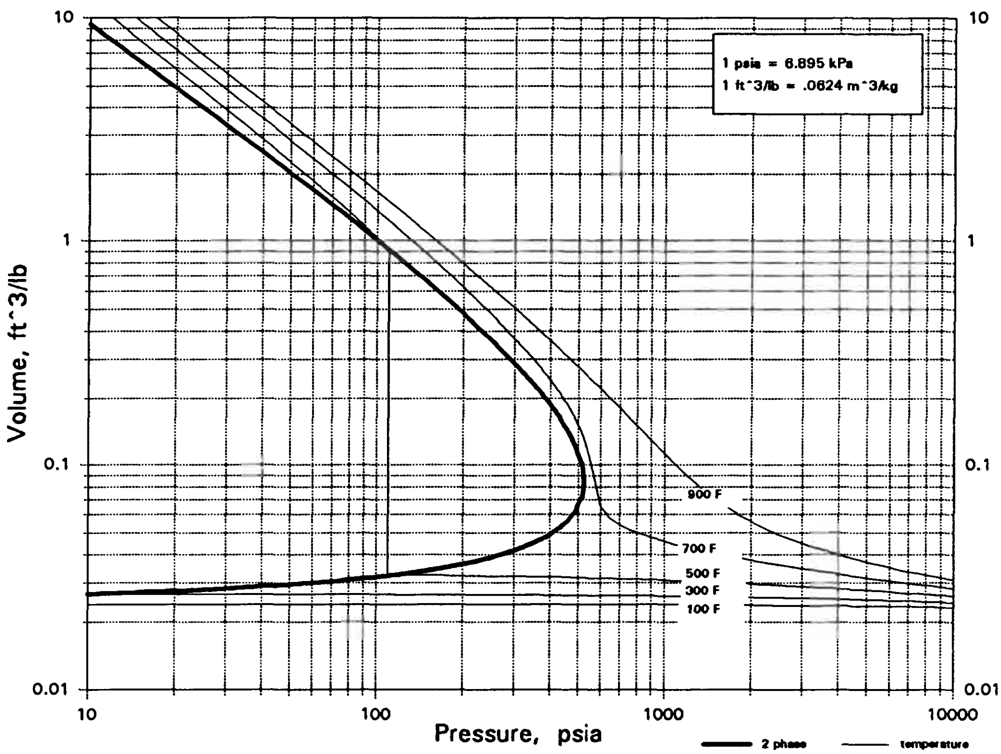


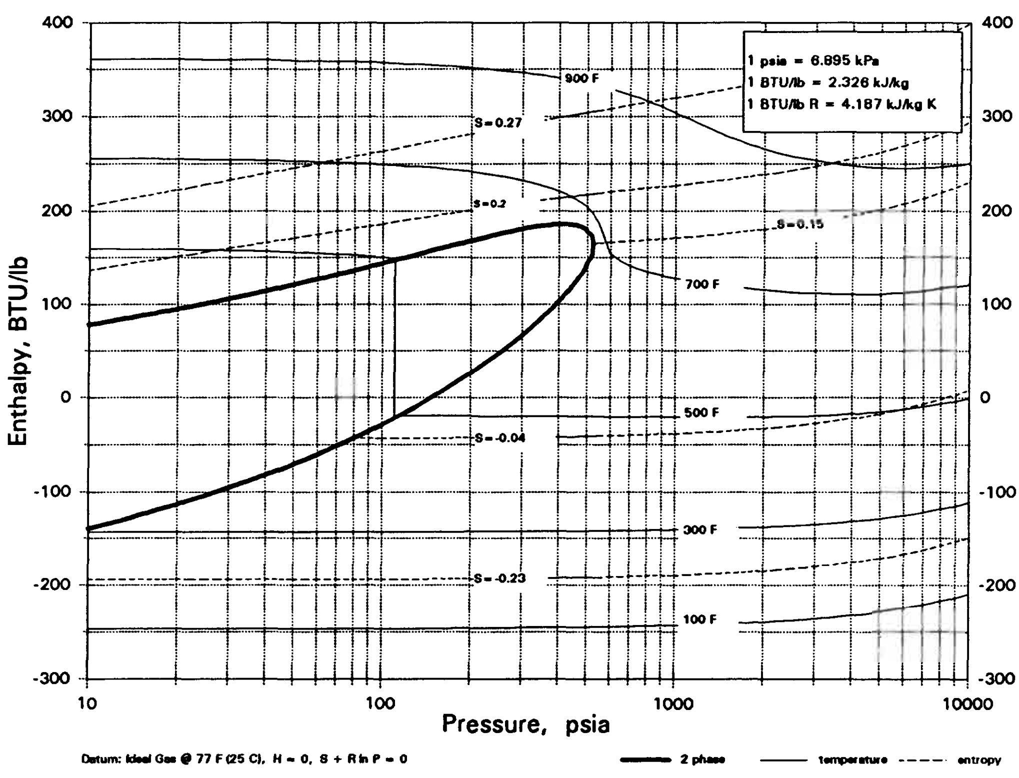
C4H7NO 2-METHACRYLAMIDE



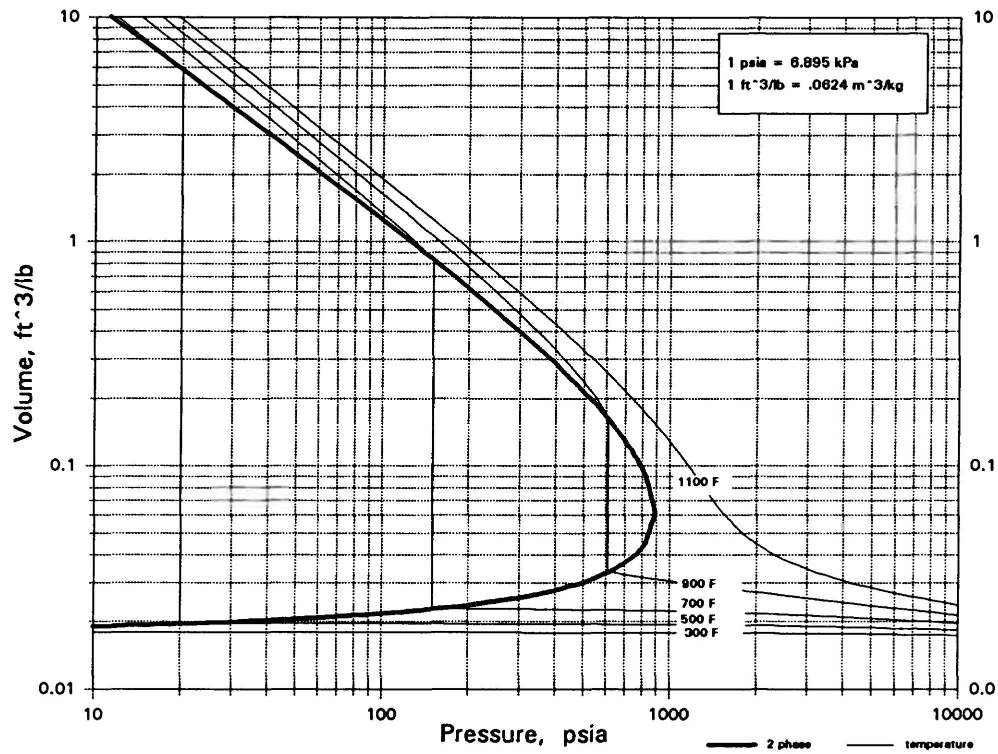


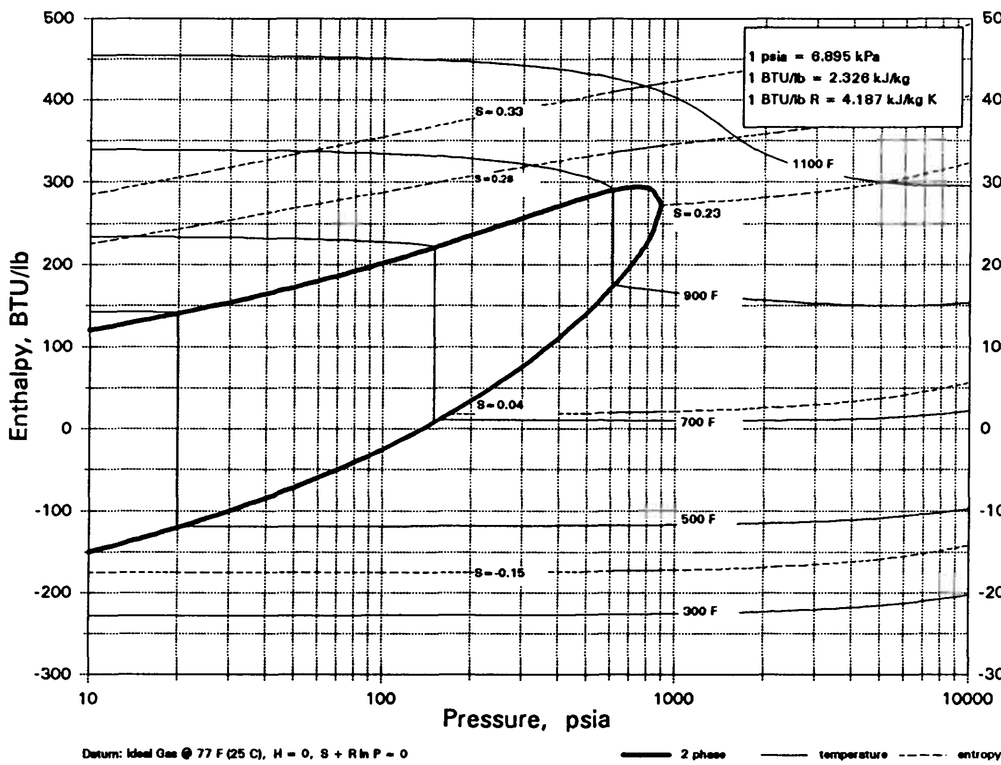
C4H7NO 3-METHOXYPROPIONITRILE



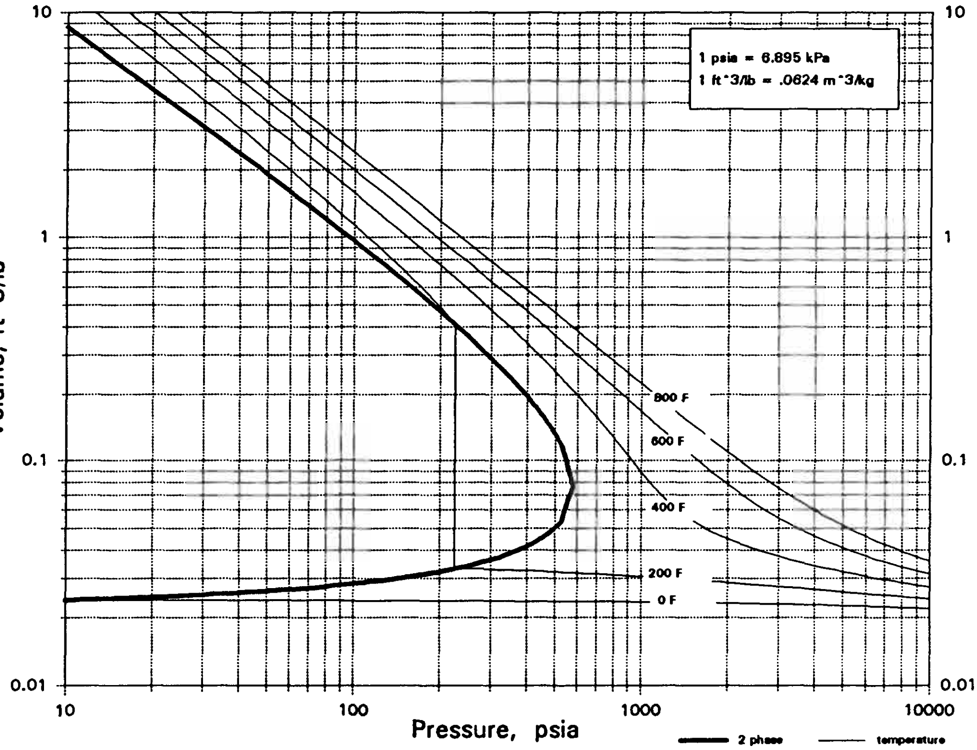


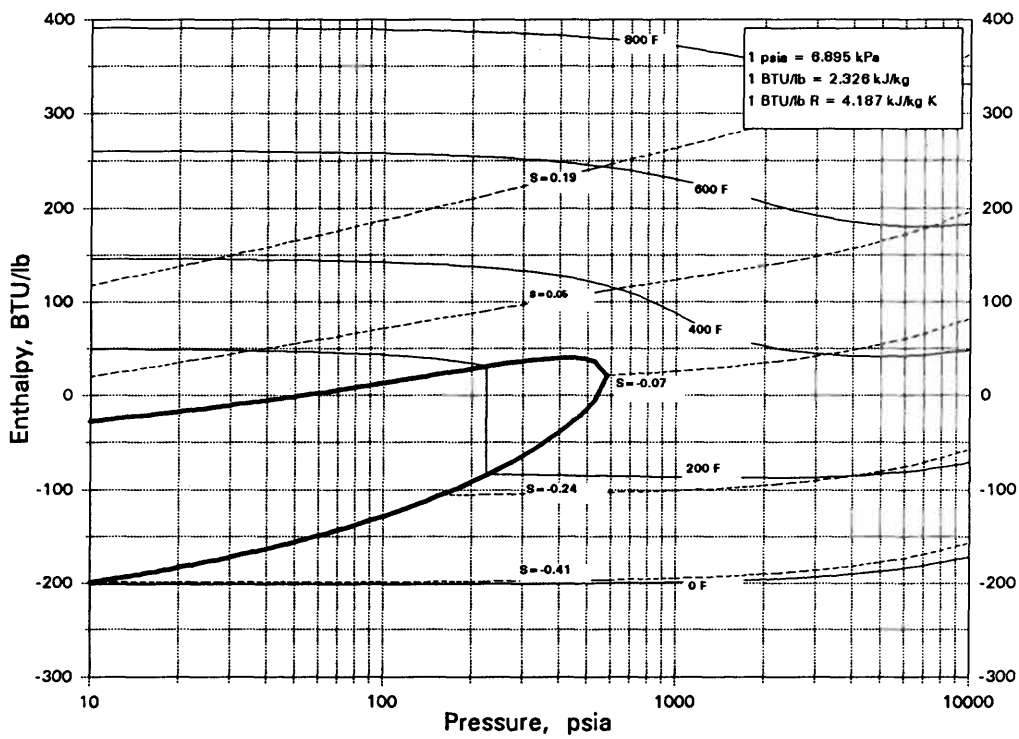
C4H7NO 2-PYRROLIDONE





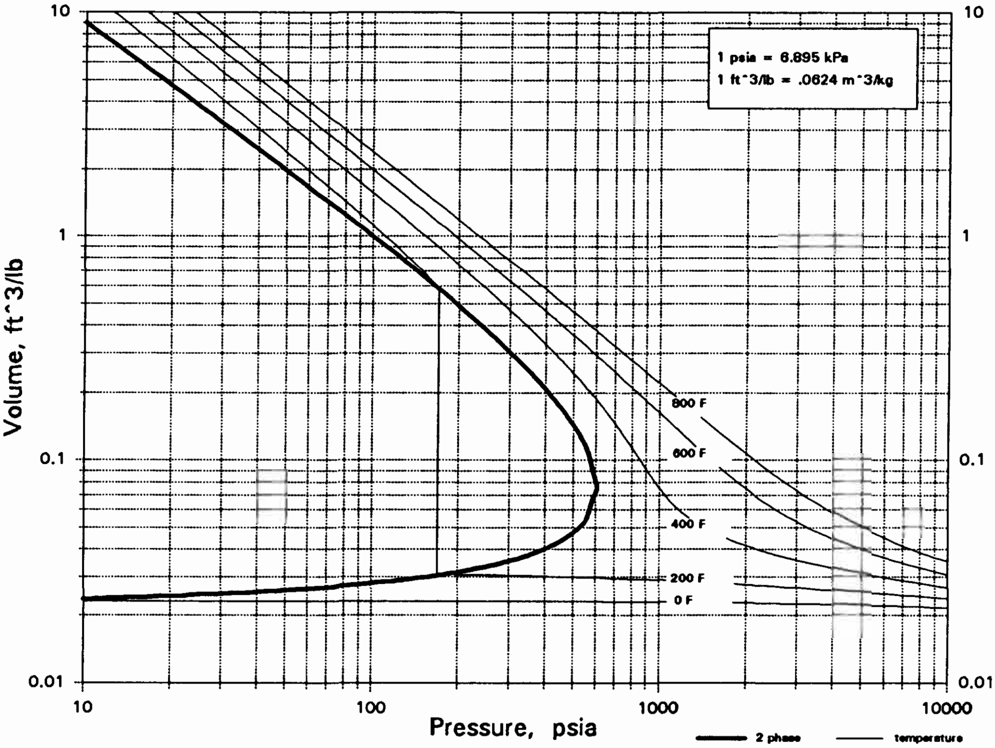
C4H8 1-BUTENE

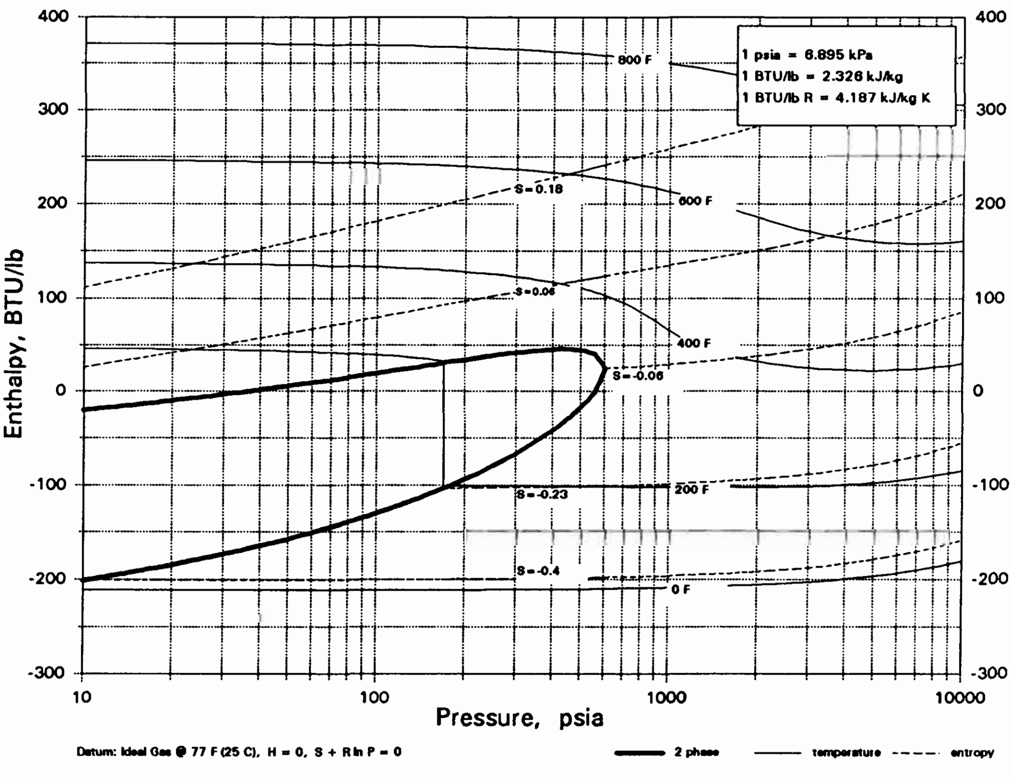




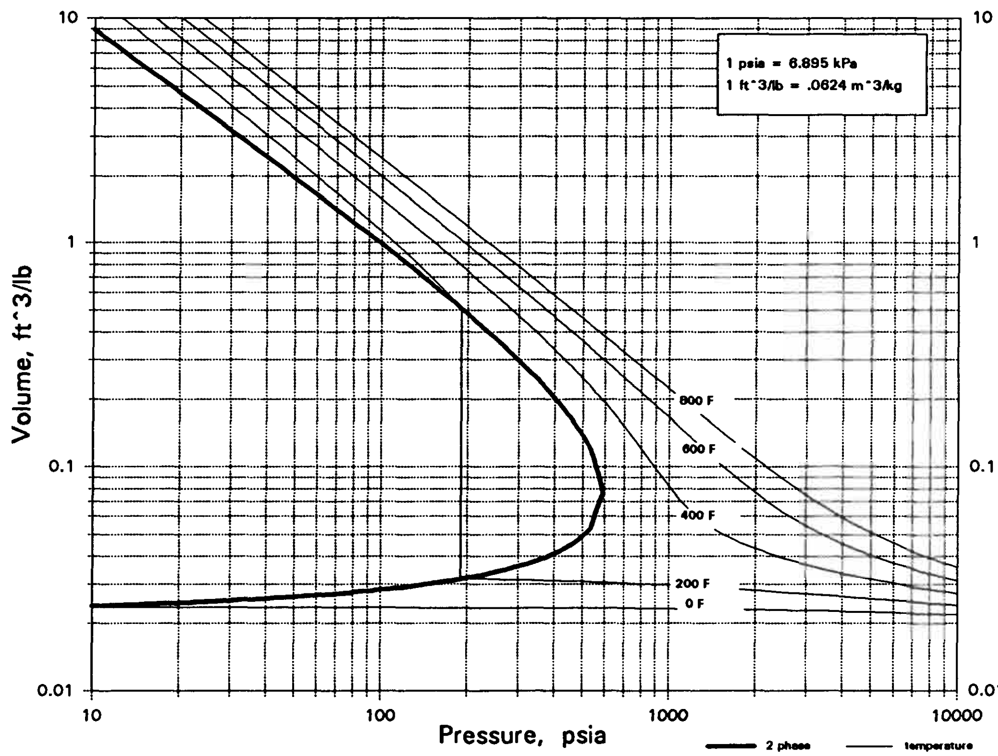
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

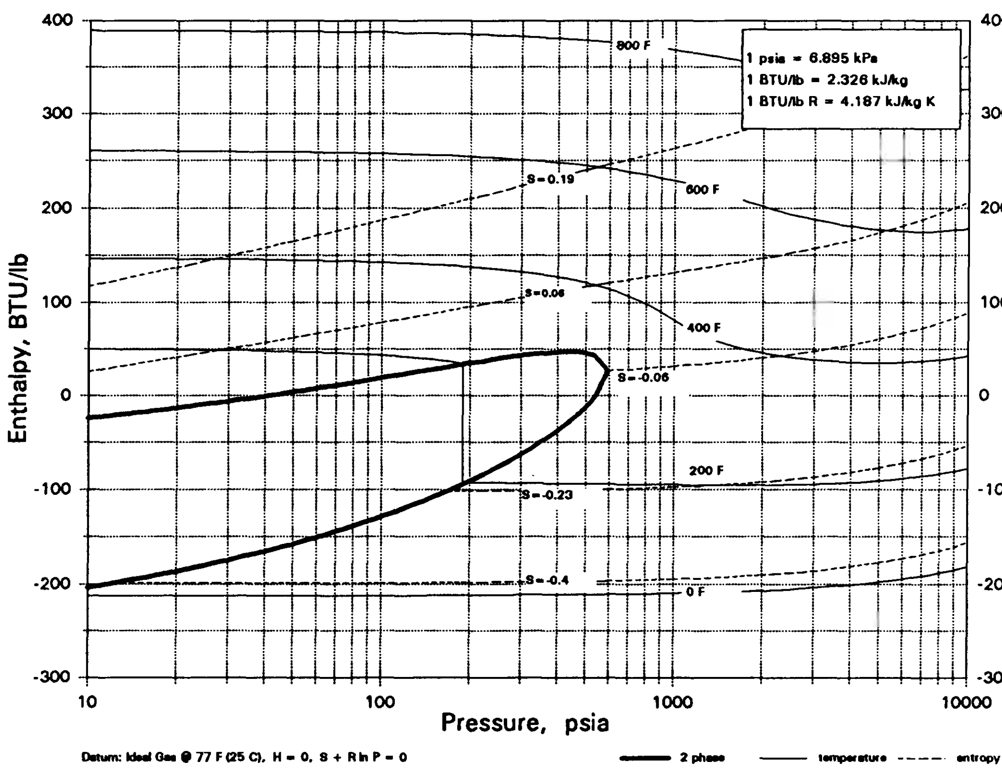
C4H8	cis-2-BUTENE



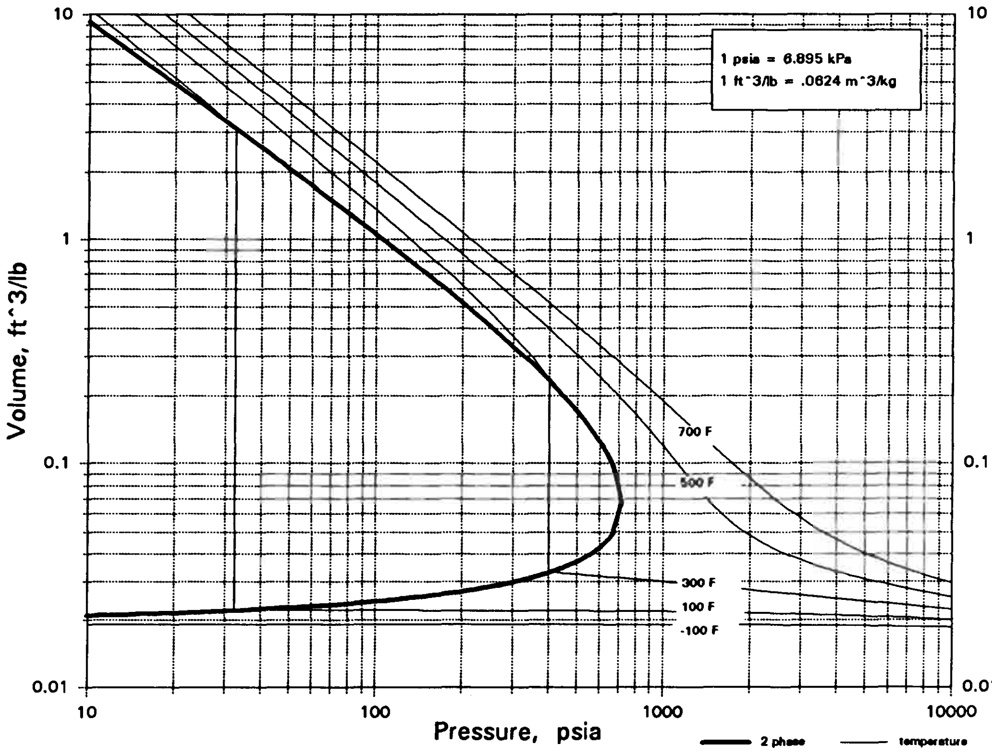


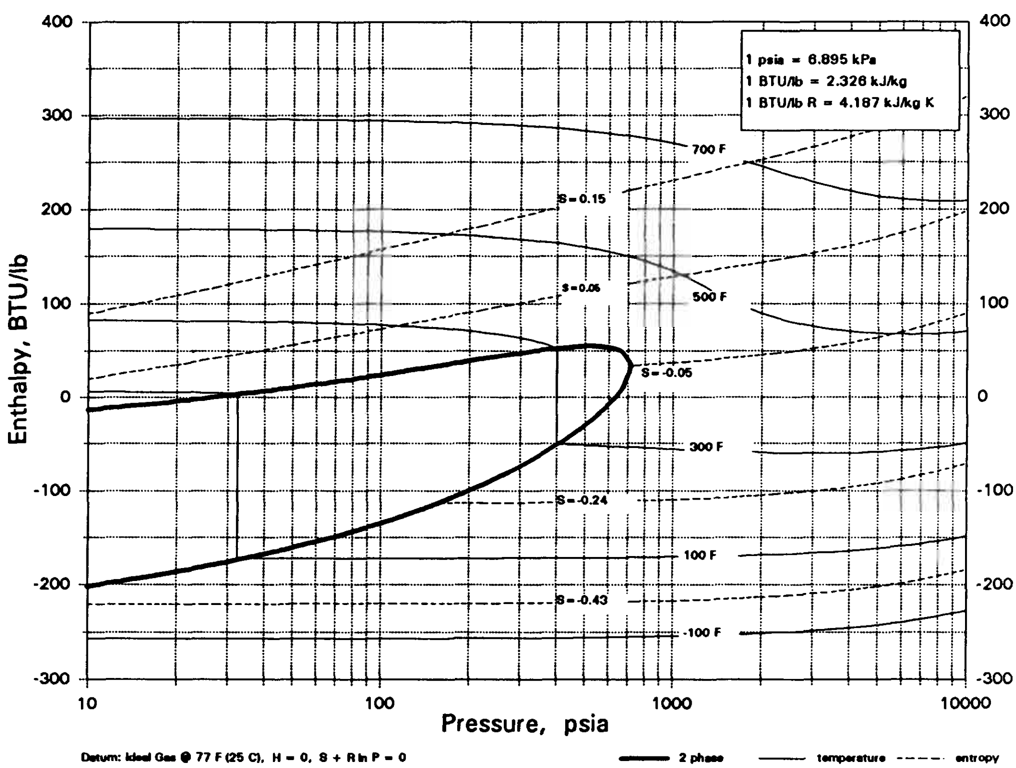
C4H8 trans-2-BUTENE



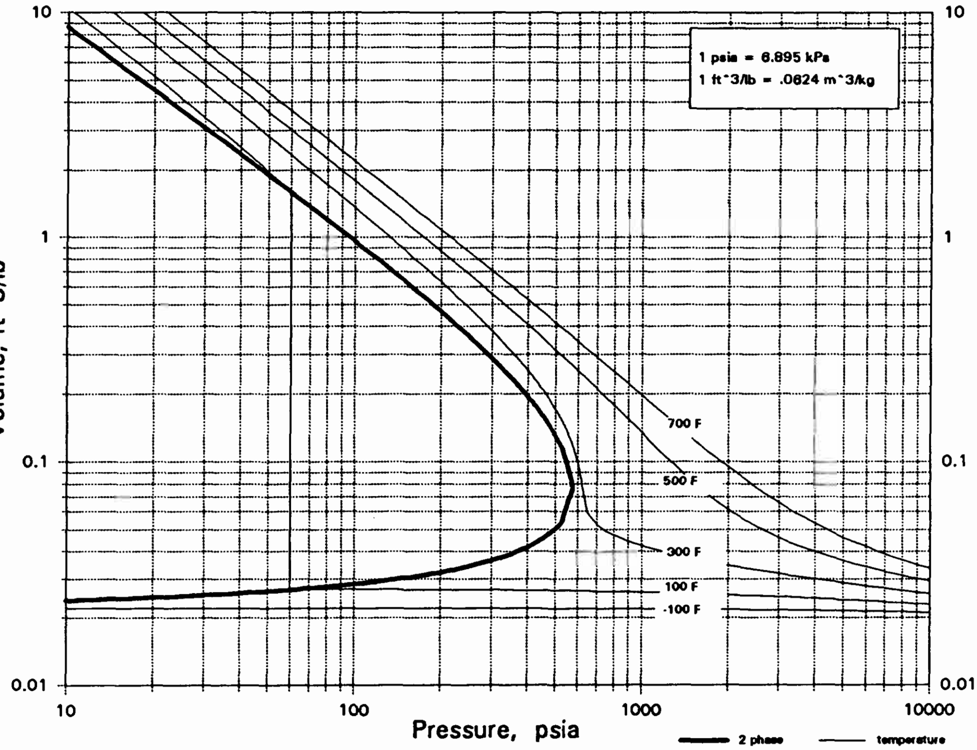


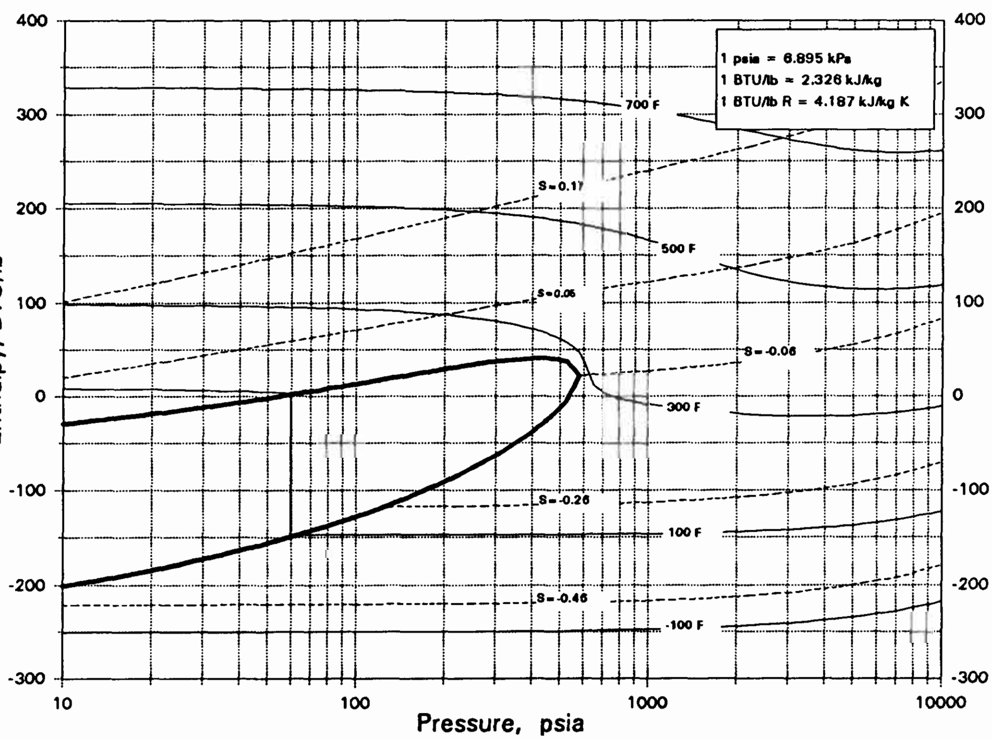
C4H8 CYCLOBUTANE



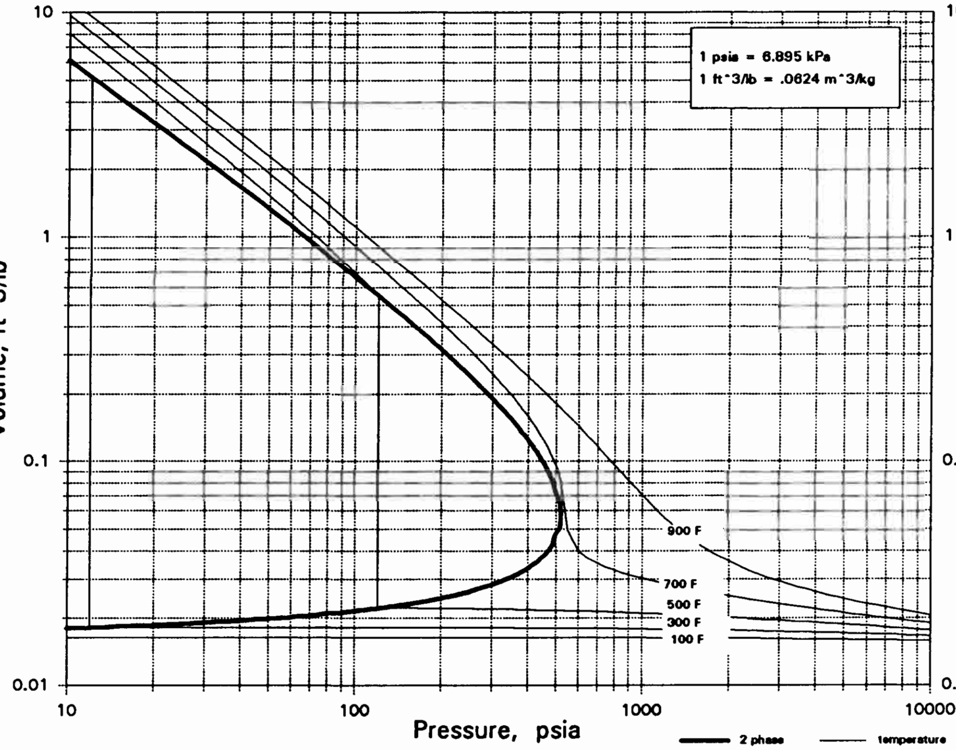


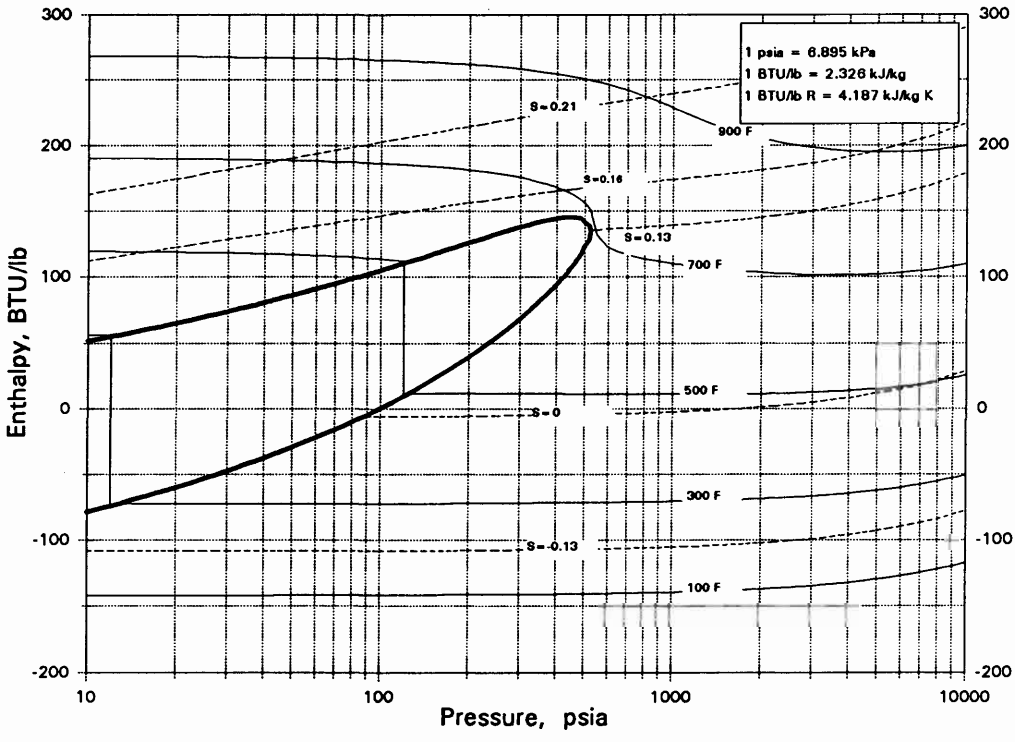
C4H8 ISOBUTENE



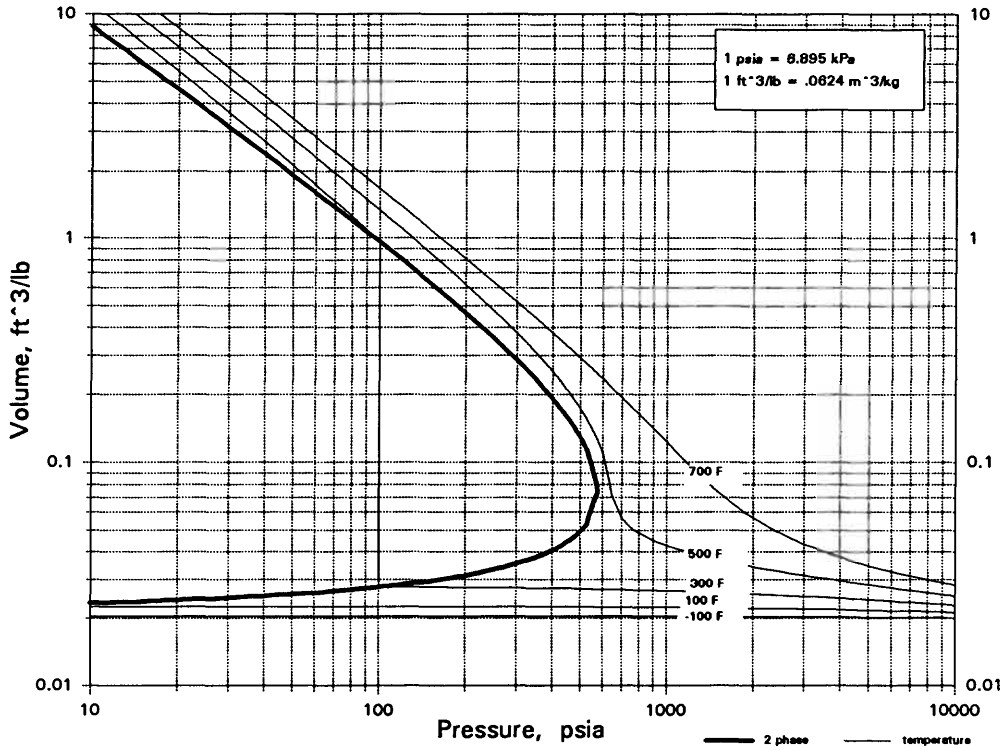


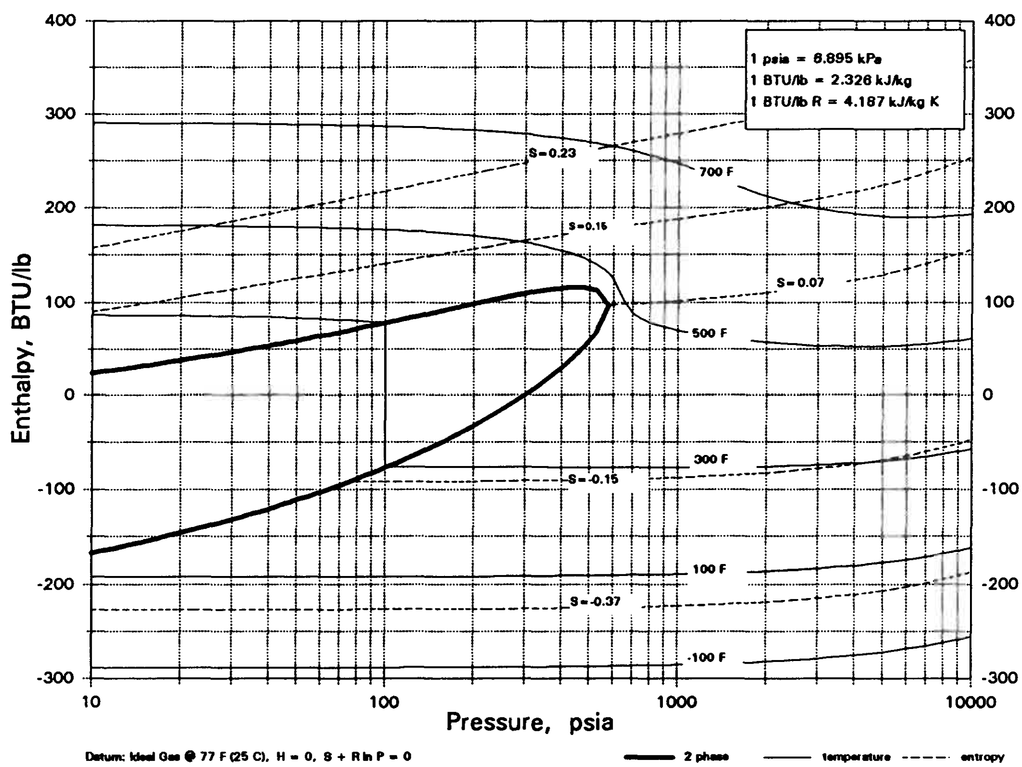
C4H8Cl2 1-4-DICHLOROBUTANE



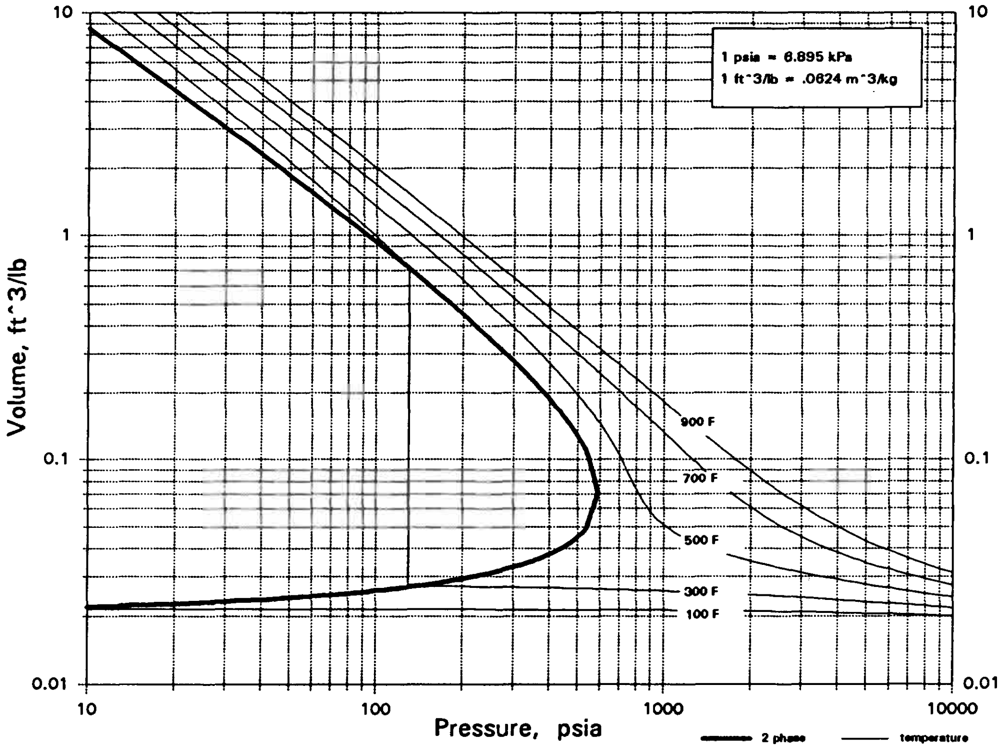


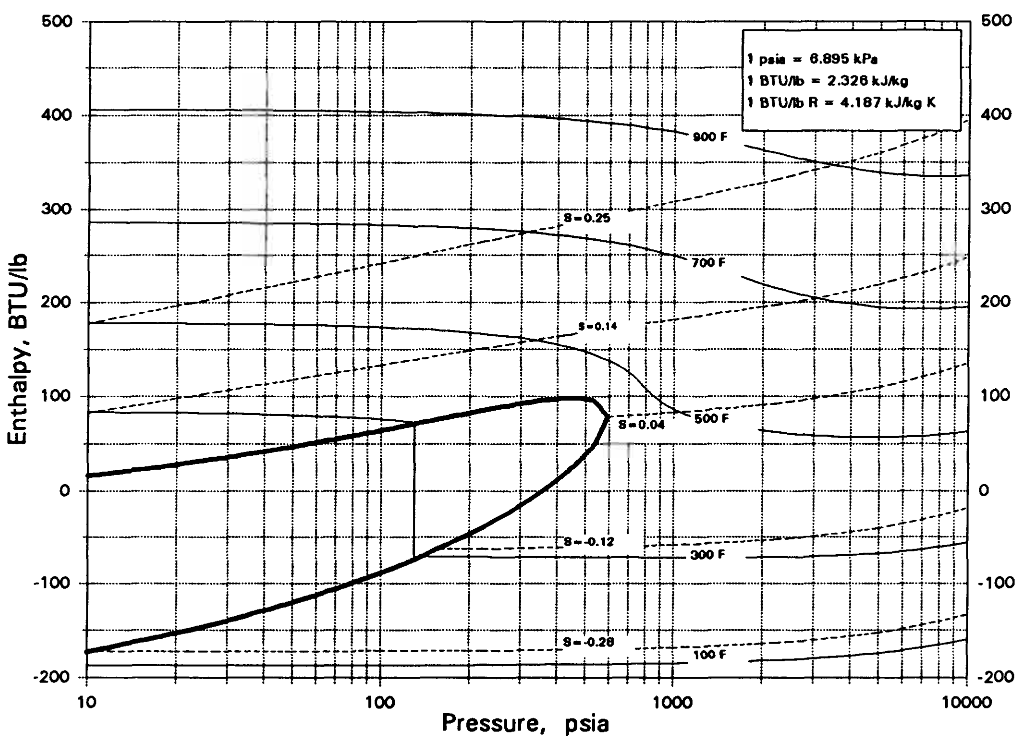
C4H8O n-BUTYRALDEHYDE





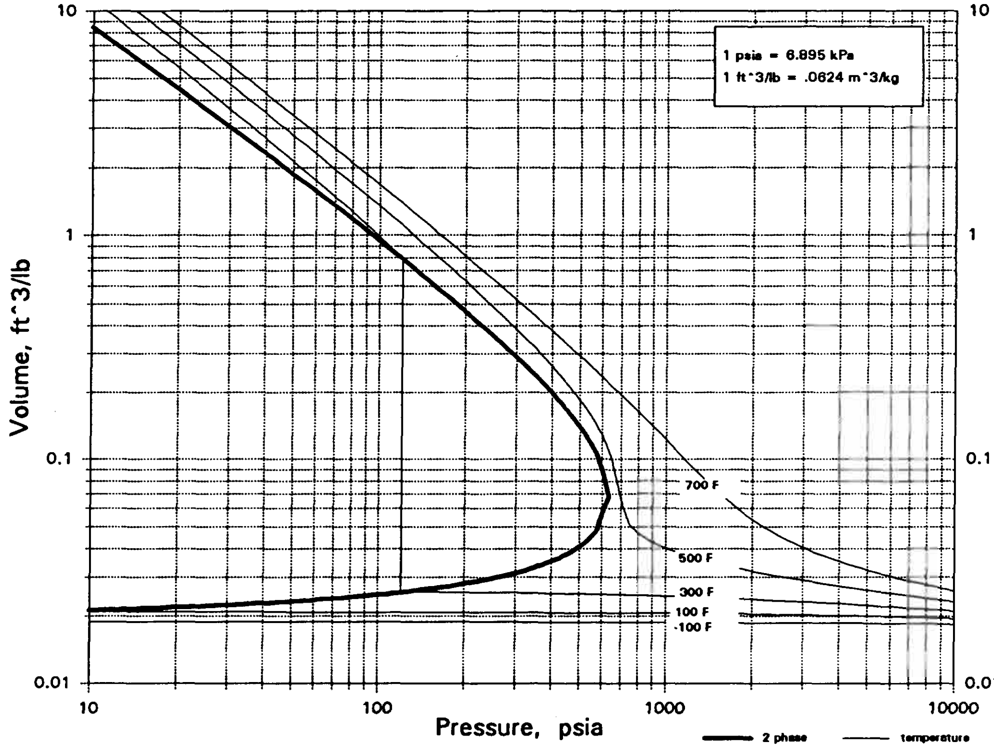
C4H8O ISOBUTYRALDEHYDE

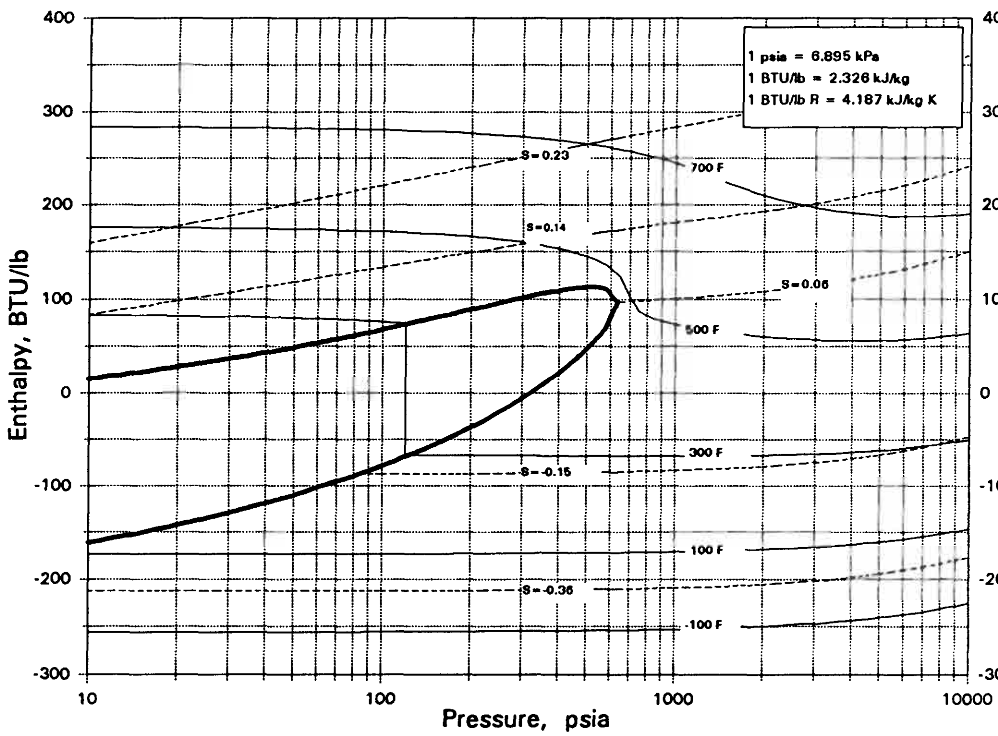




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

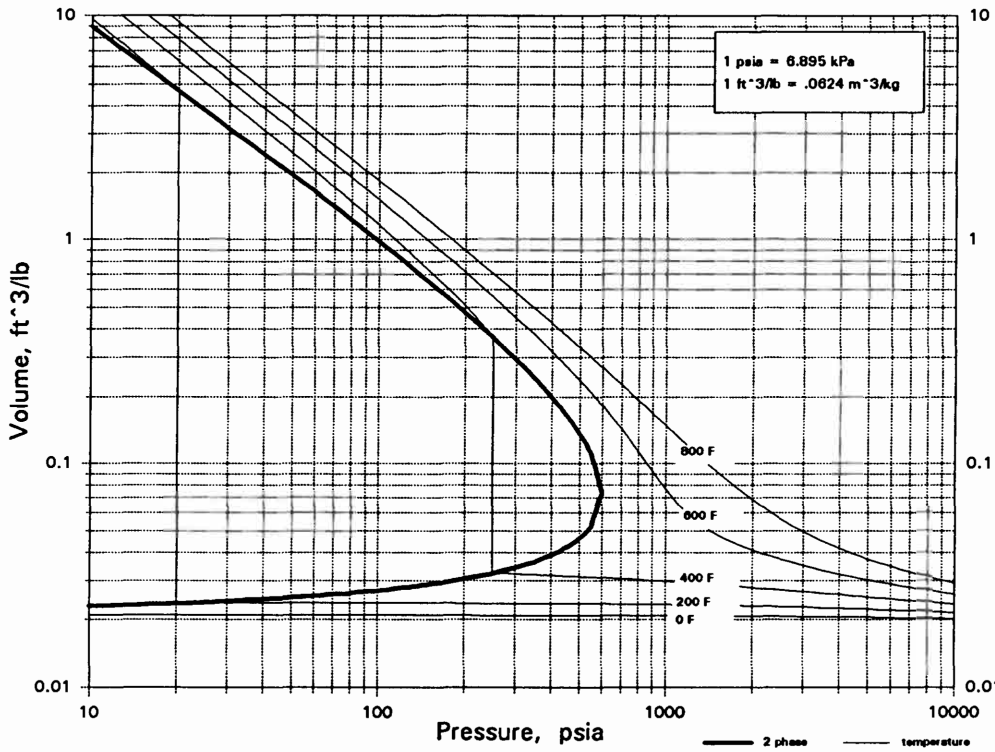
C4H8O 1-2-EPOXYBUTANE

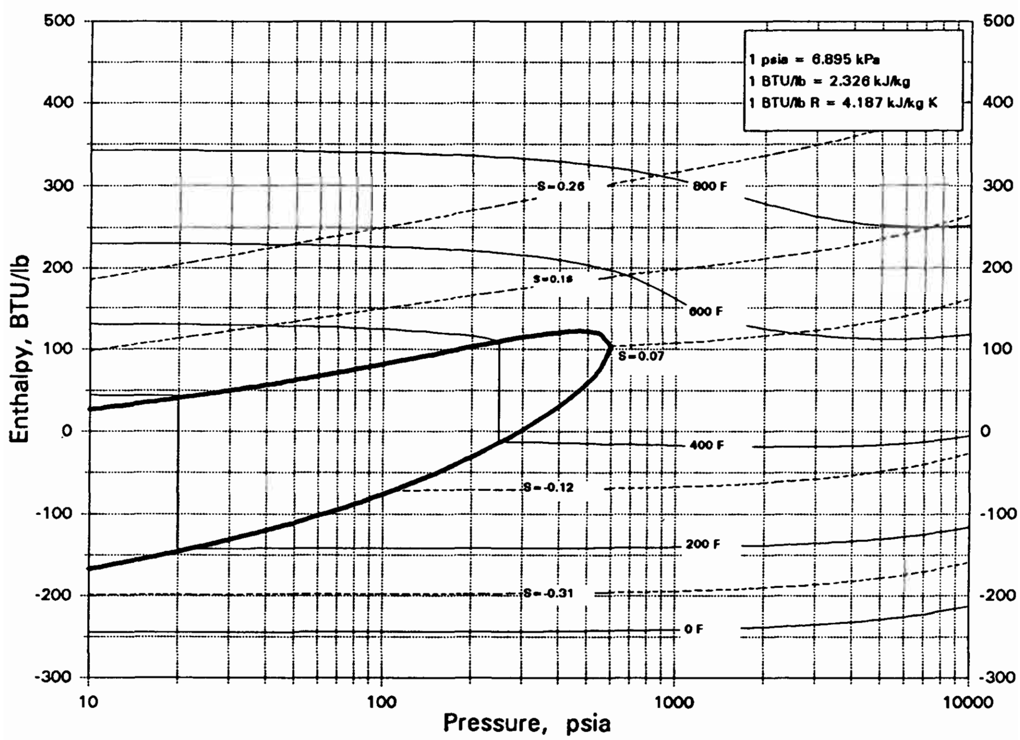




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

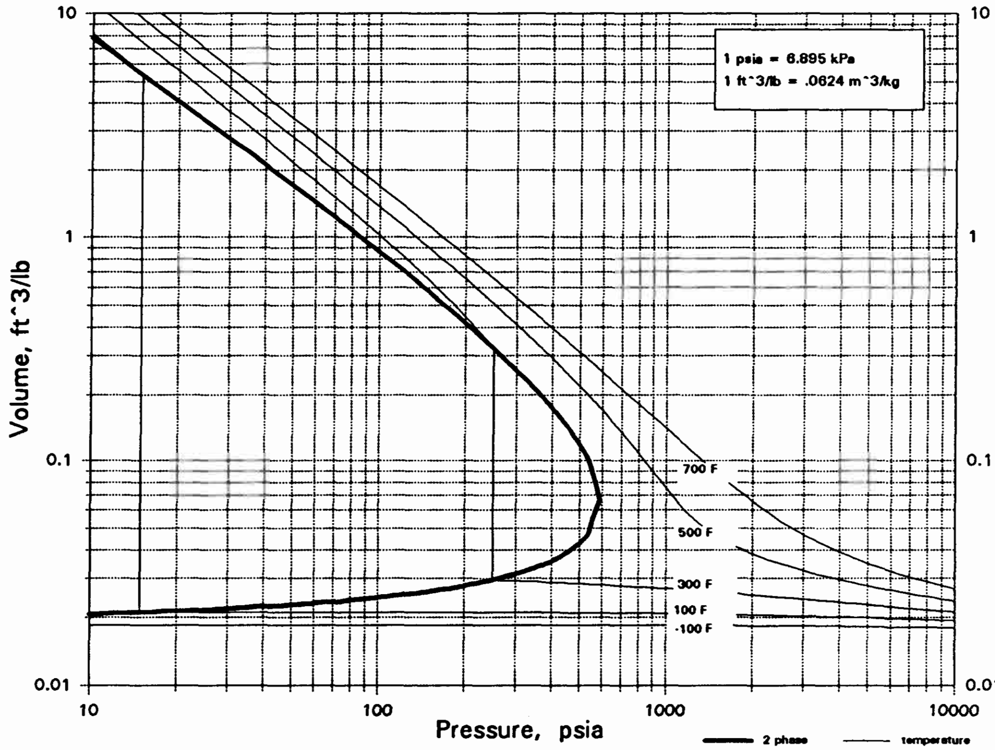
C4H8O METHYL ETHYL KETONE

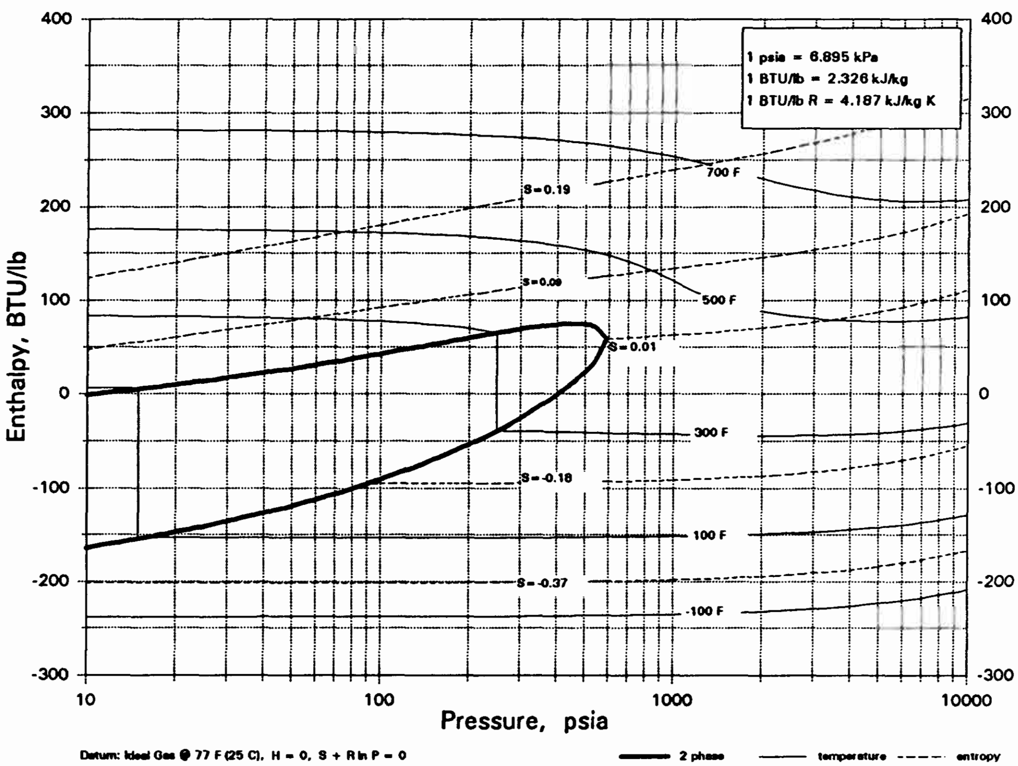




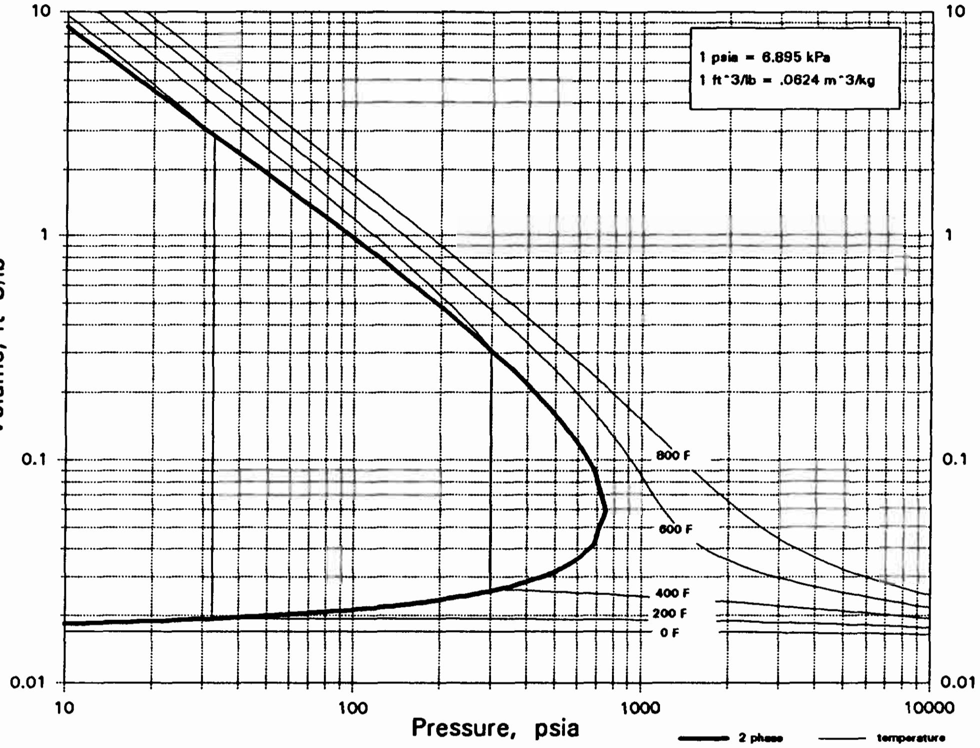
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

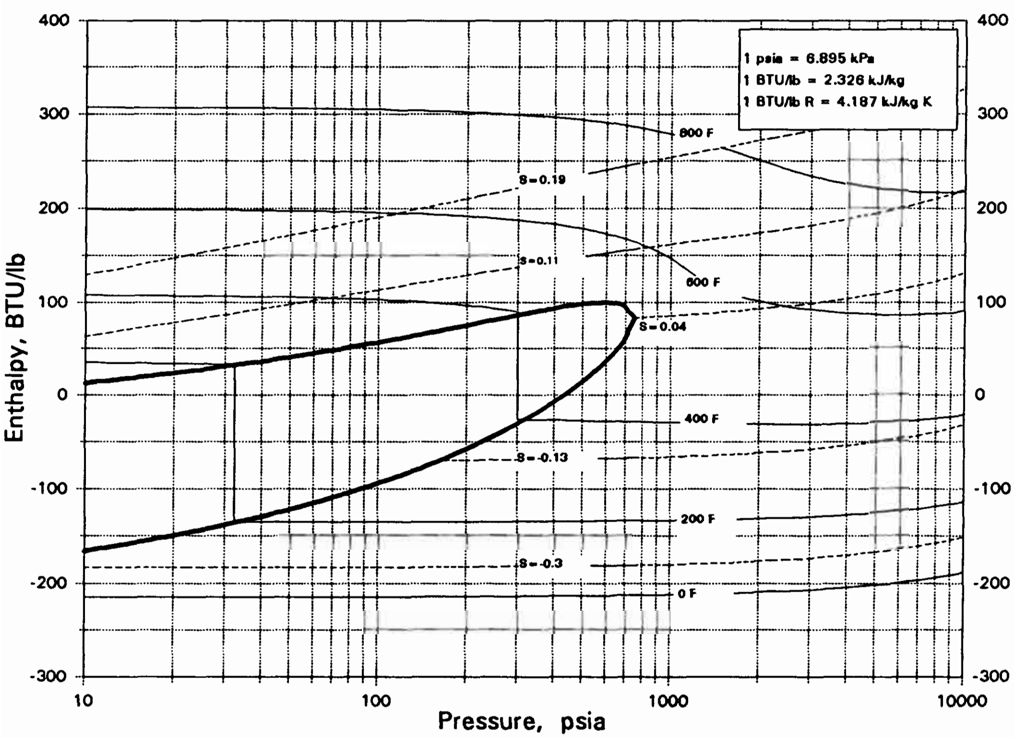
C4H8O	ETHYL VINYL ETHER





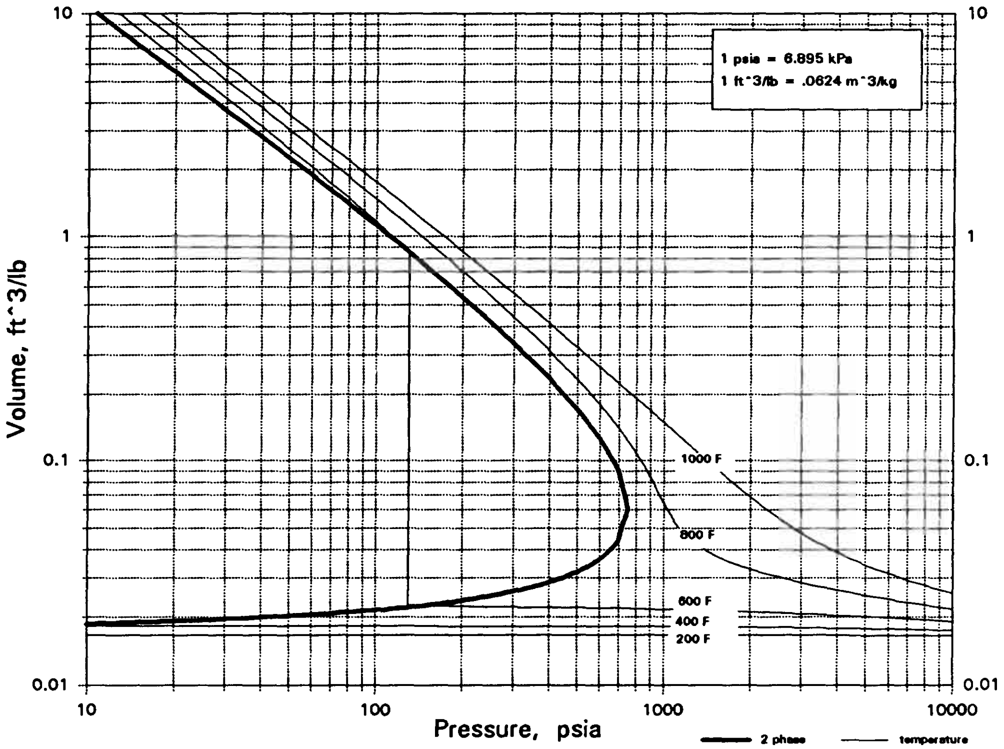
C4H8O TETRAHYDROFURAN

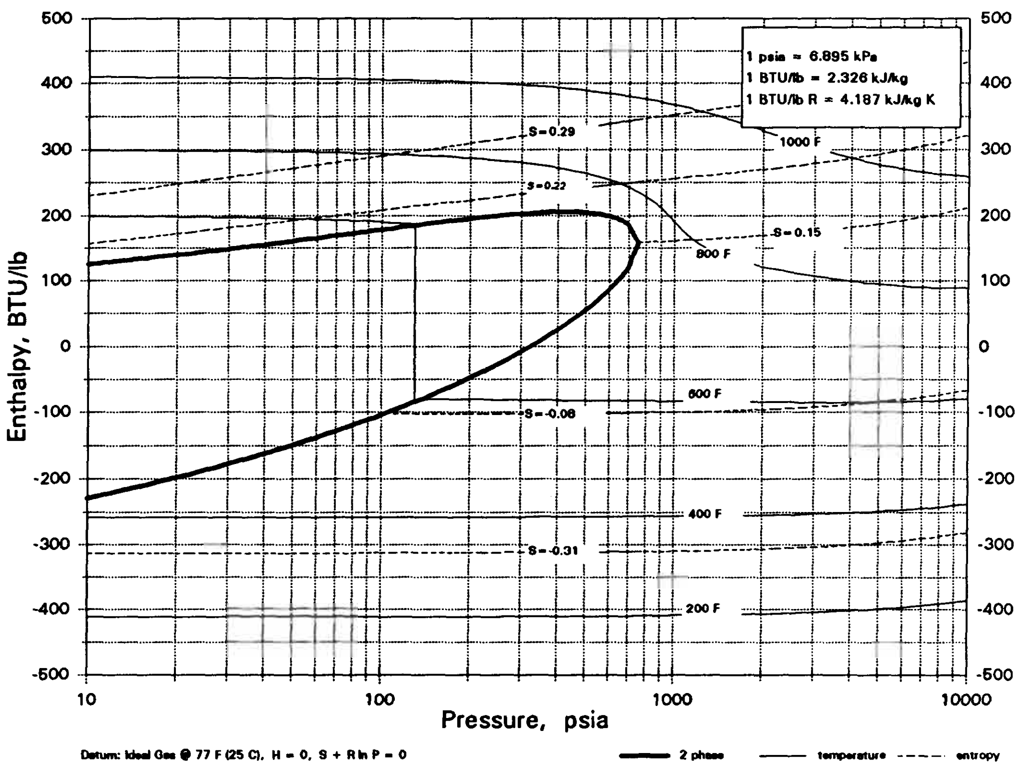




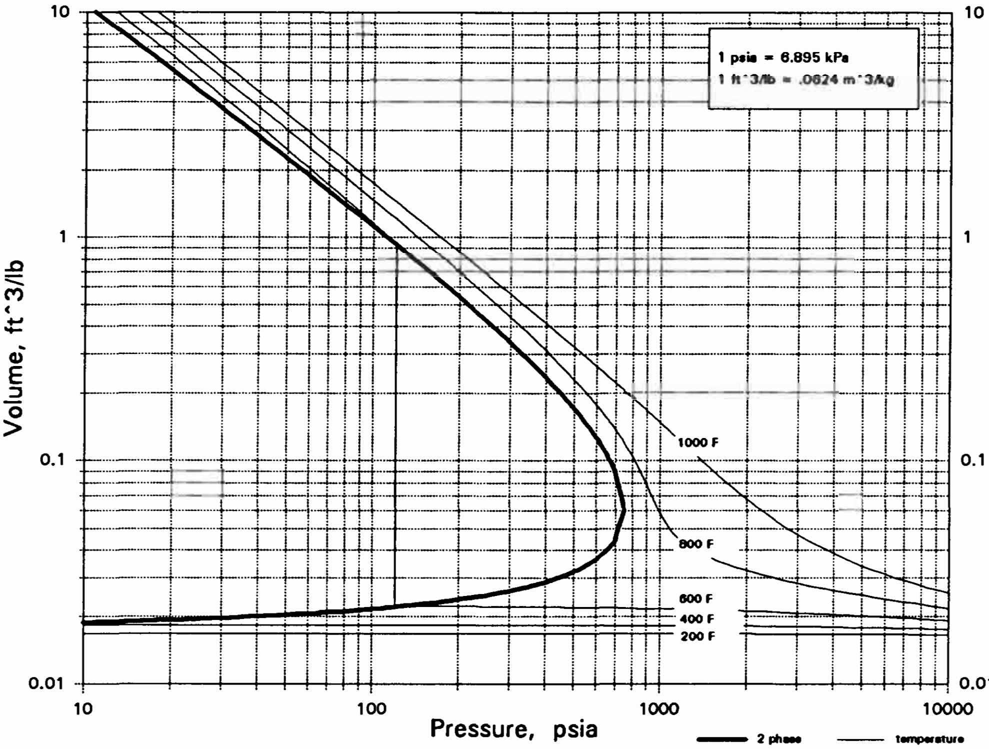
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

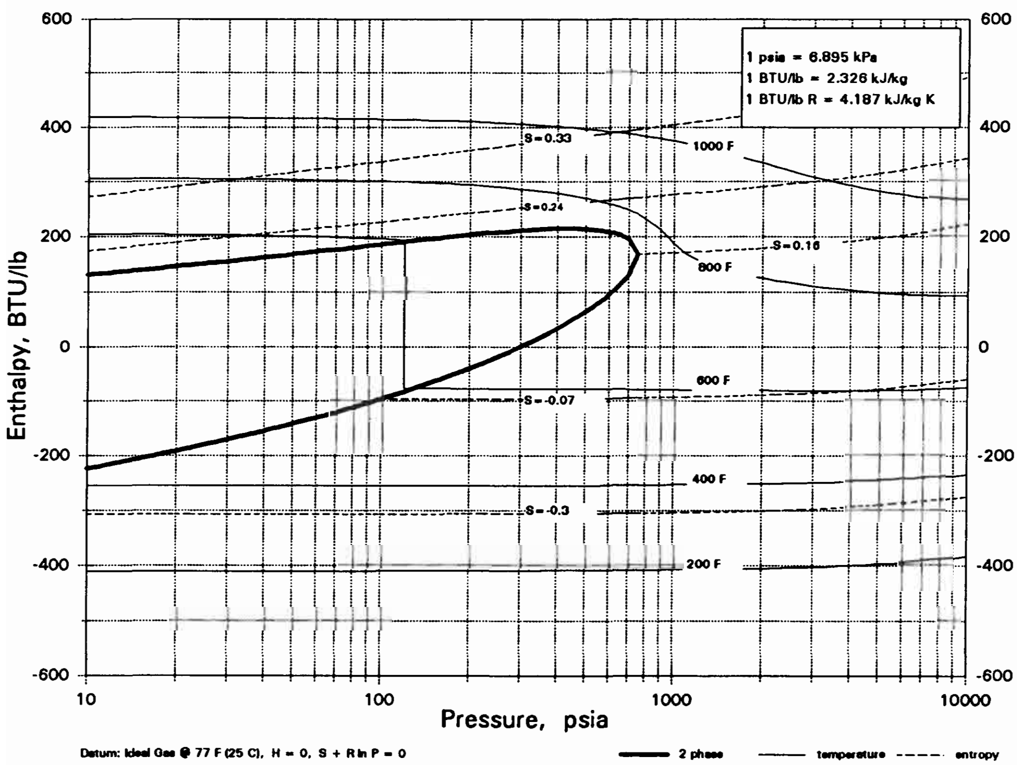
C4H8O2 cis-2-BUTENE-1-4-DIOL



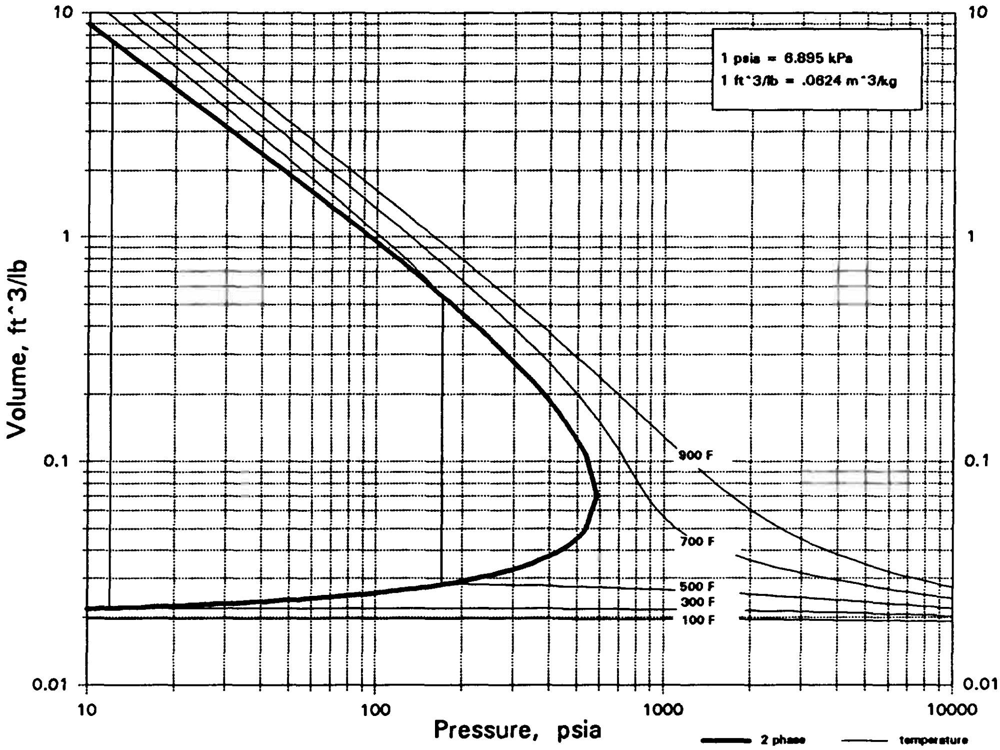


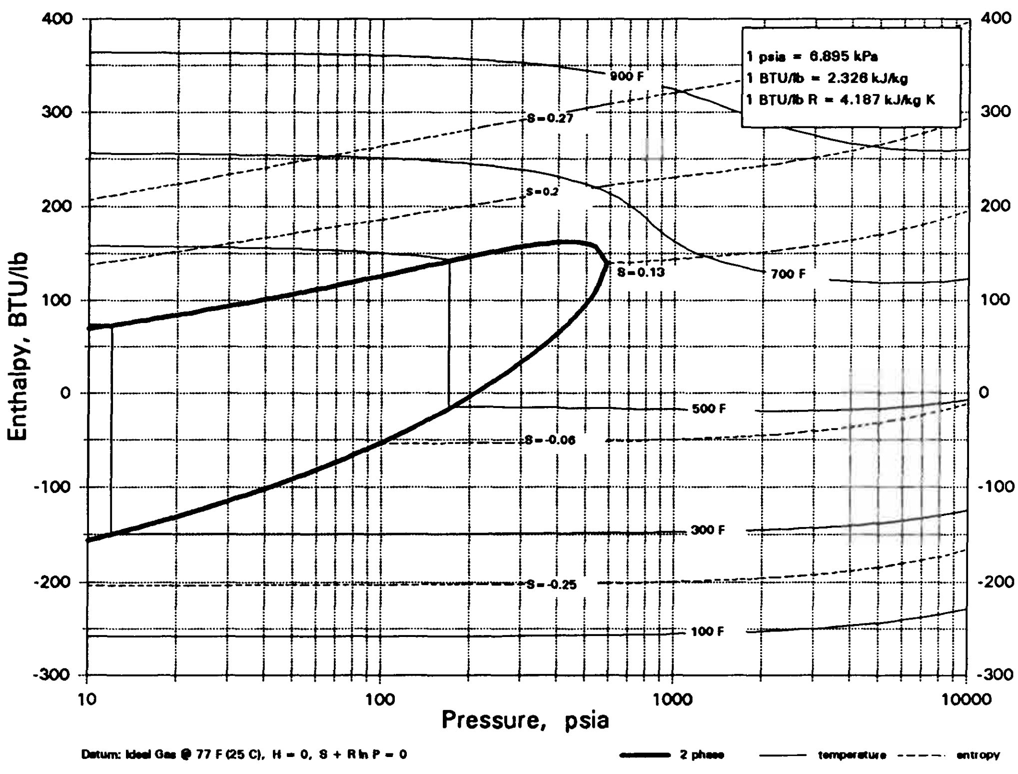
C4H8O2 trans-2-BUTENE-1-4-DIOL



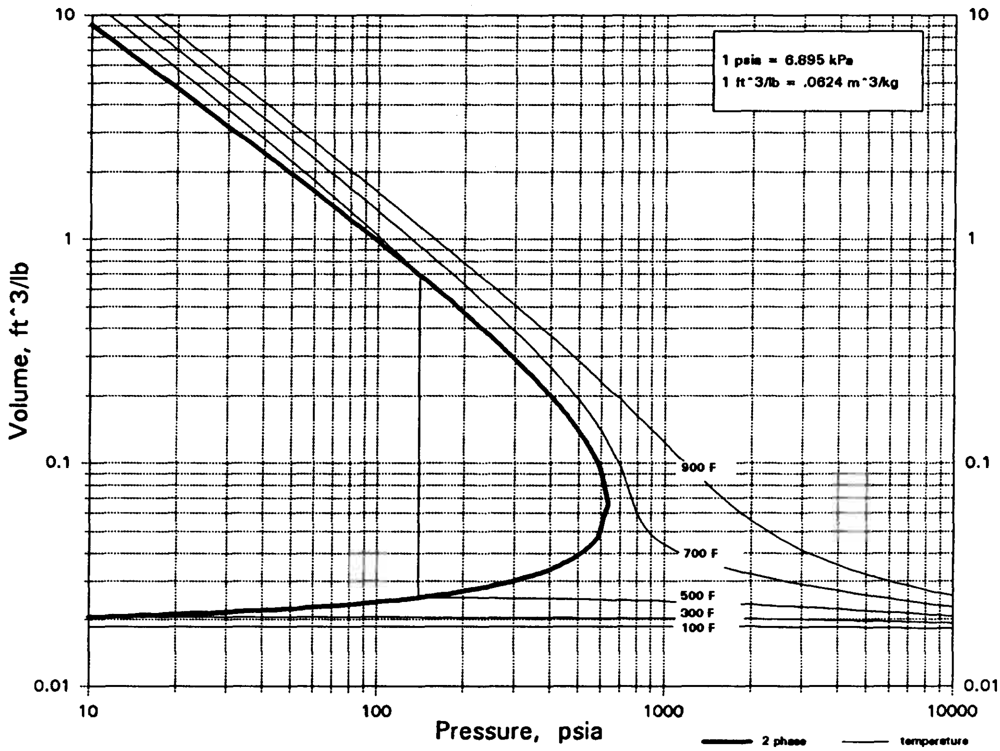


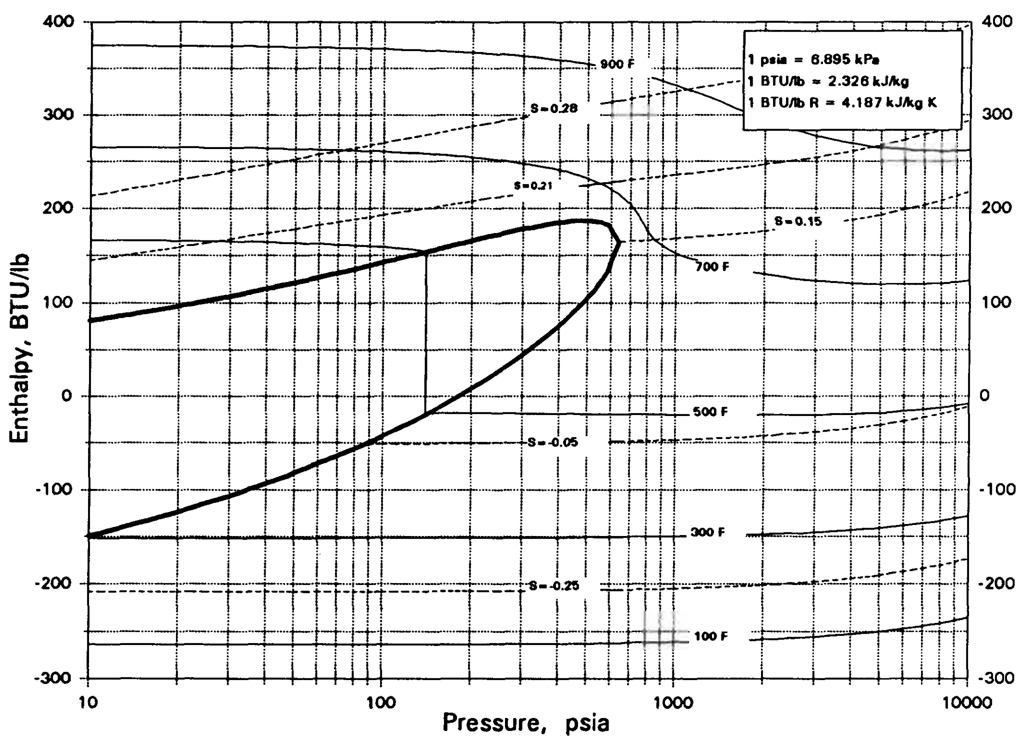
C4H8O2 ISOBUTYRIC ACID



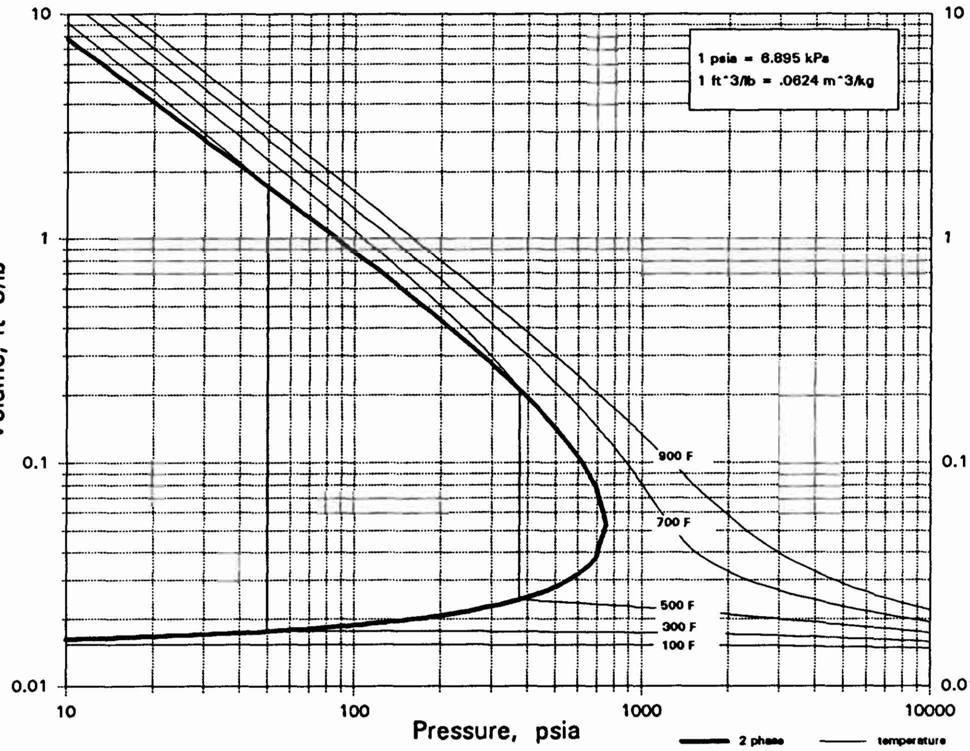


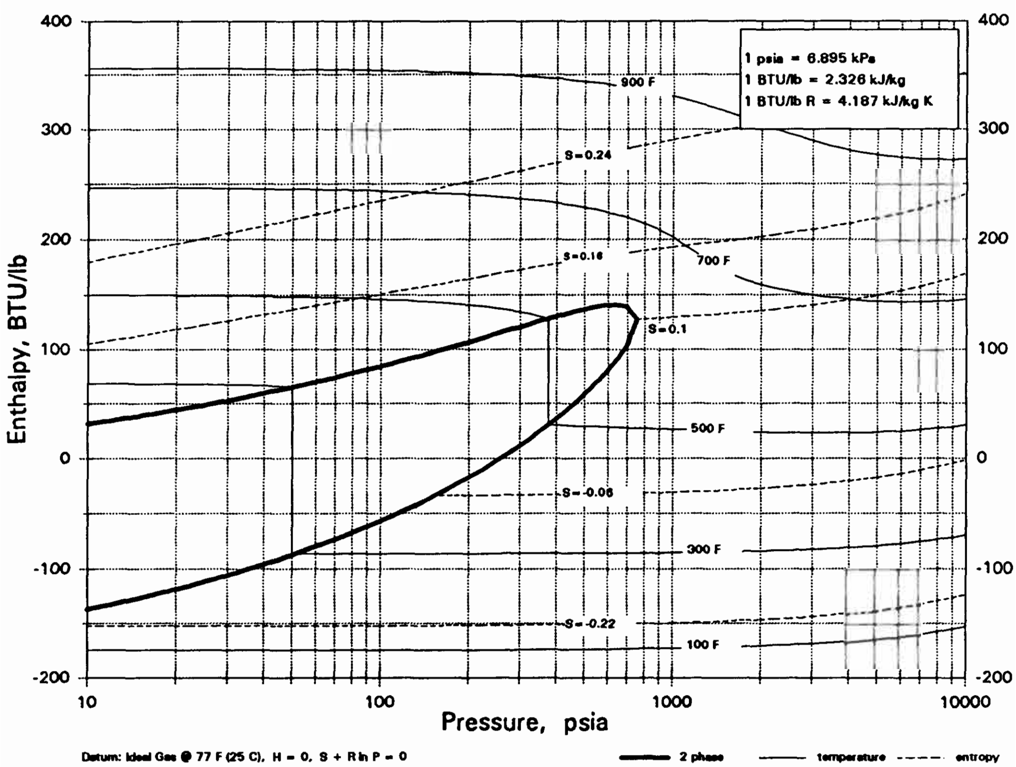
C4H8O2 n-BUTYRIC ACID



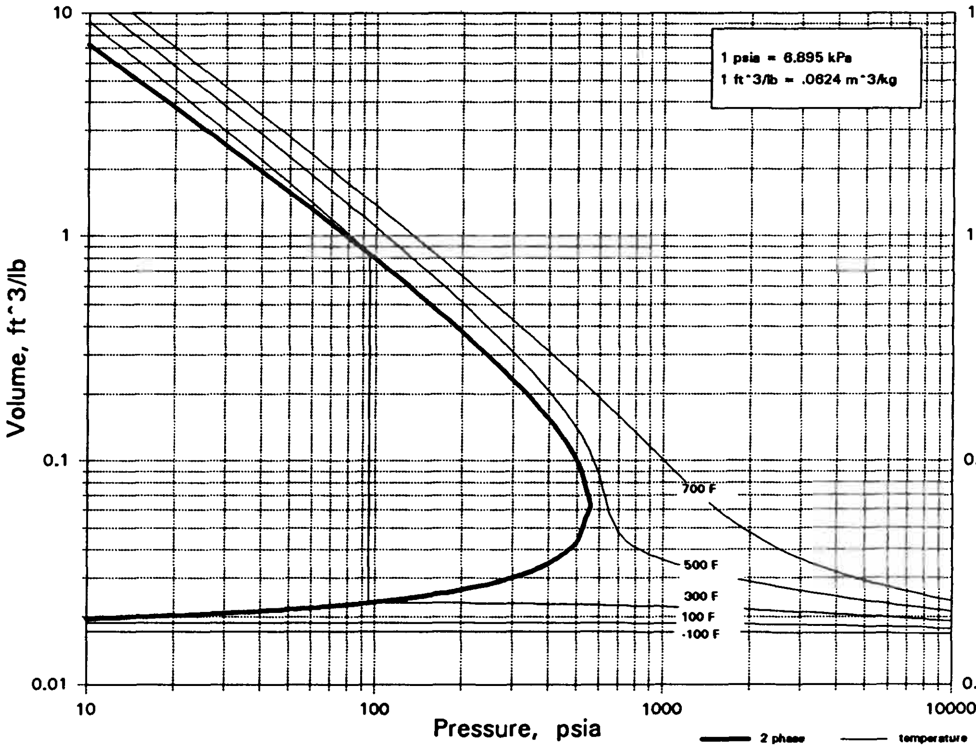


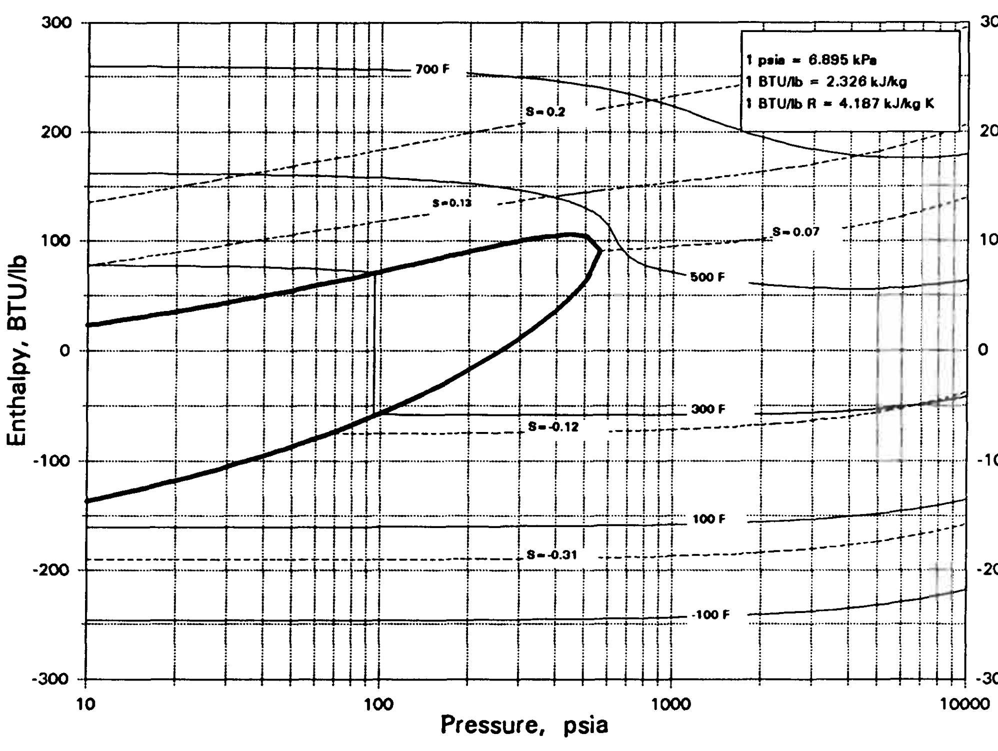
C4H8O2 1-4-DIOXANE



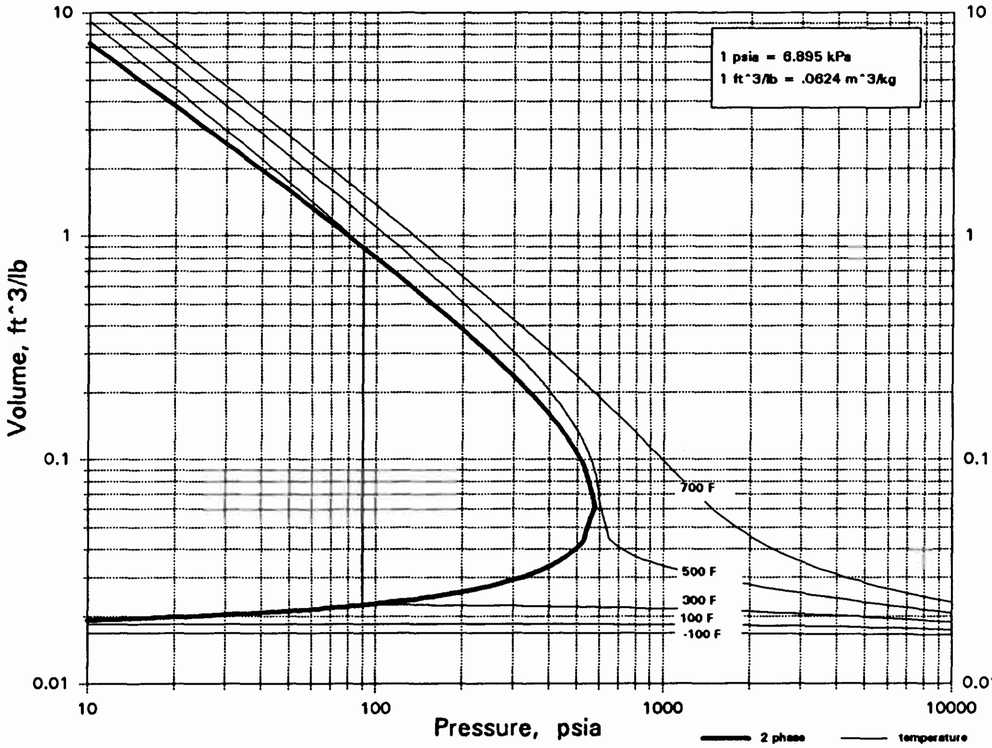


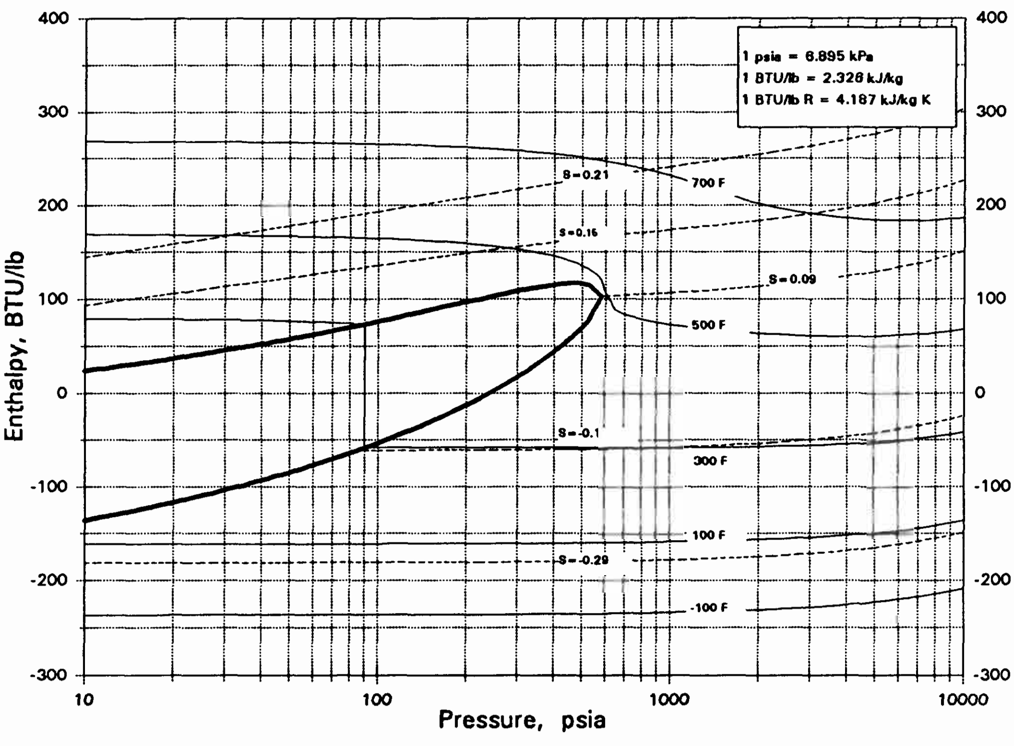
C4H8O2 ETHYL ACETATE



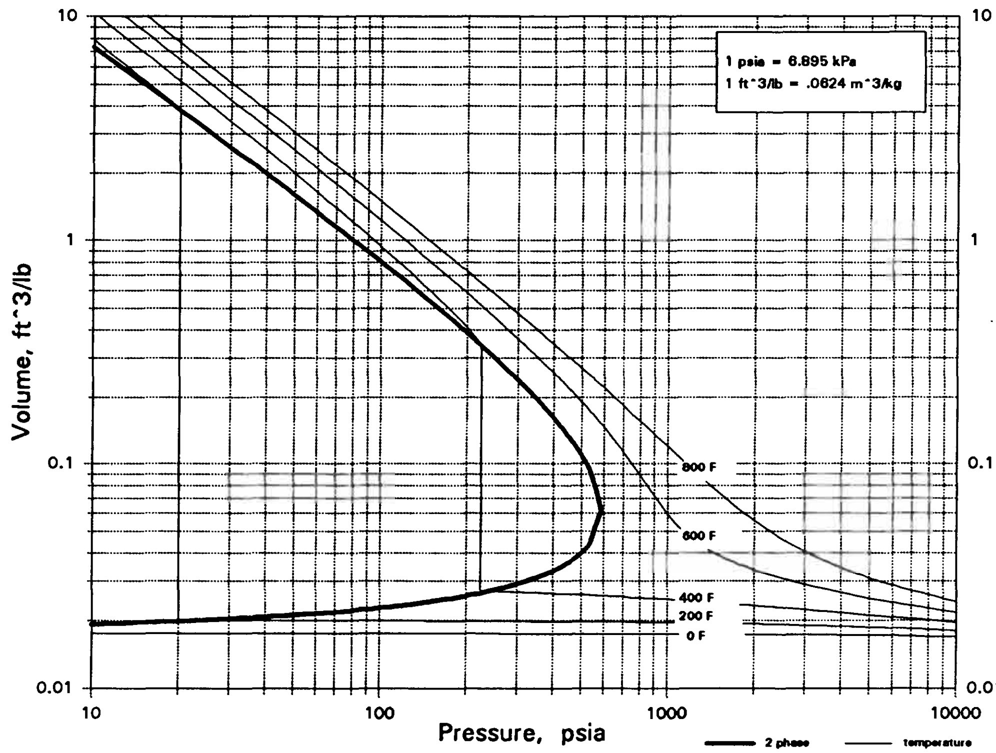


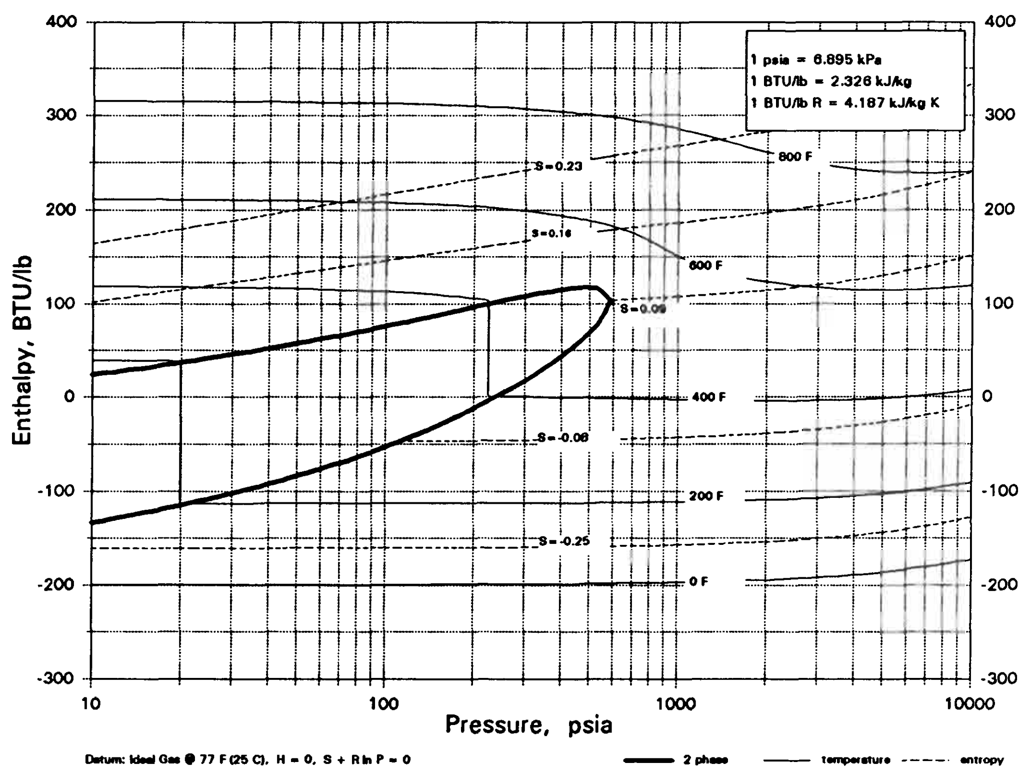
C4H8O2 METHYL PROPIONATE



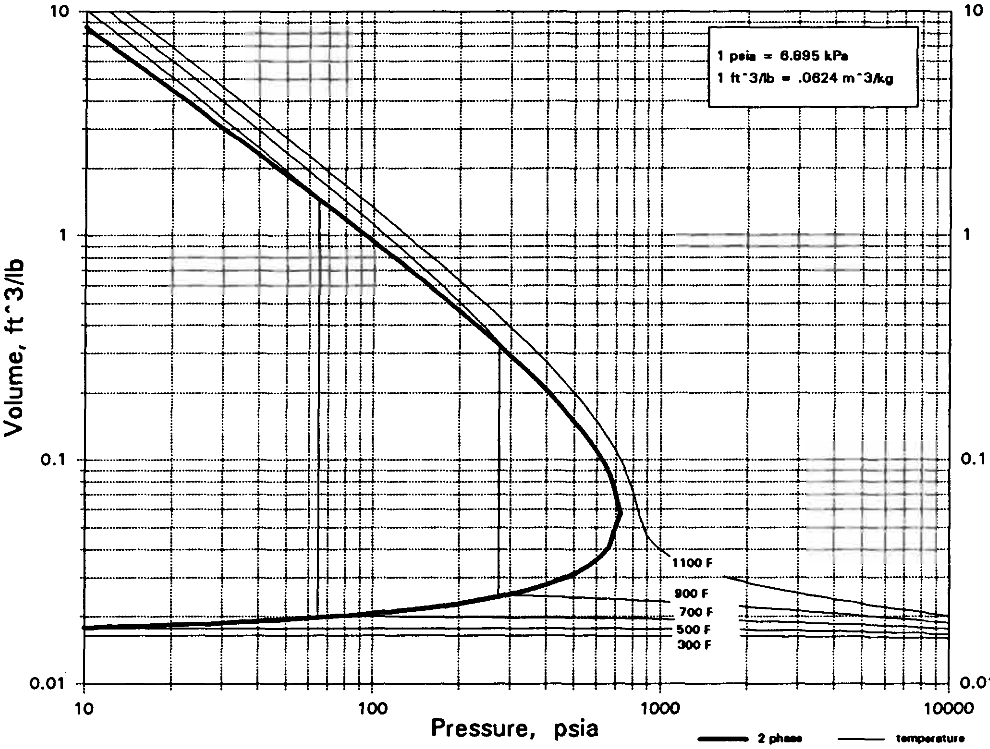


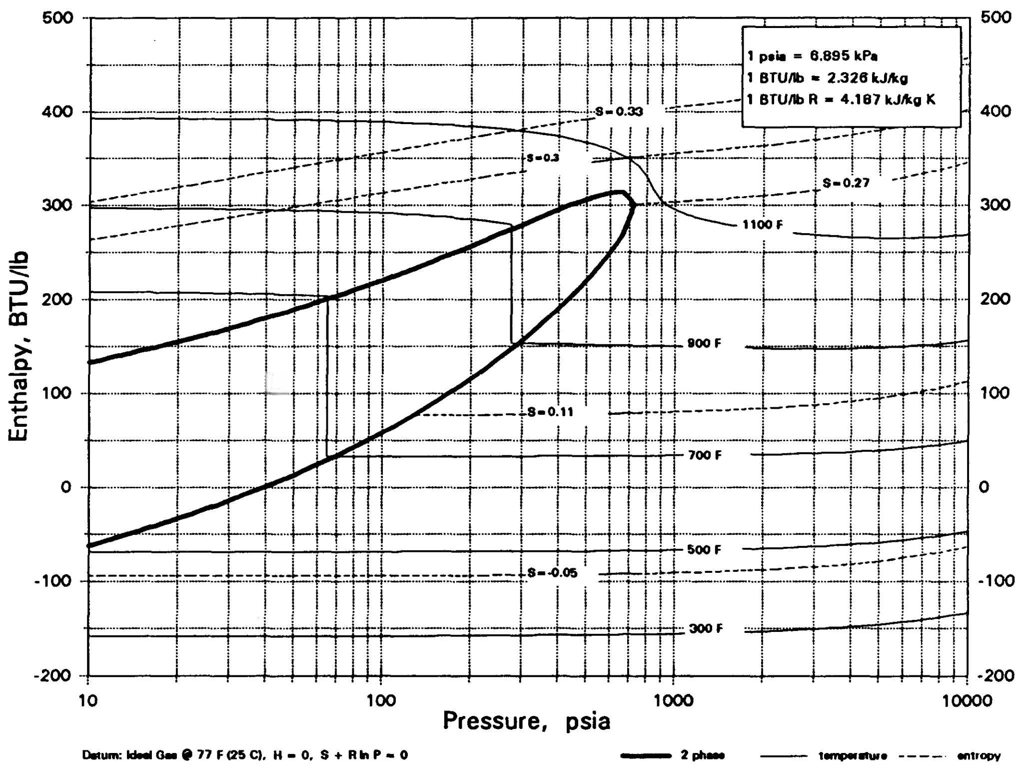
C4H8O2 n-PROPYL FORMATE



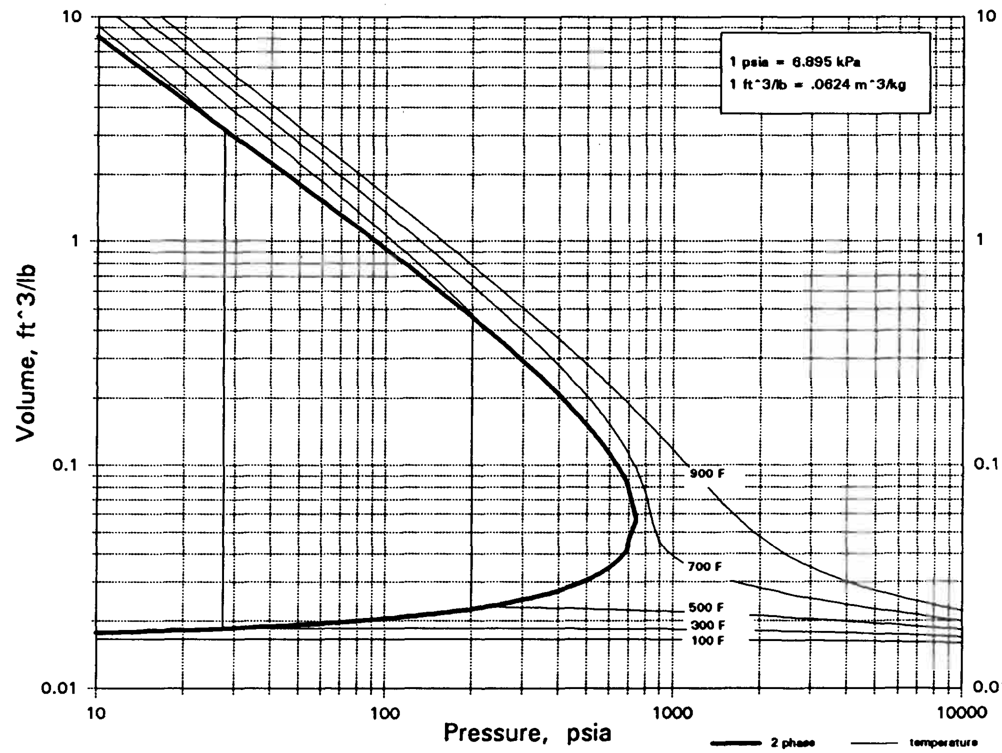


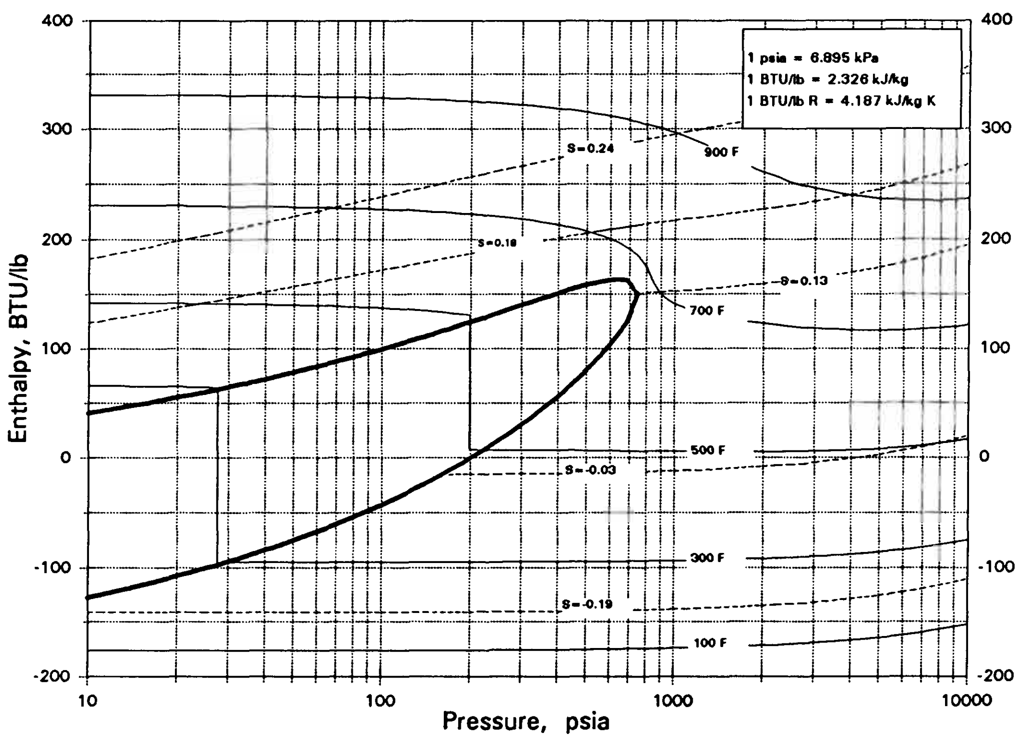
C4H8O2S SULFOLANE



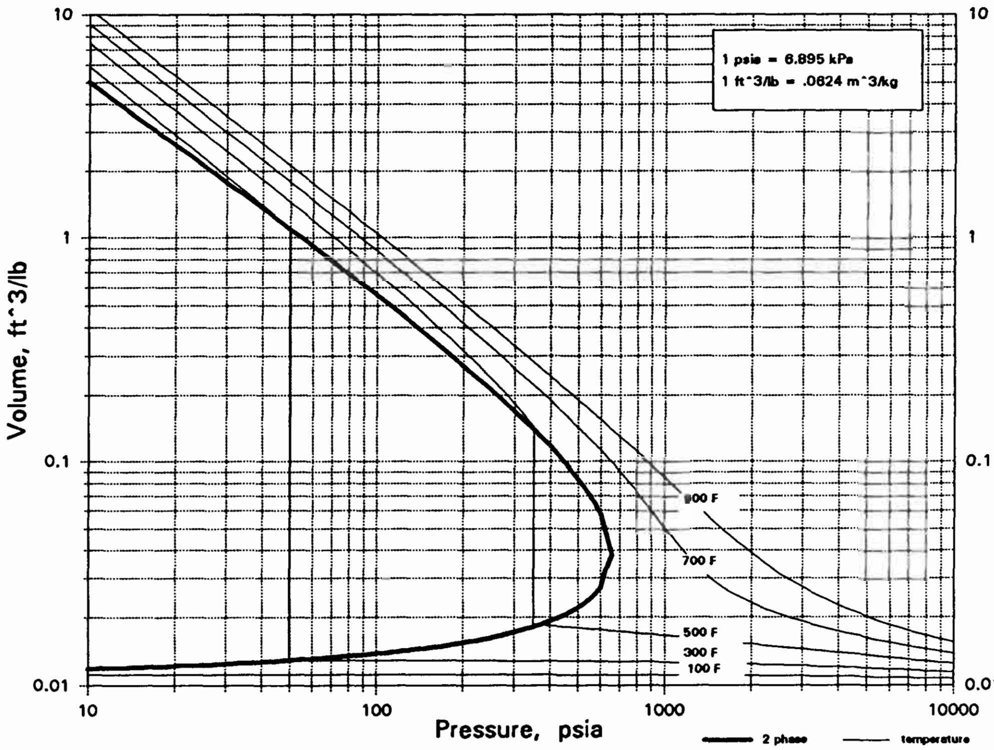


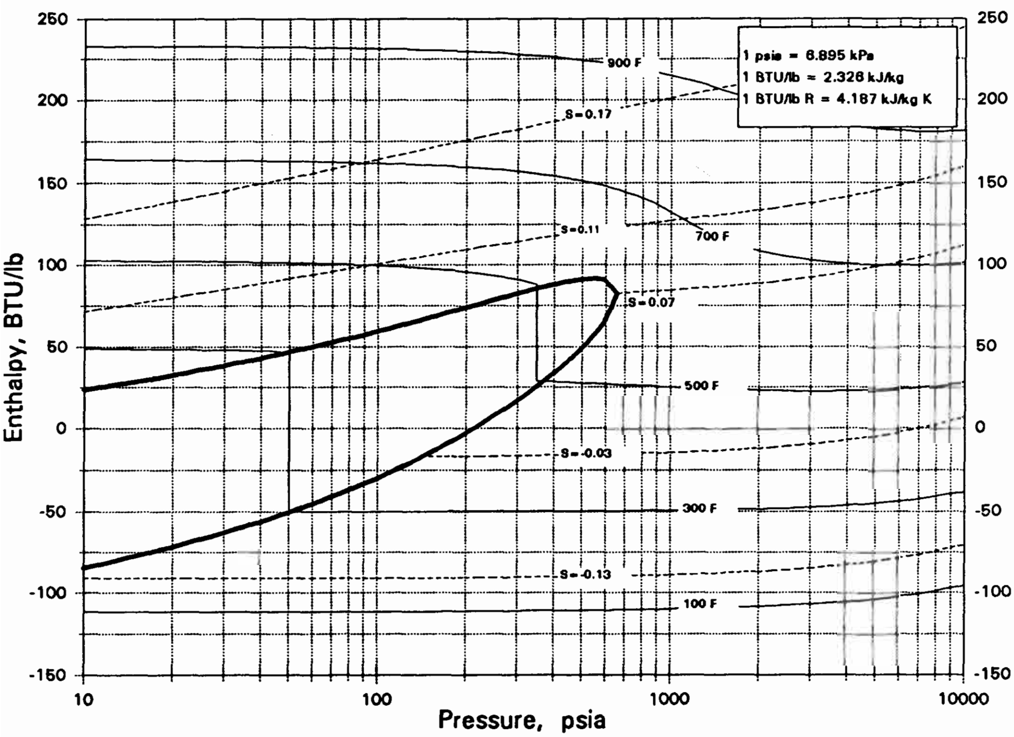
C4H8S TETRAHYDROTHIOPHENE



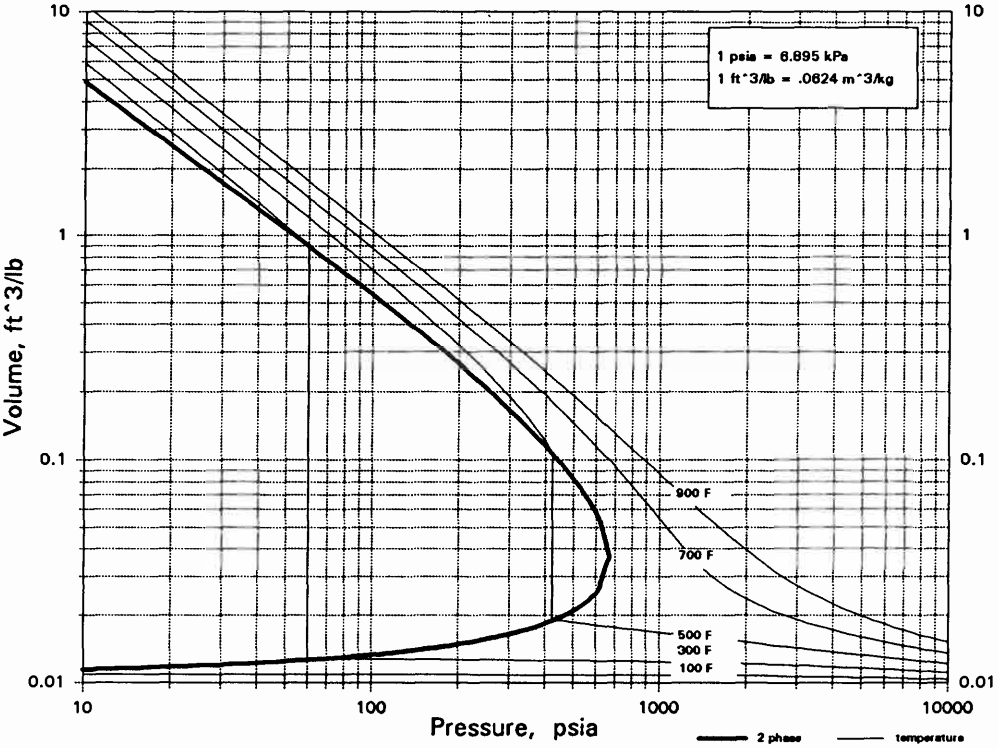


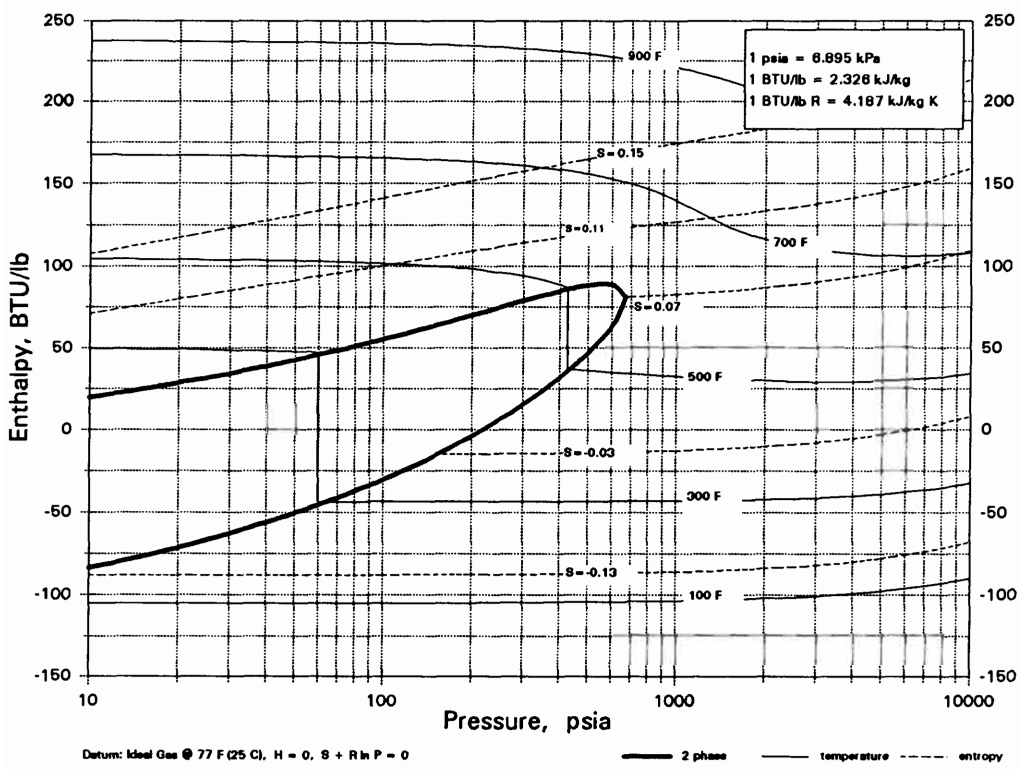
C4H9Br 1-BROMOBUTANE





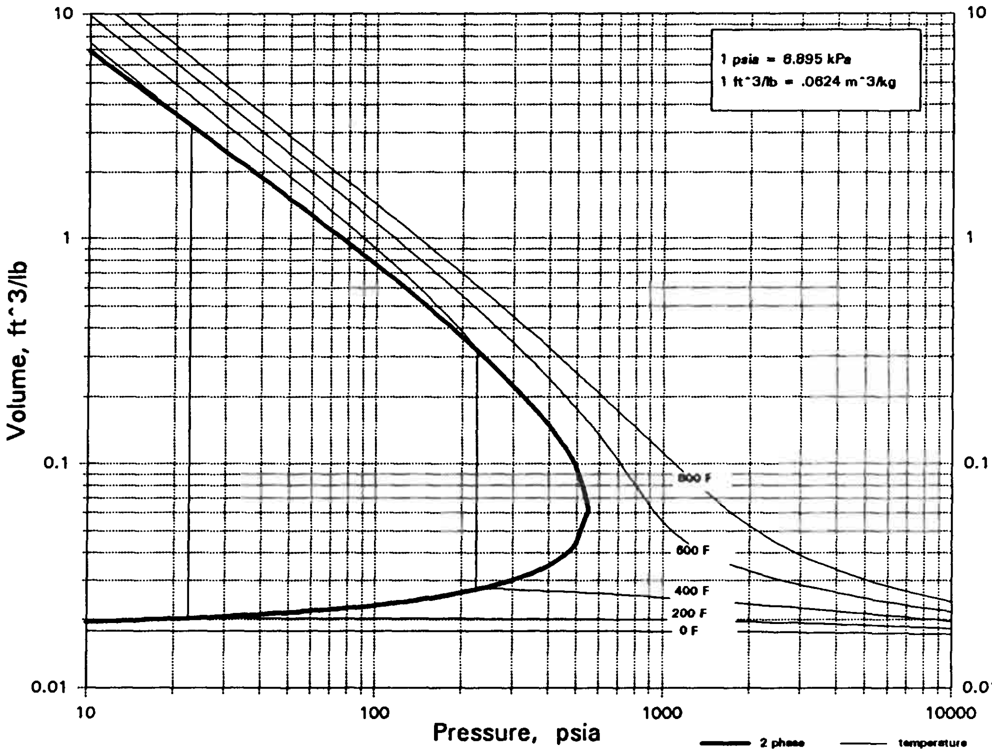
C4H9Br 2-BROMOBUTANE

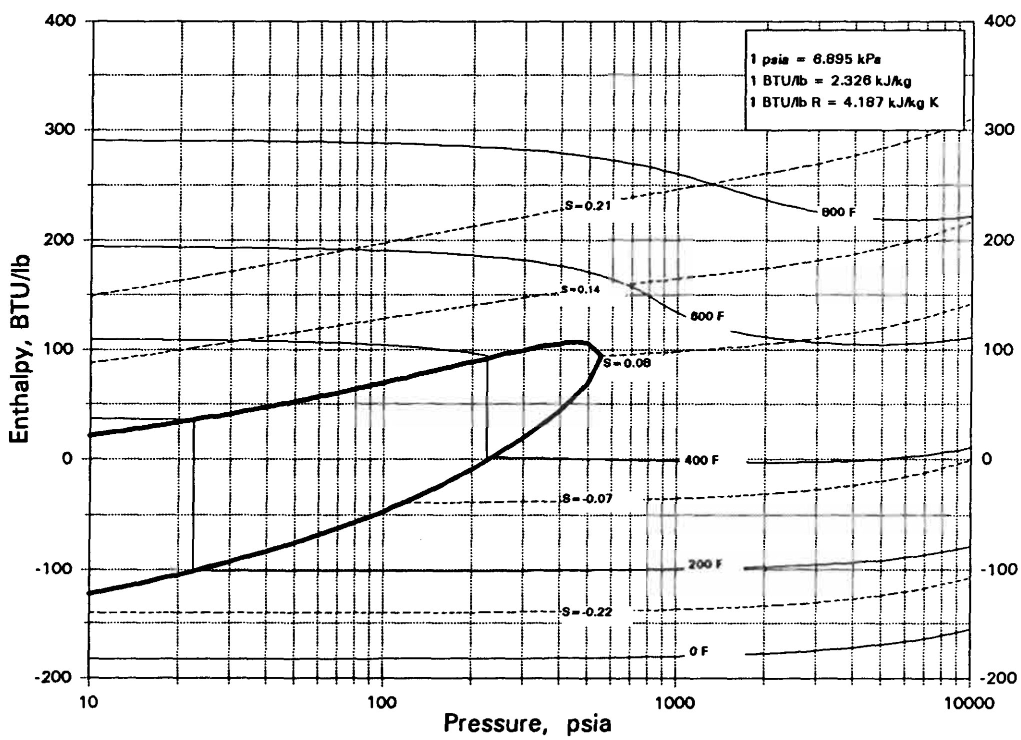




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

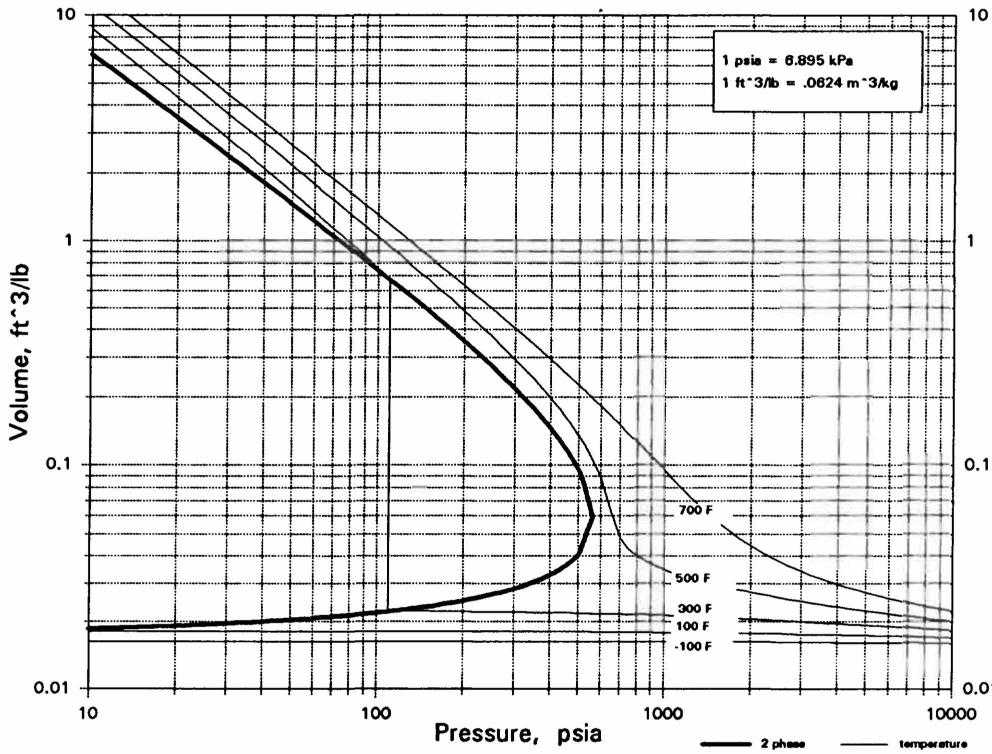
C4H9Cl n-BUTYL CHLORIDE

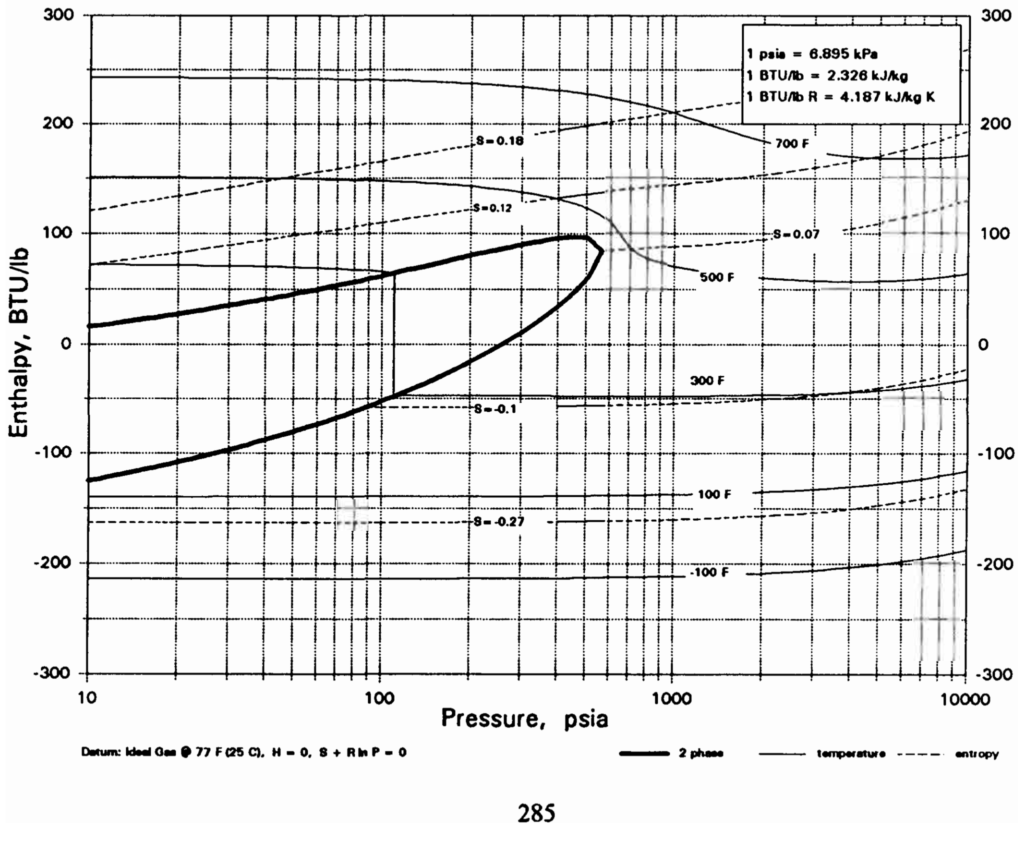




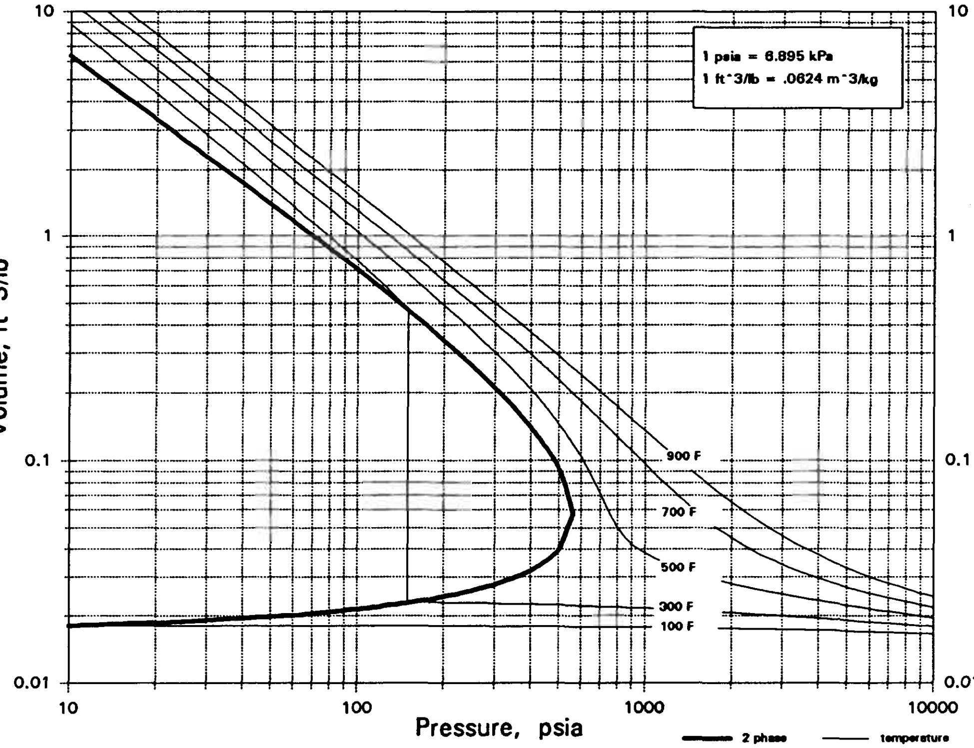
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

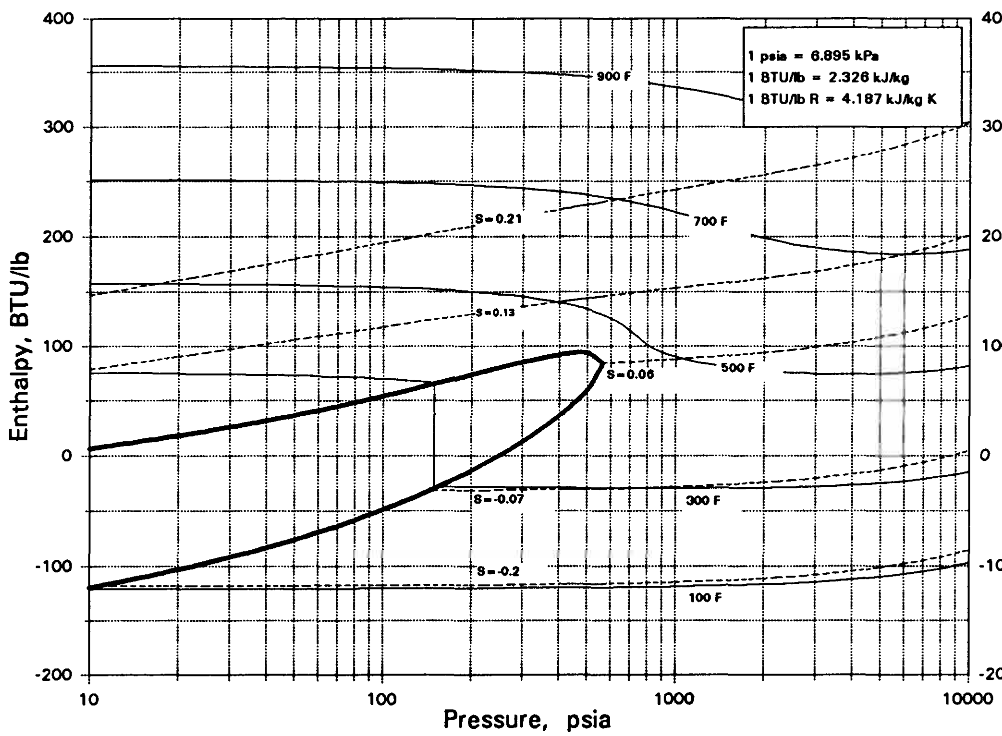
C4H9Cl sec-BUTYL CHLORIDE



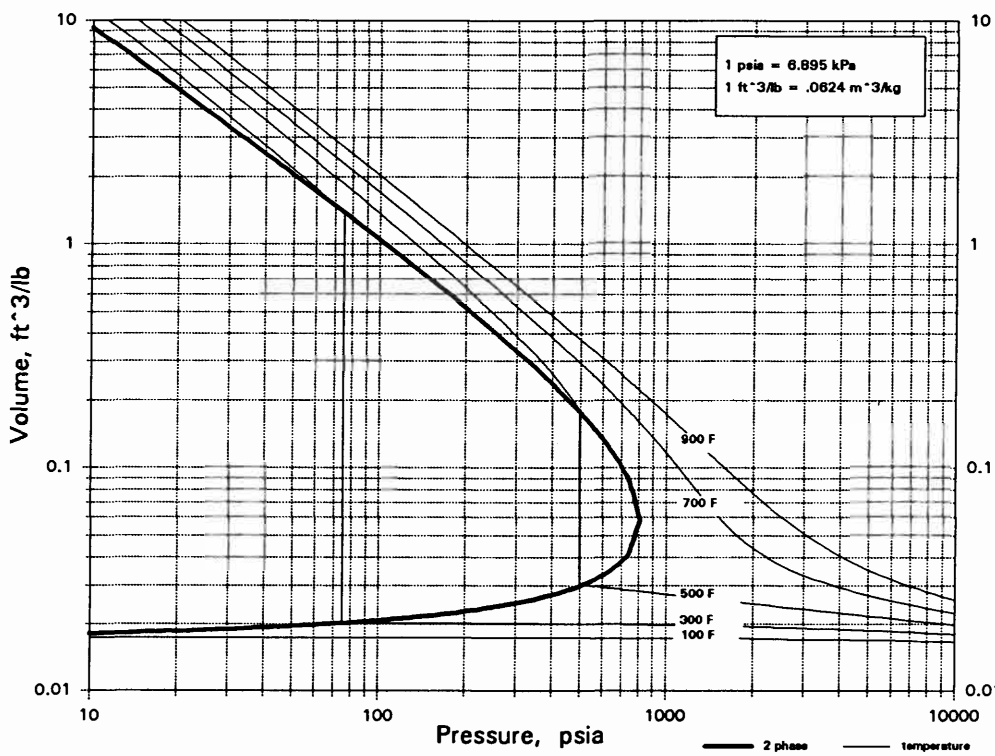


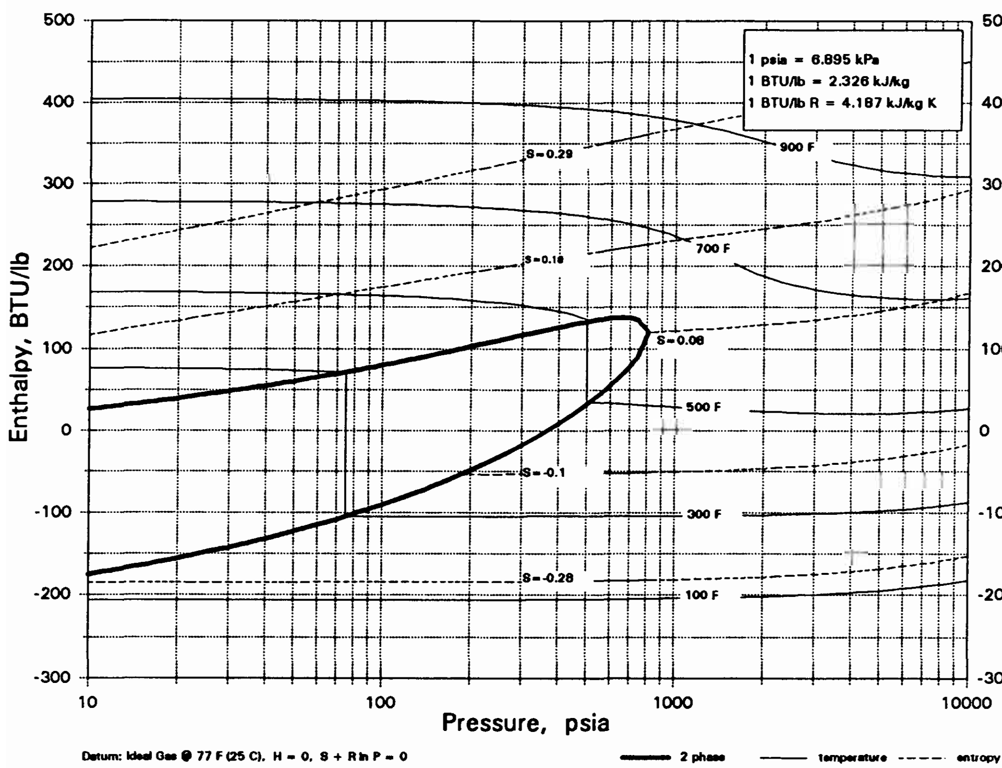
C4H9Cl tert-BUTYL CHLORIDE



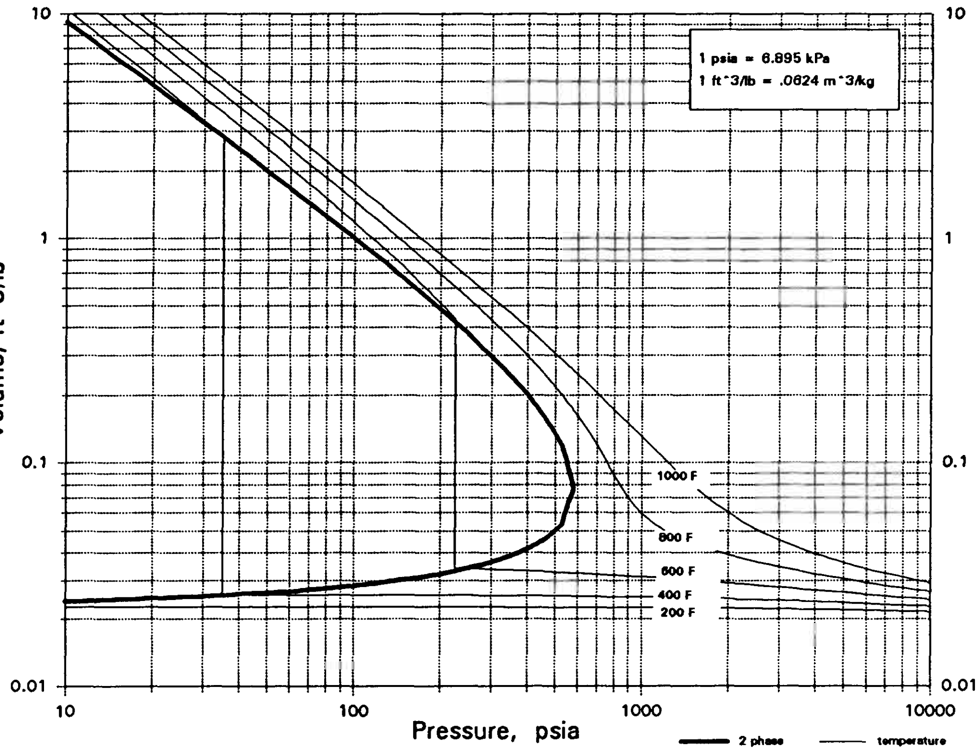


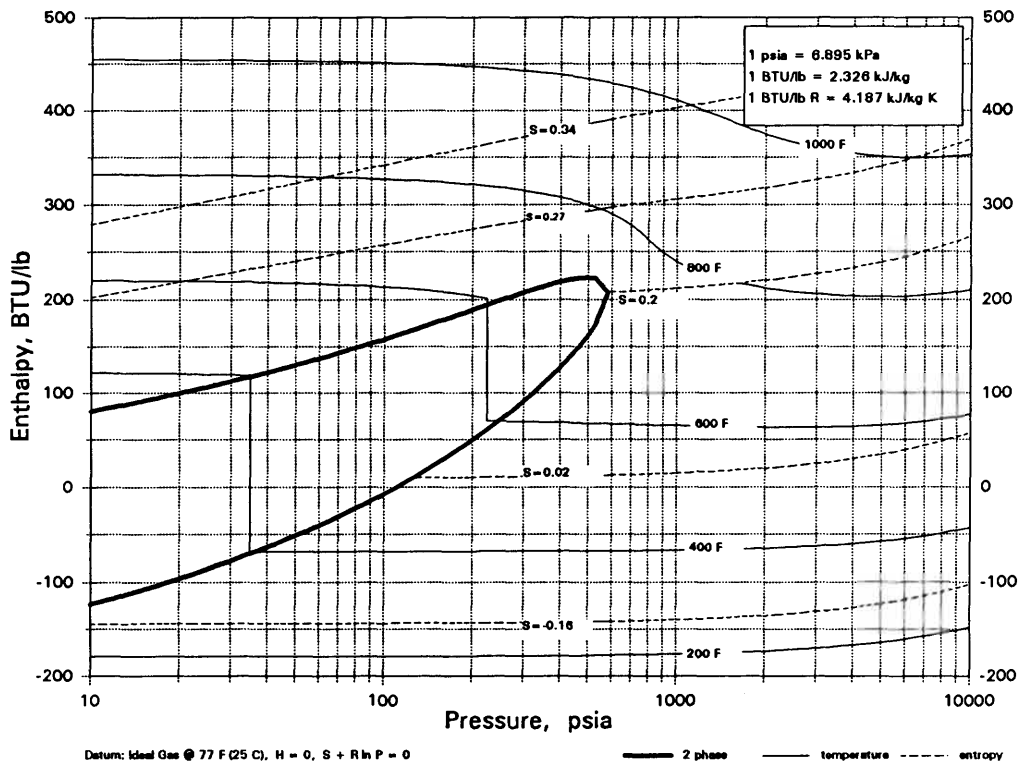
C4H9N PYRROLIDINE



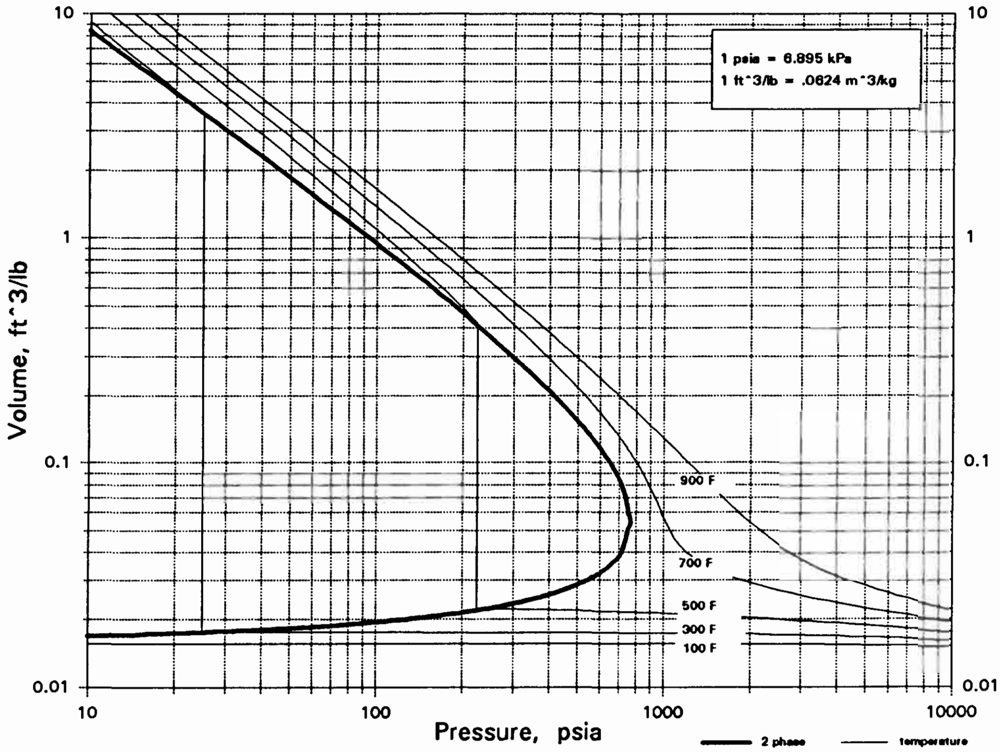


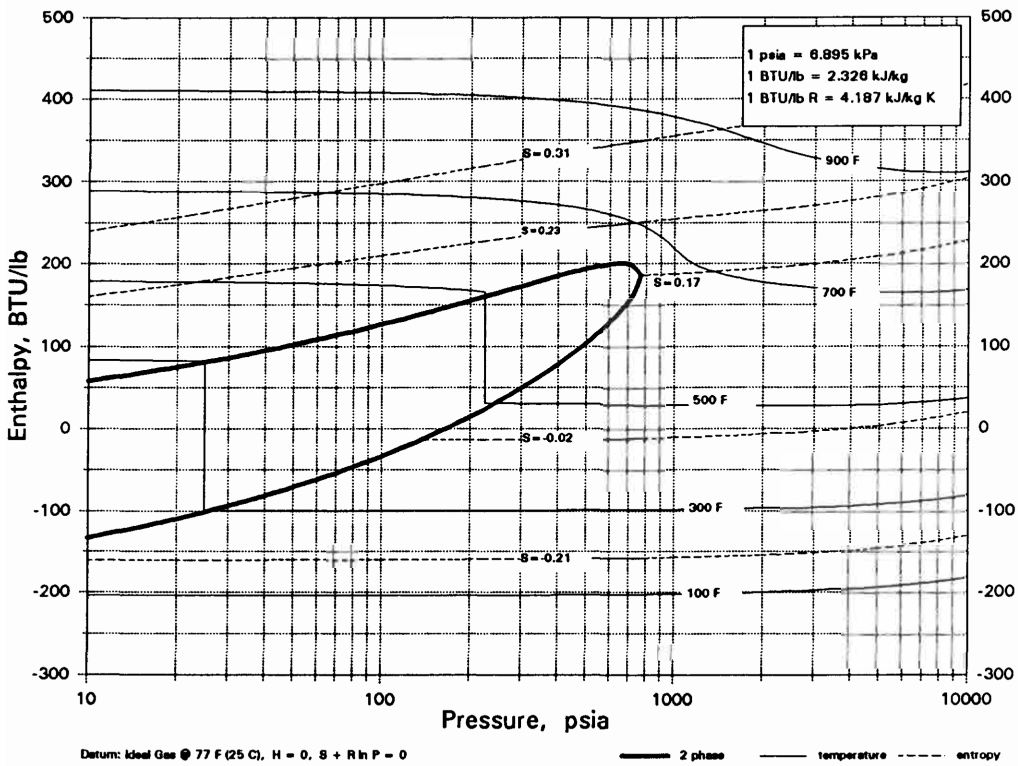
C4H9NO N-N-DIMETHYLACETAMIDE



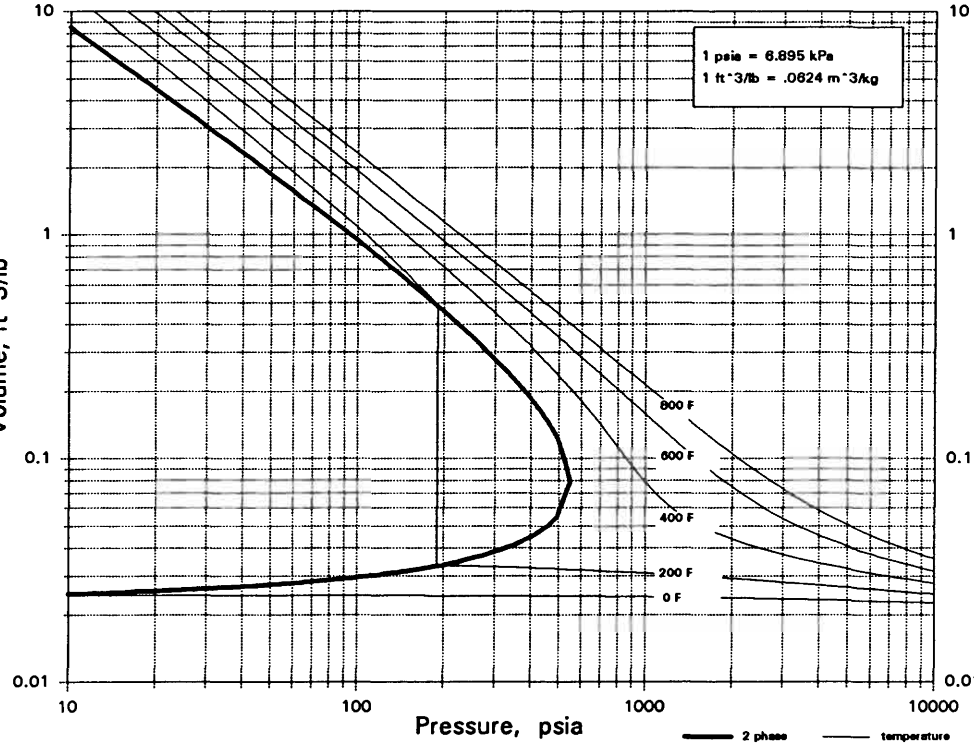


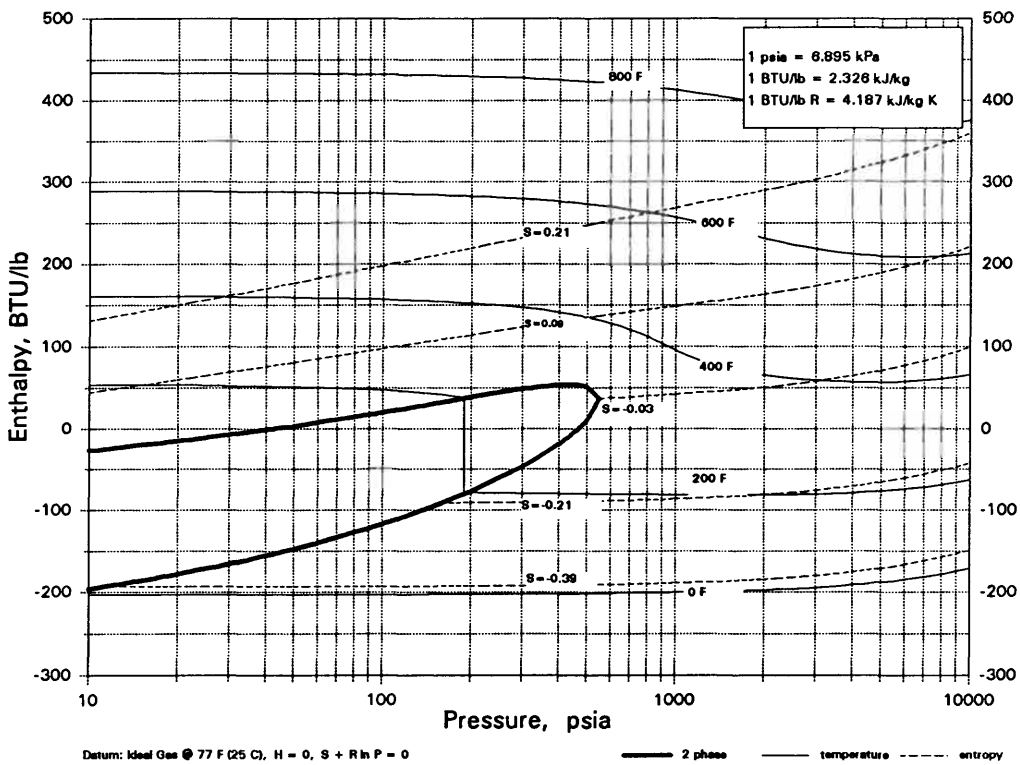
C_4H_9NO MORPHOLINE



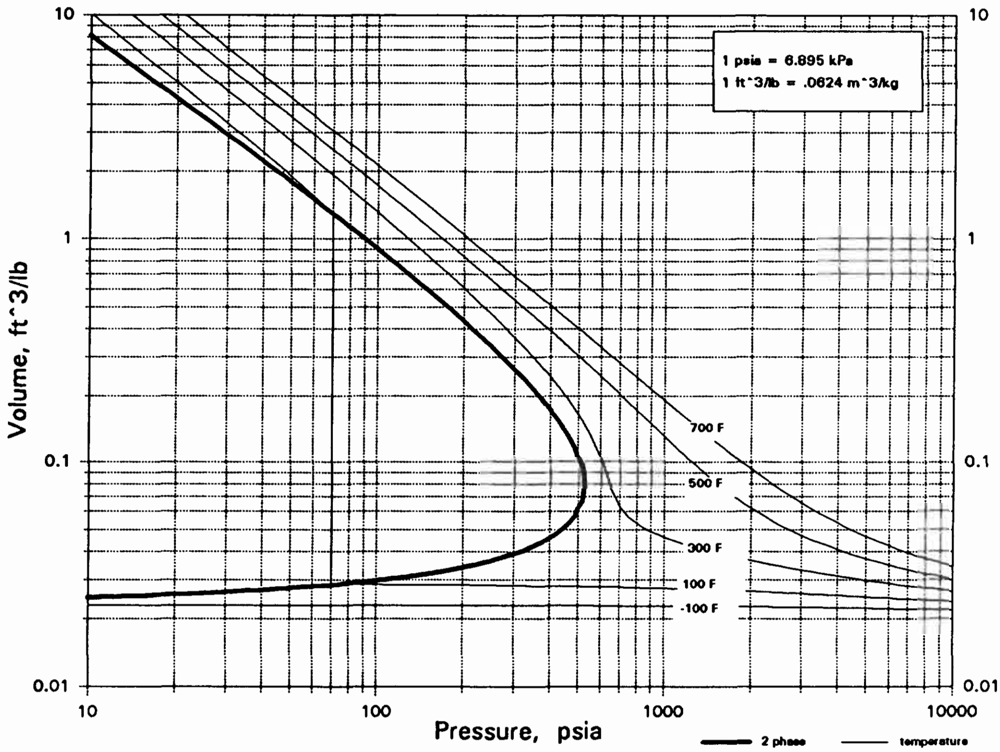


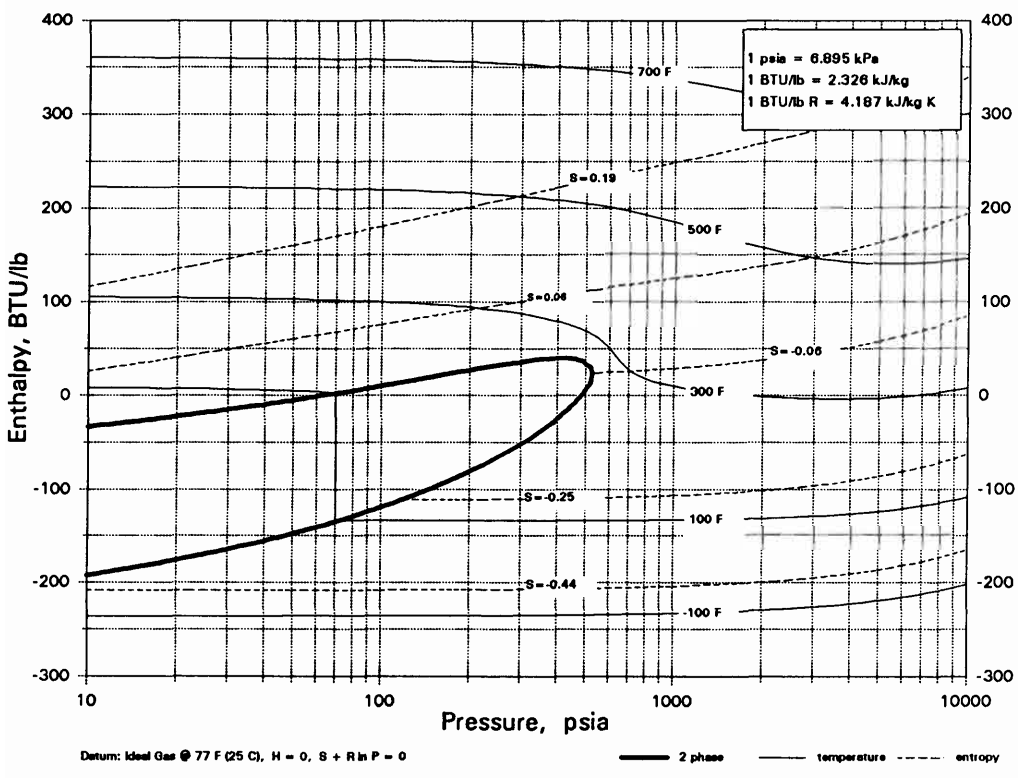
C4H10 n-BUTANE



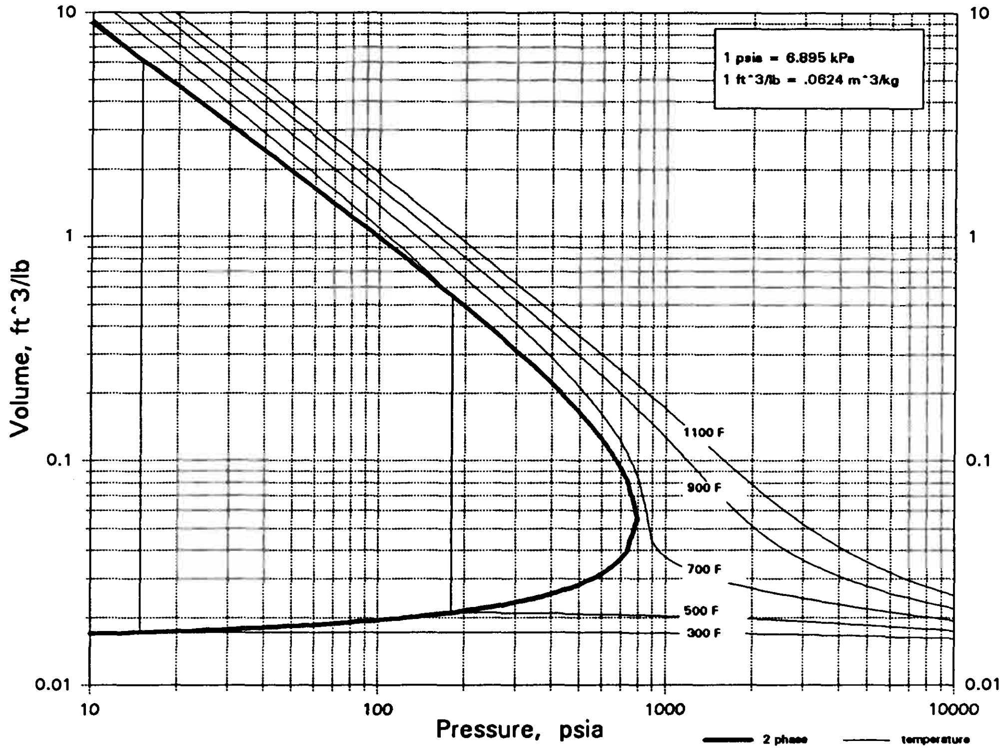


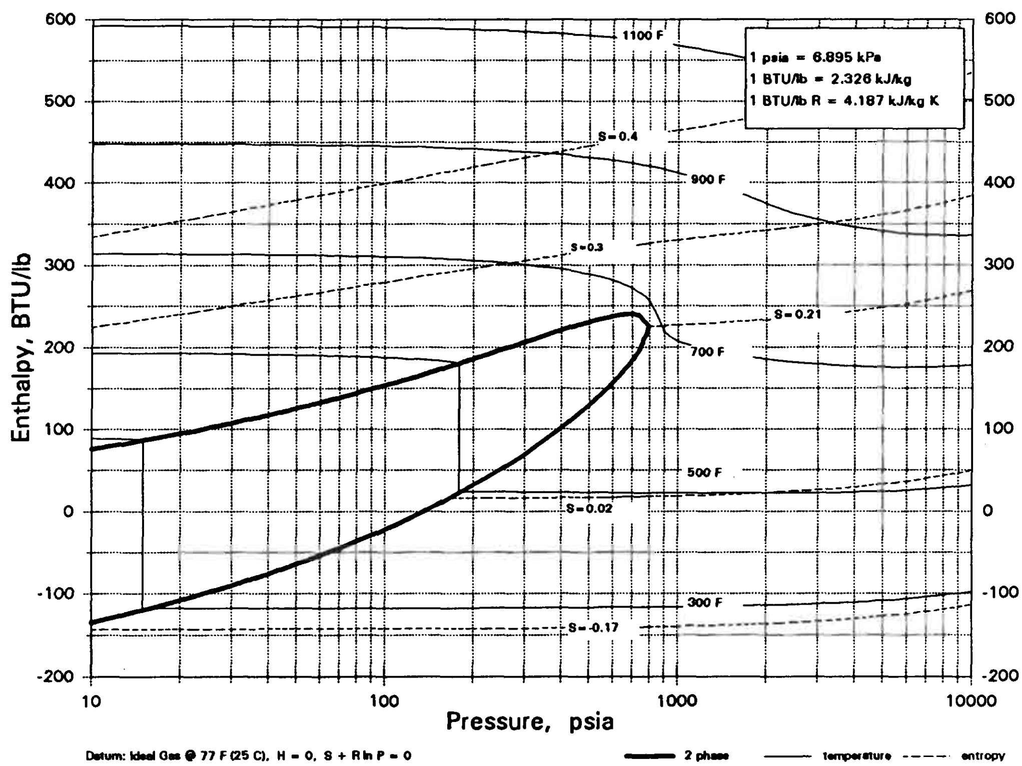
C4H10	ISOBUTANE



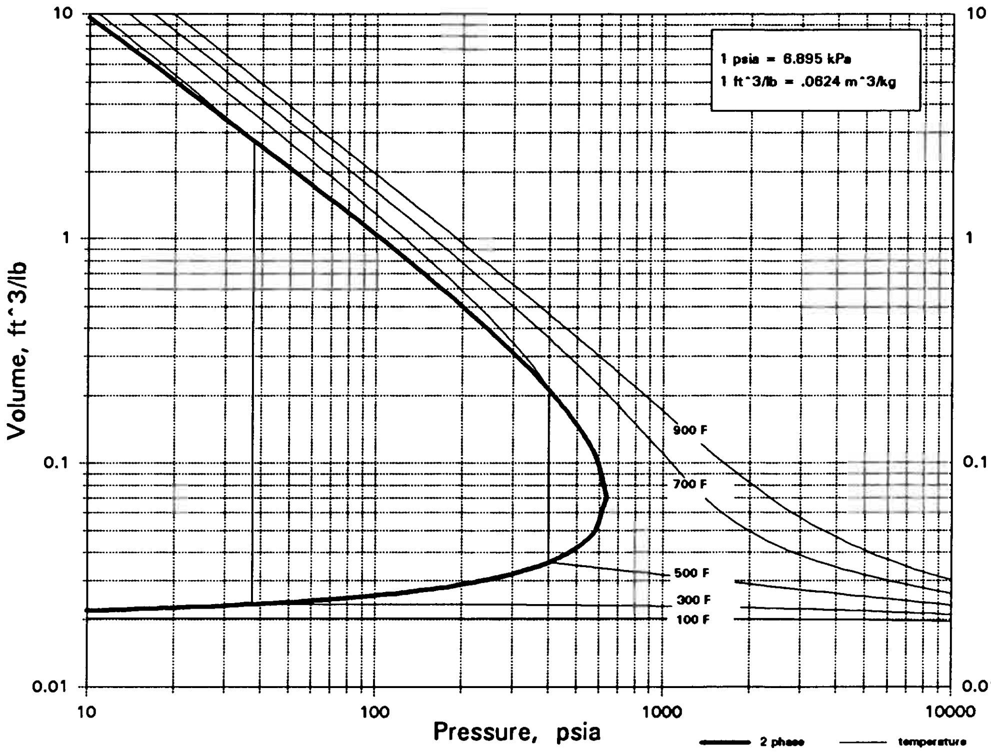


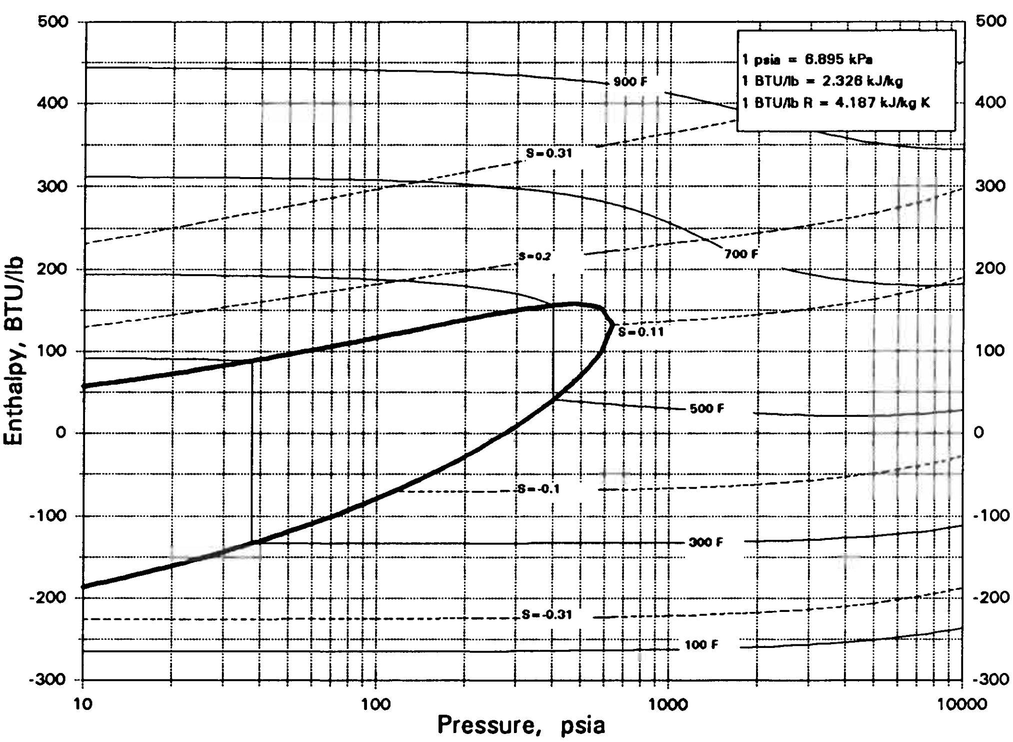
C4H10N2 PIPERAZINE





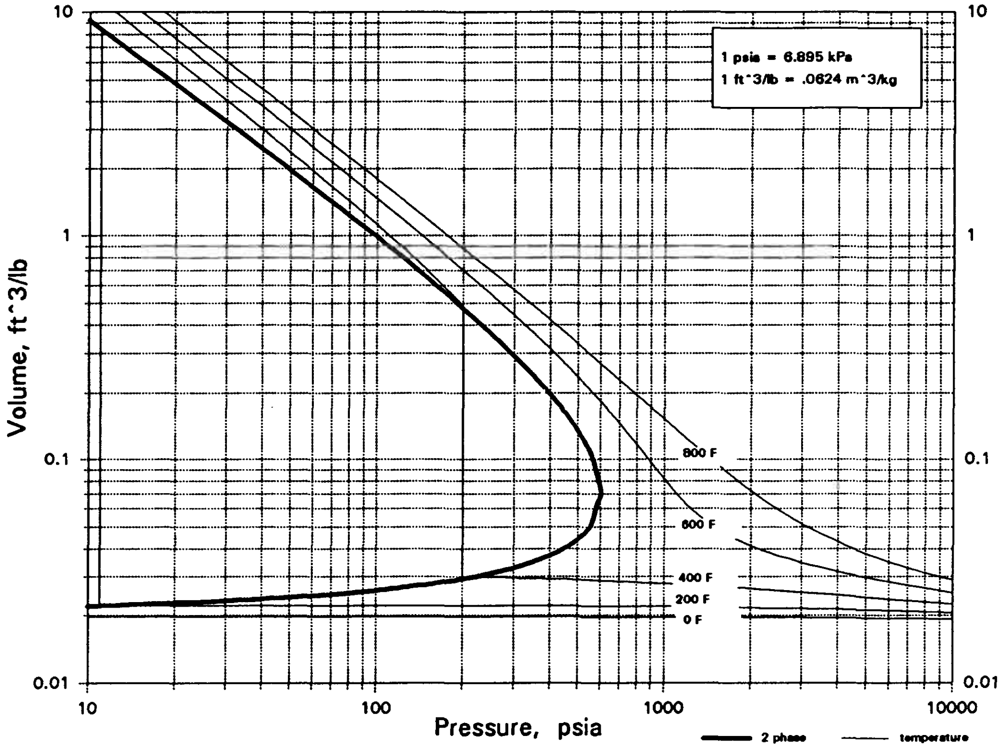
C4H10O n-BUTANOL

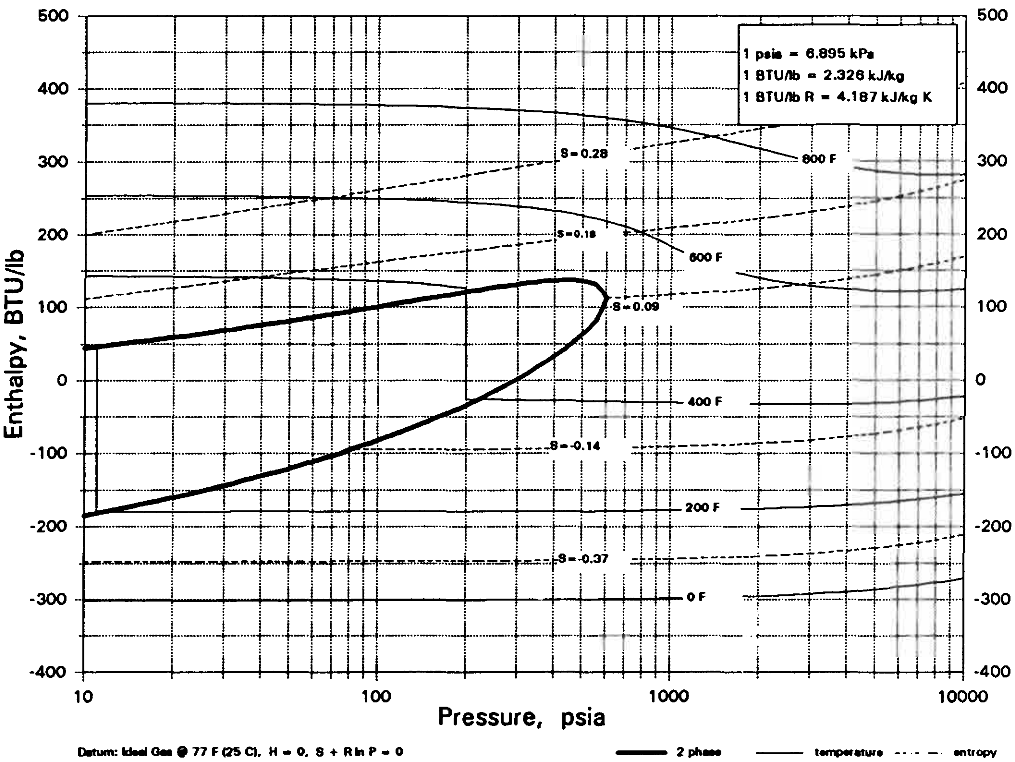




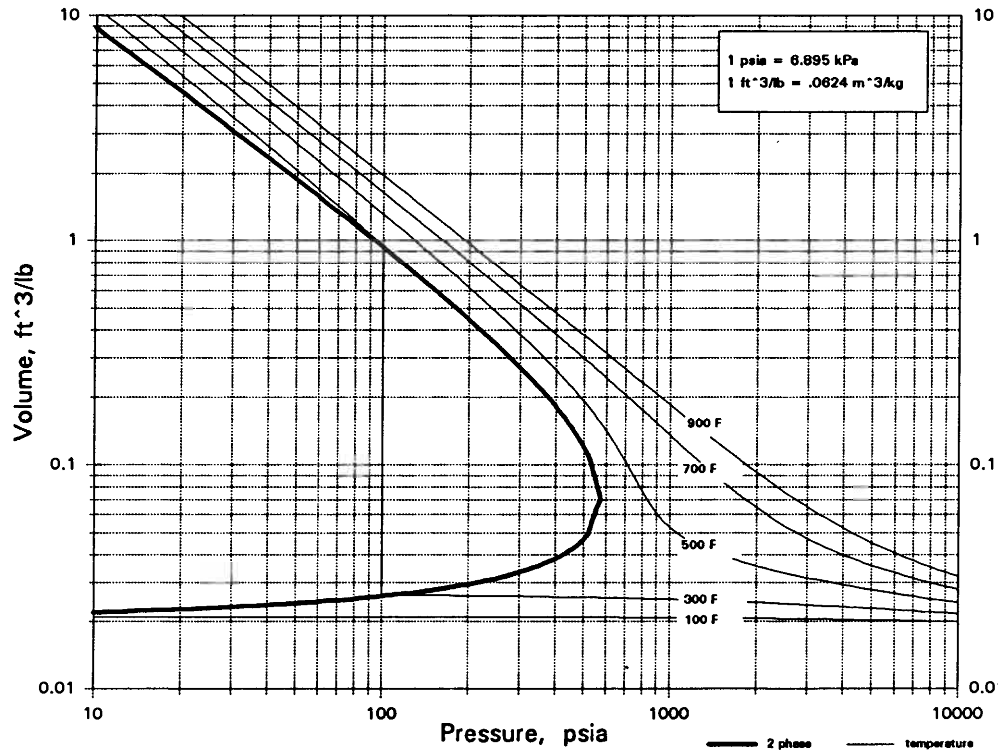
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

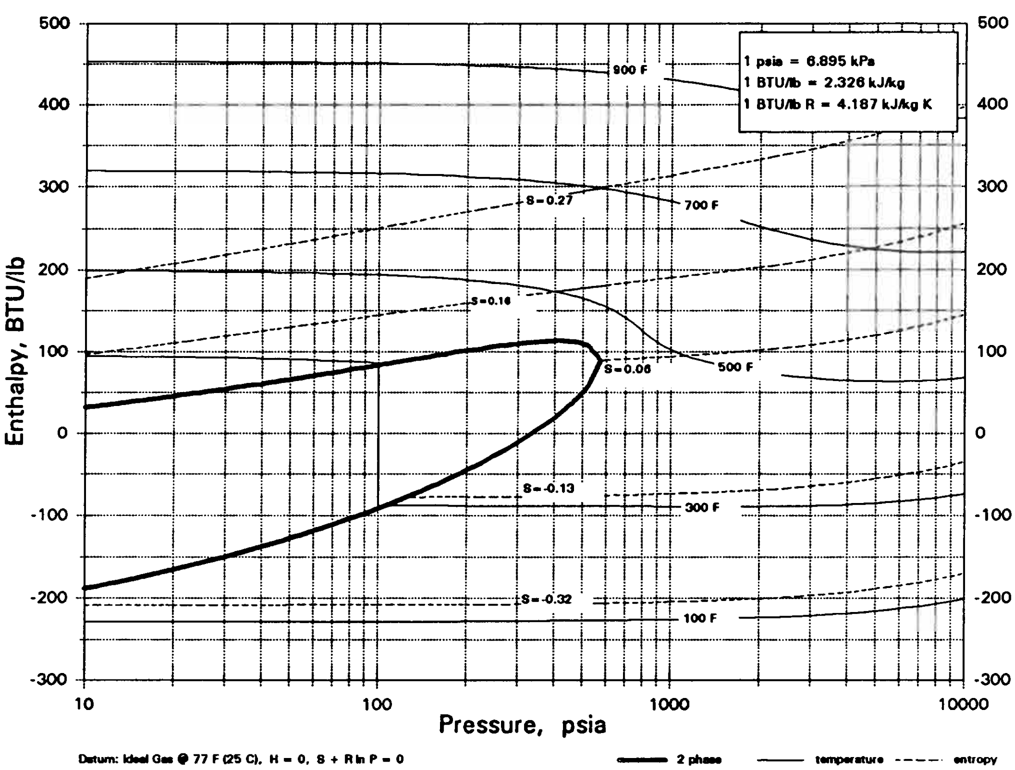
C4H10O sec-BUTANOL



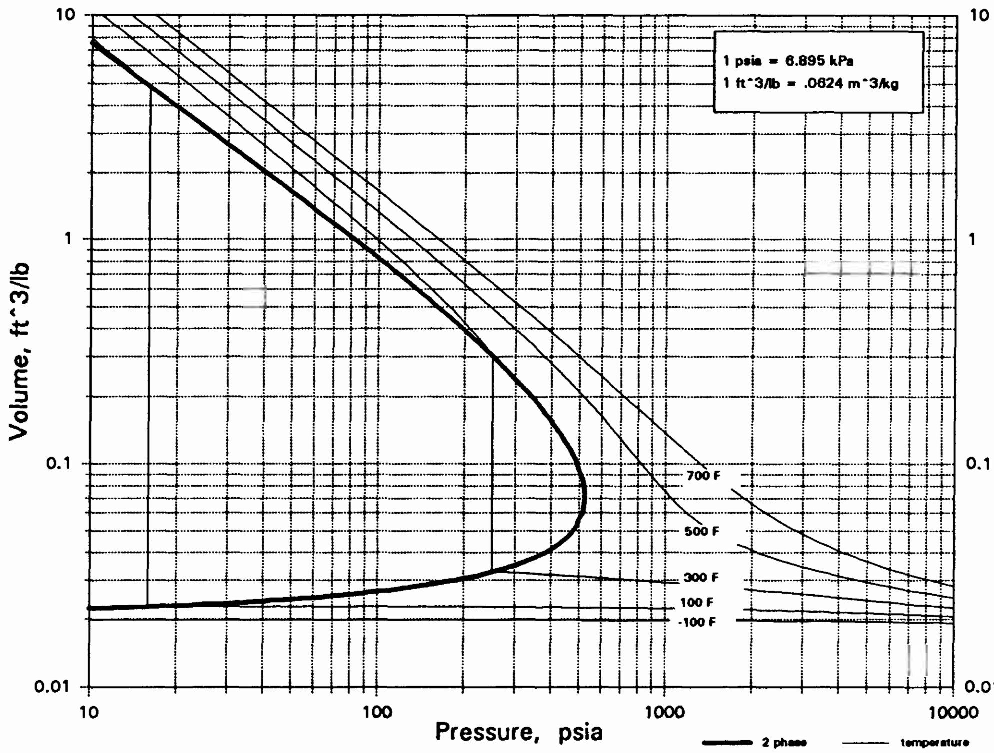


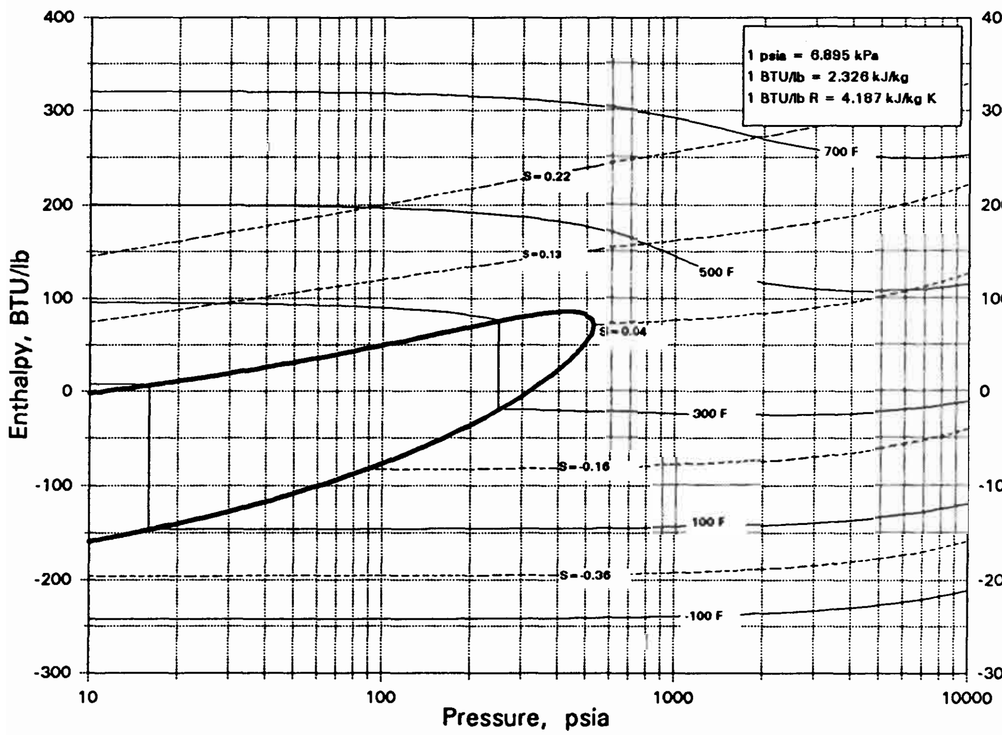
C4H10O tert-BUTANOL





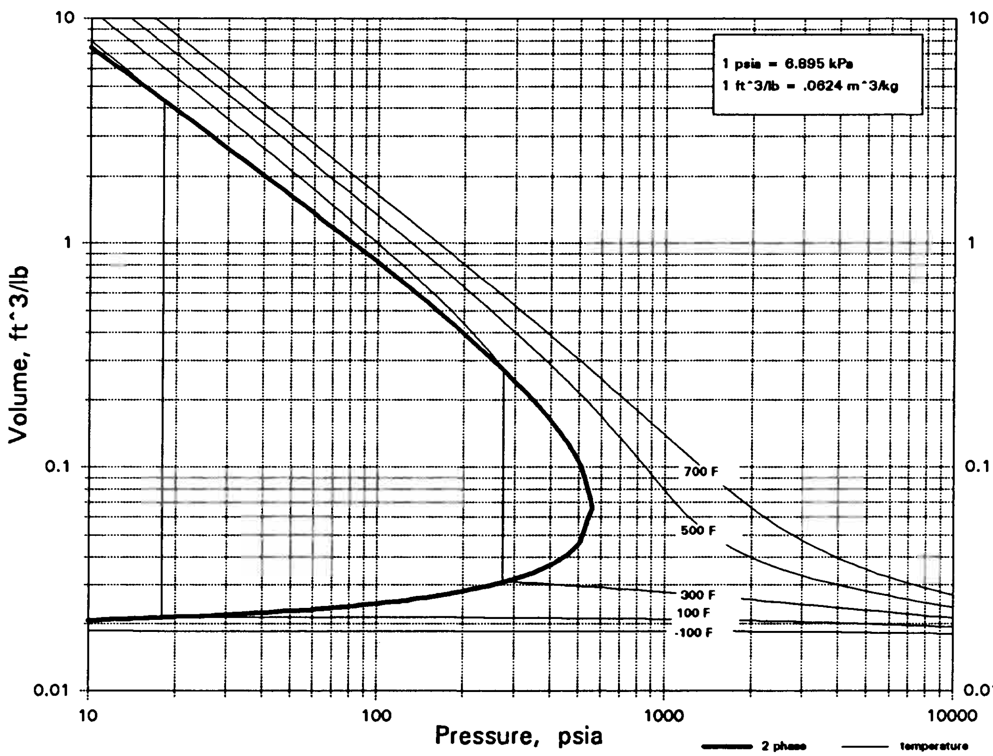
C4H10O DIETHYL ETHER

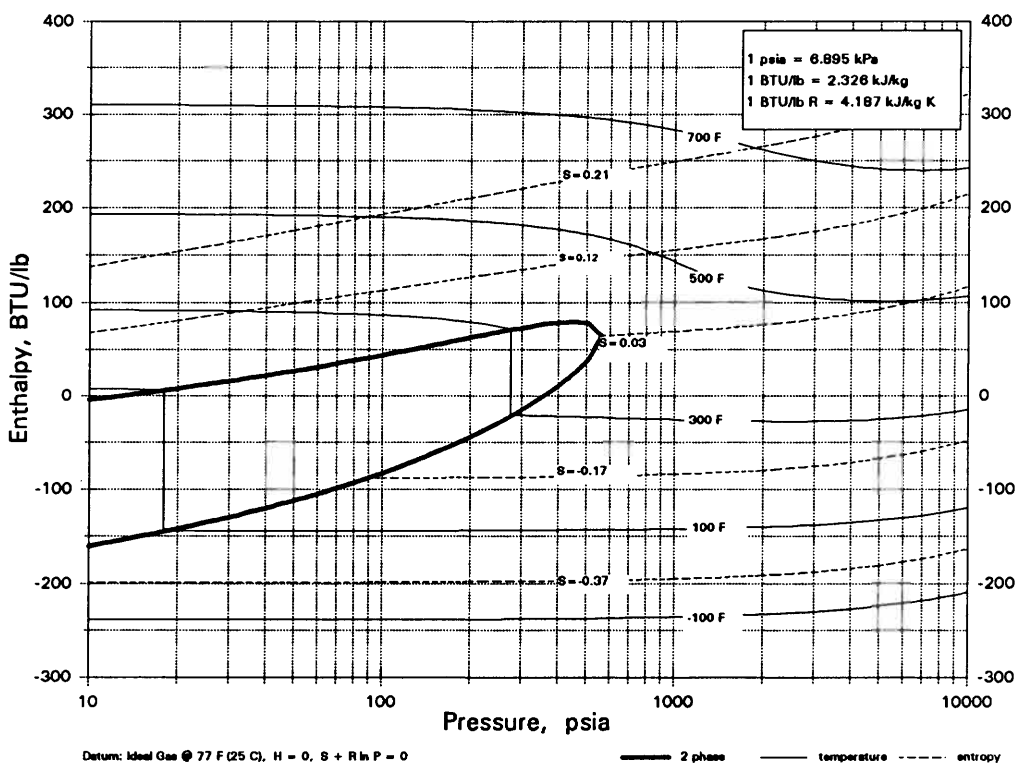




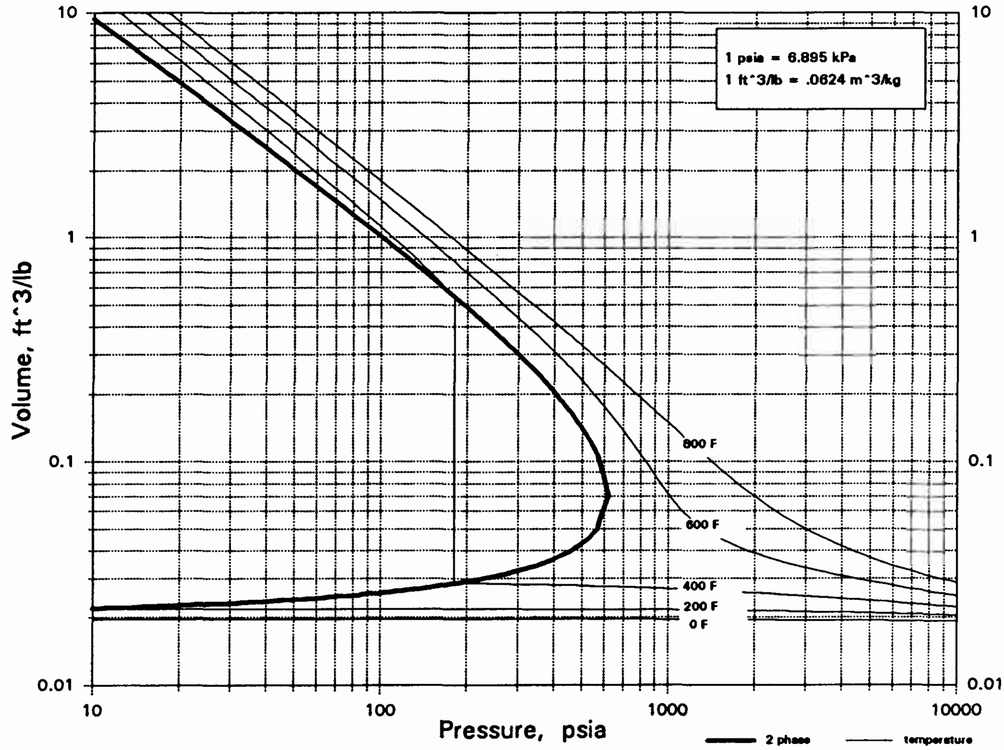
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

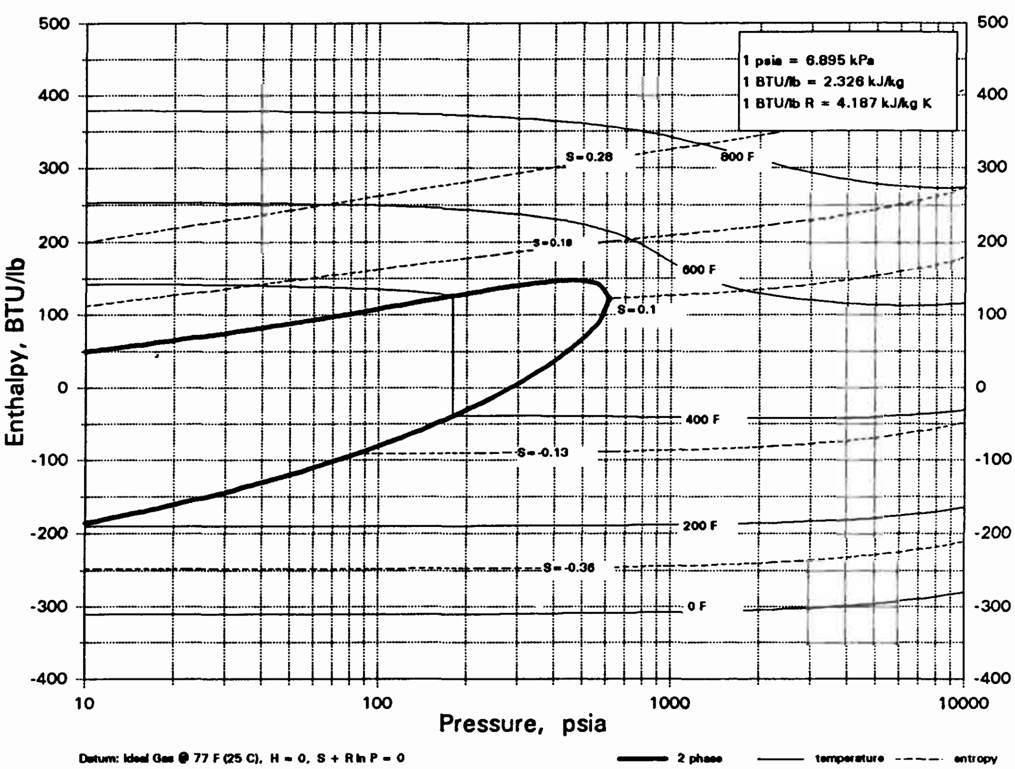
C4H10O METHYL ISOPROPYL ETHER



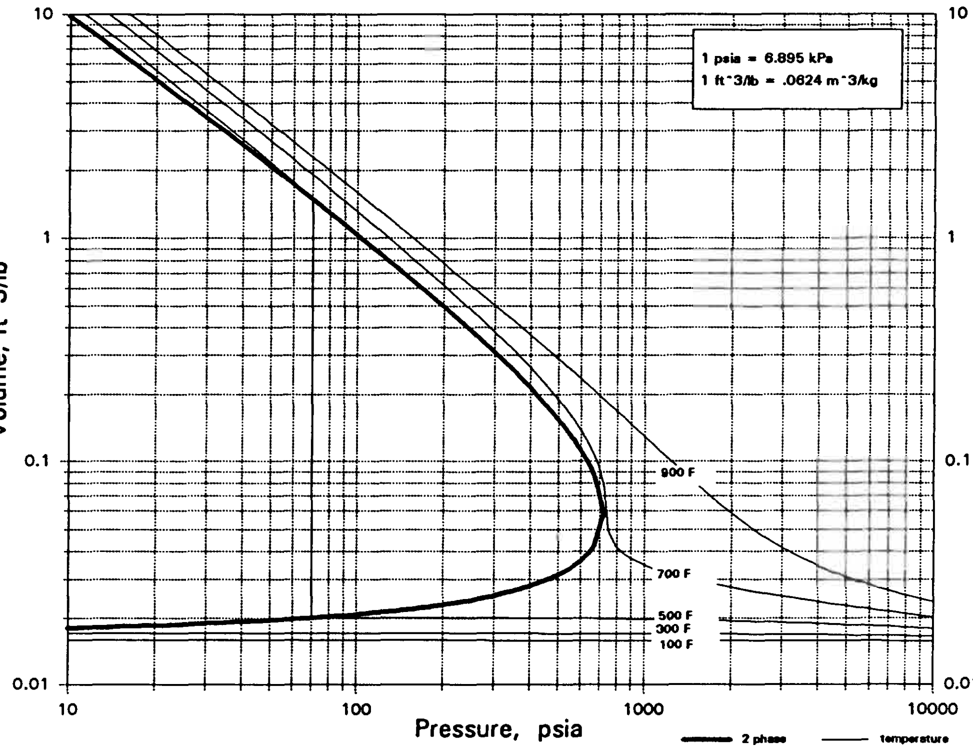


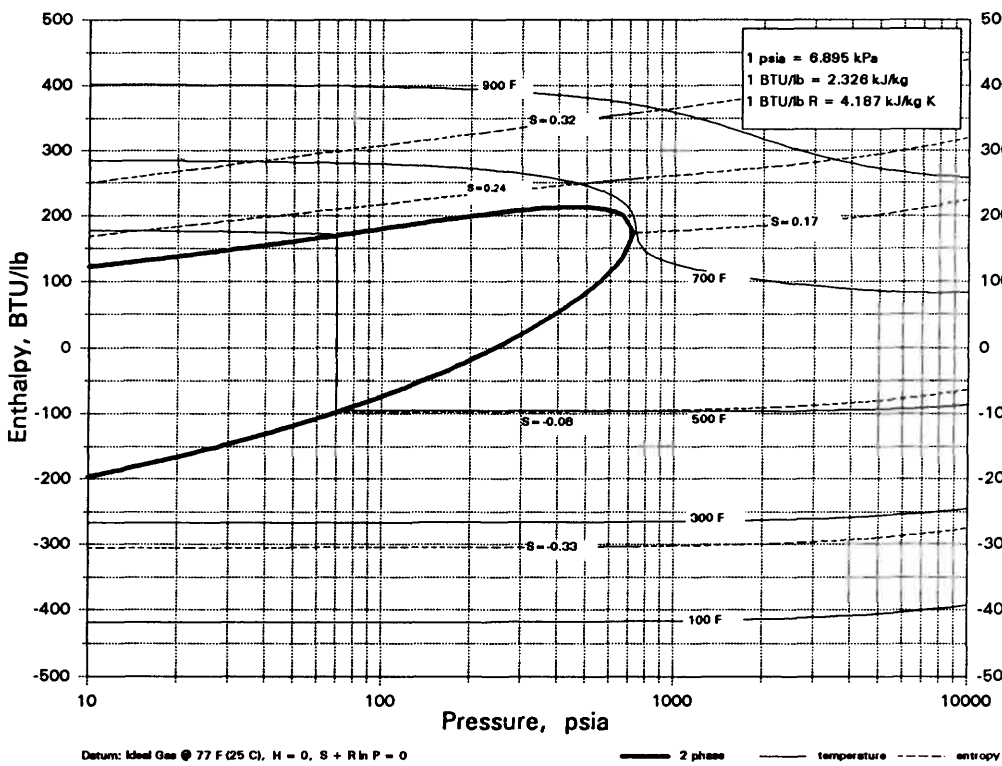
C4H10O ISOBUTANOL



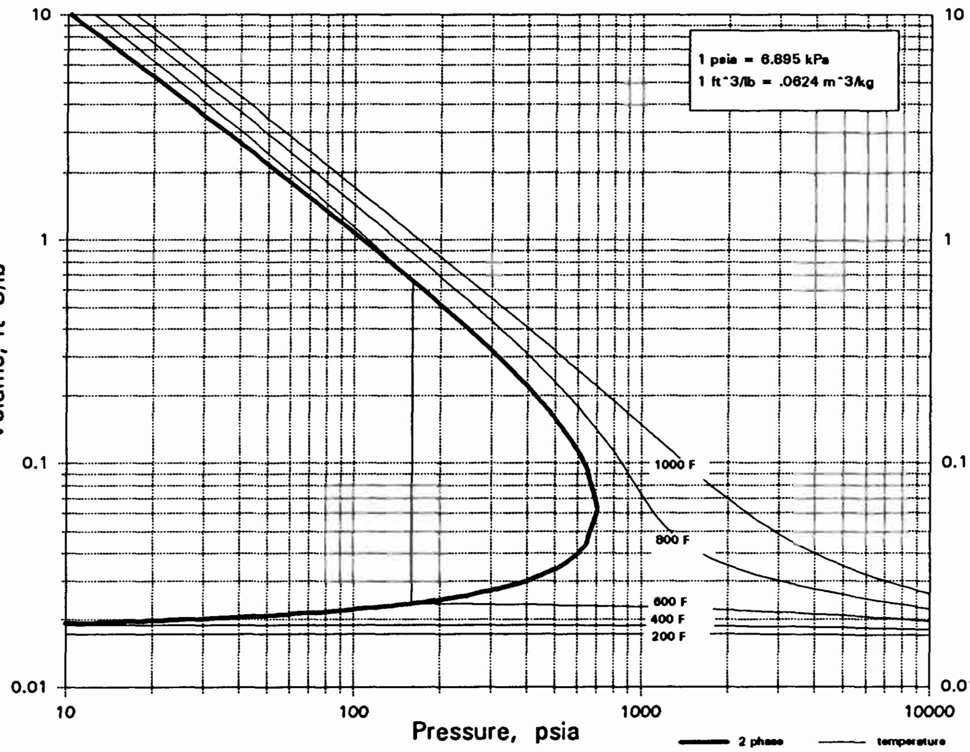


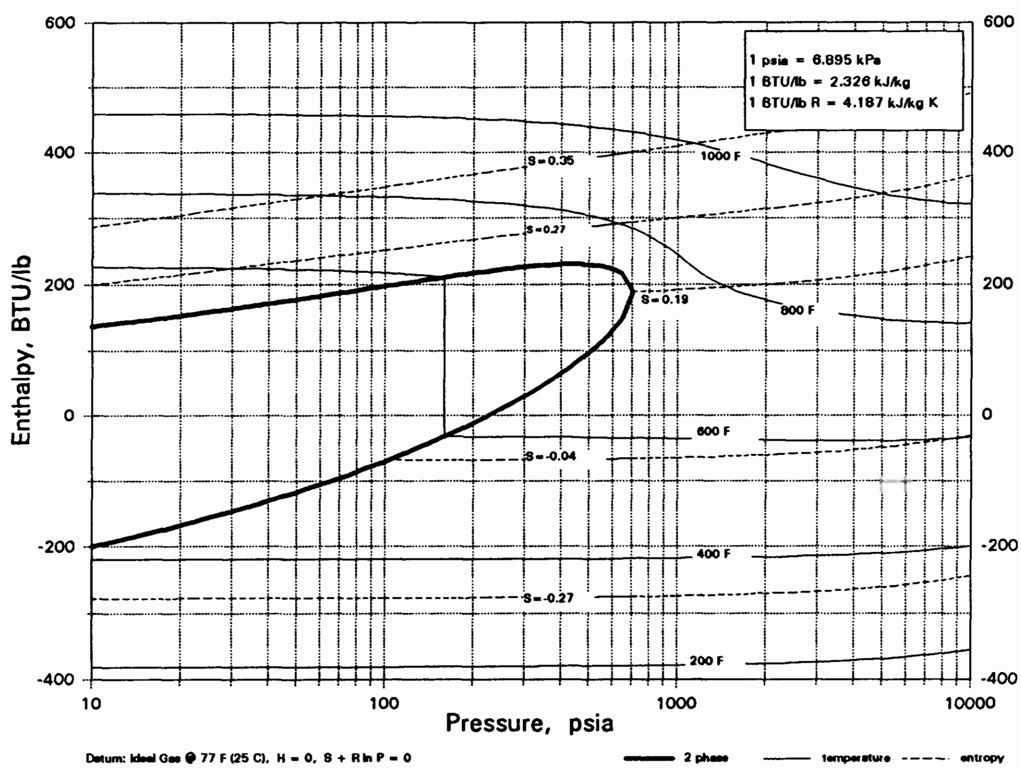
C4H10O2 1-3-BUTANEDIOL



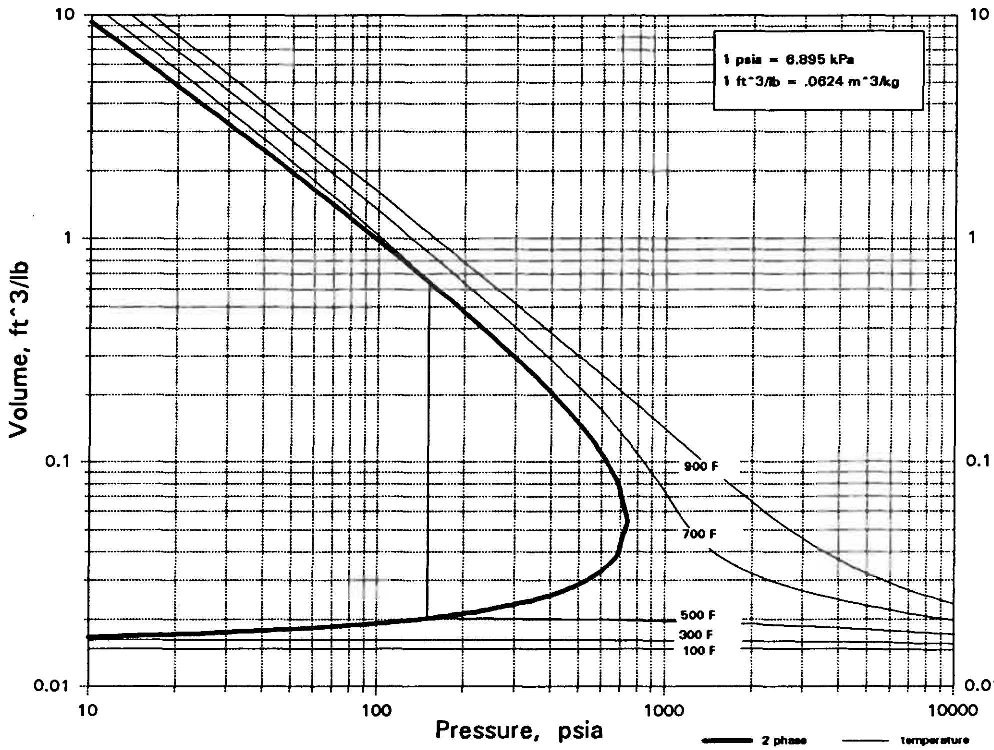


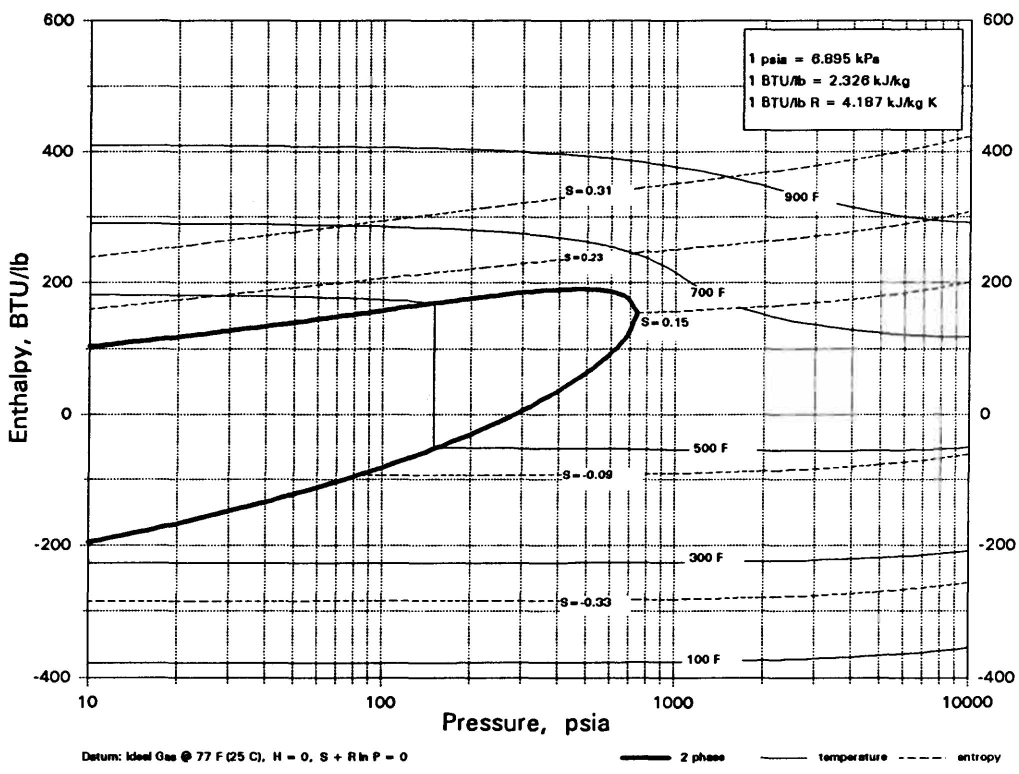
C4H10O2 1-4-BUTANEDIOL



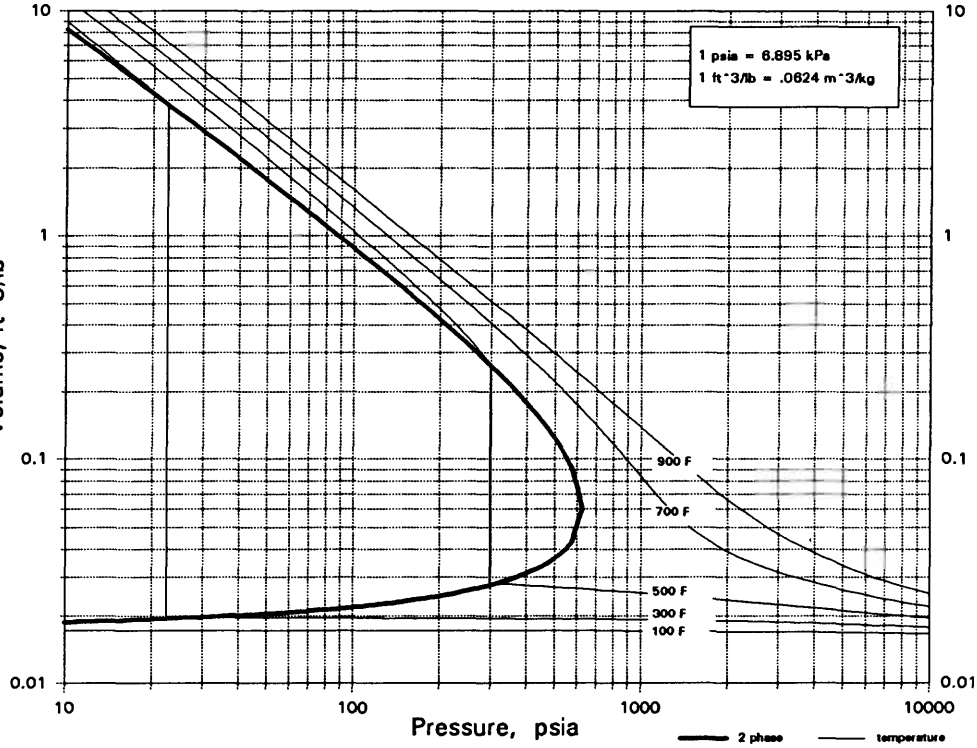


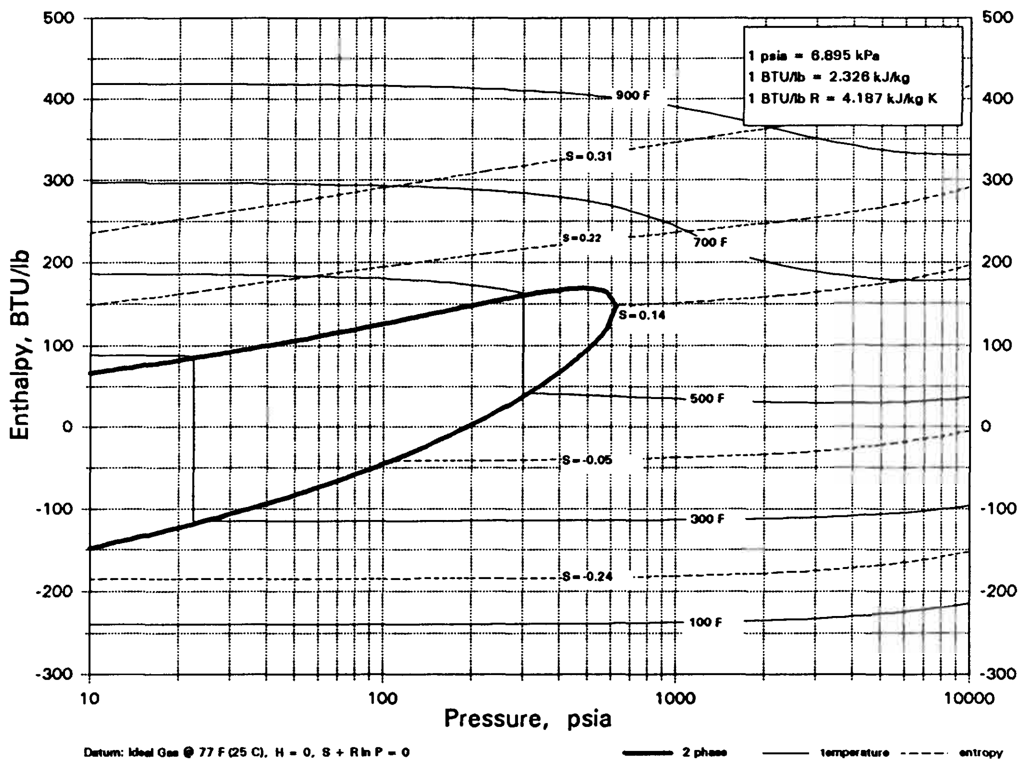
C4H10O2 2-3-BUTANEDIOL



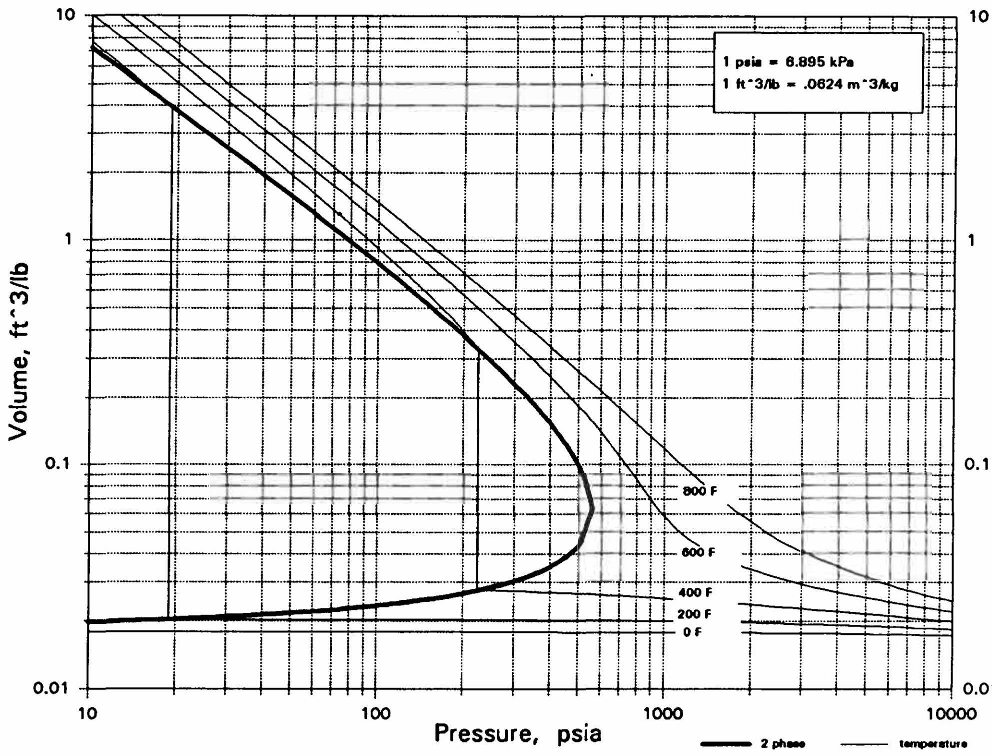


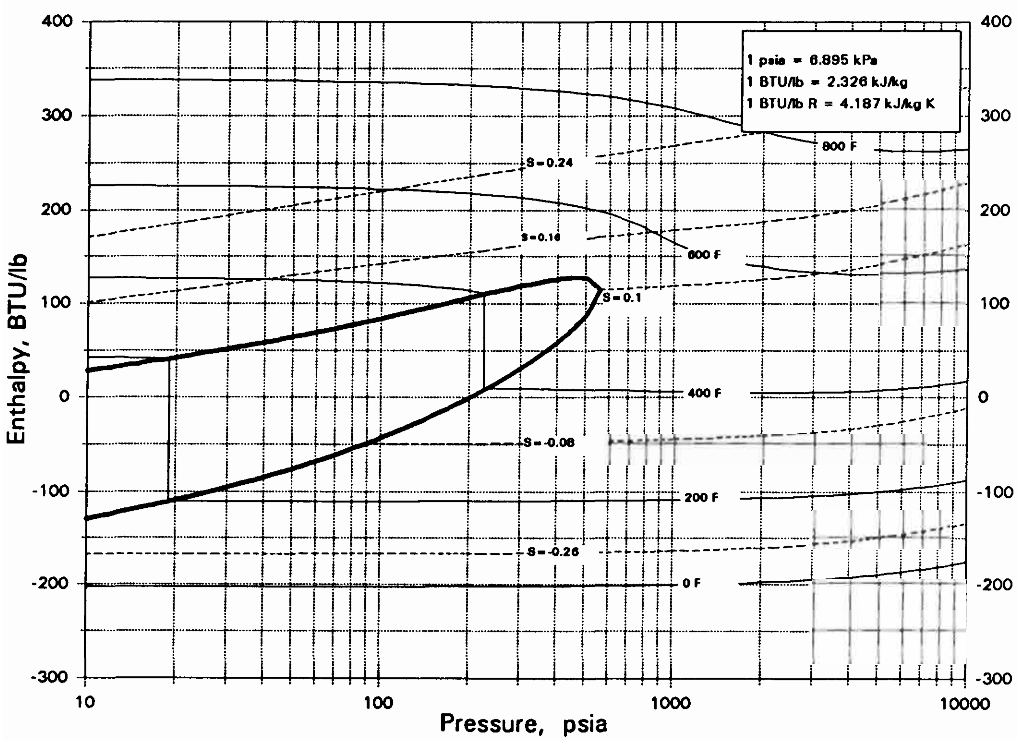
C4H10O2 t-BUTYL HYDROPEROXIDE





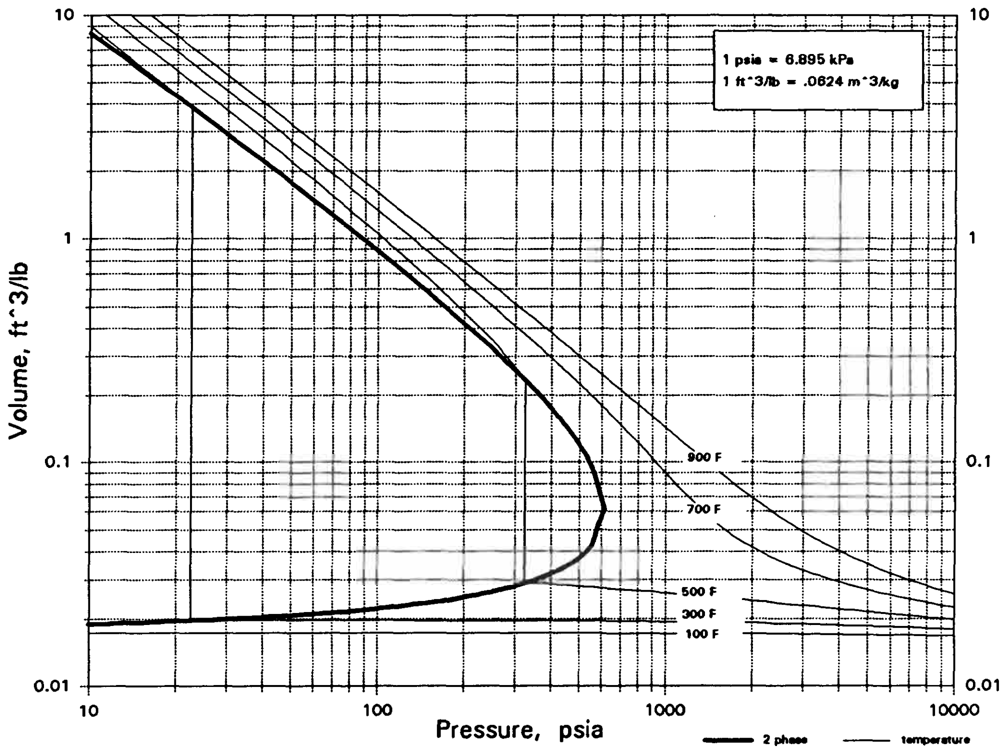
C4H10O2 1-2-DIMETHOXYETHANE

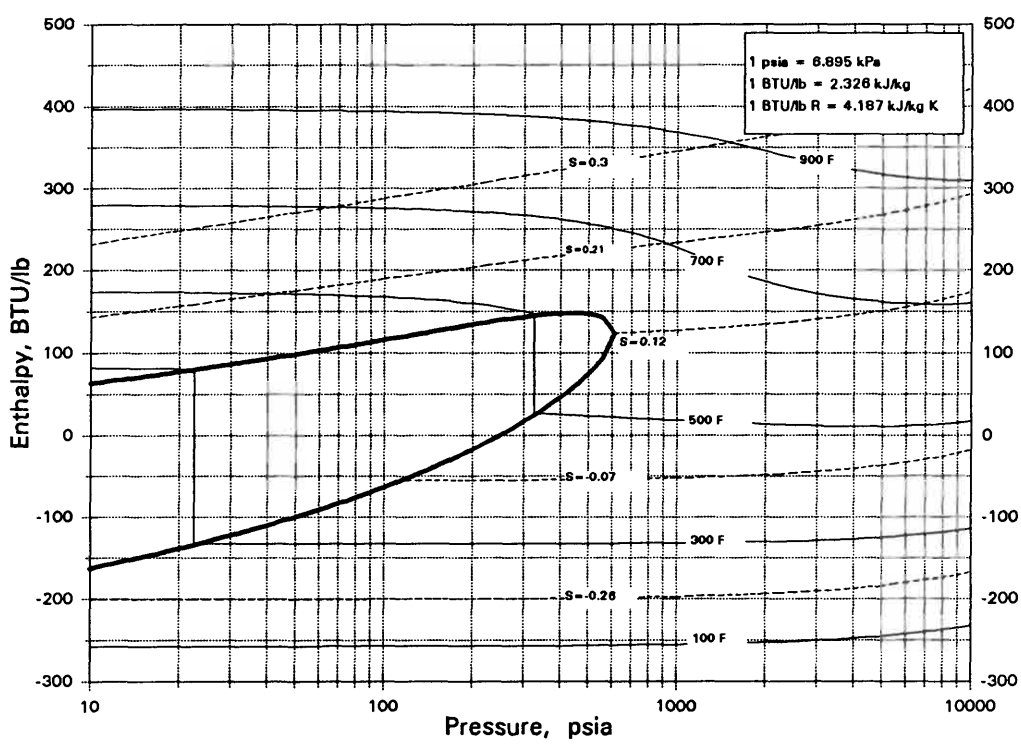




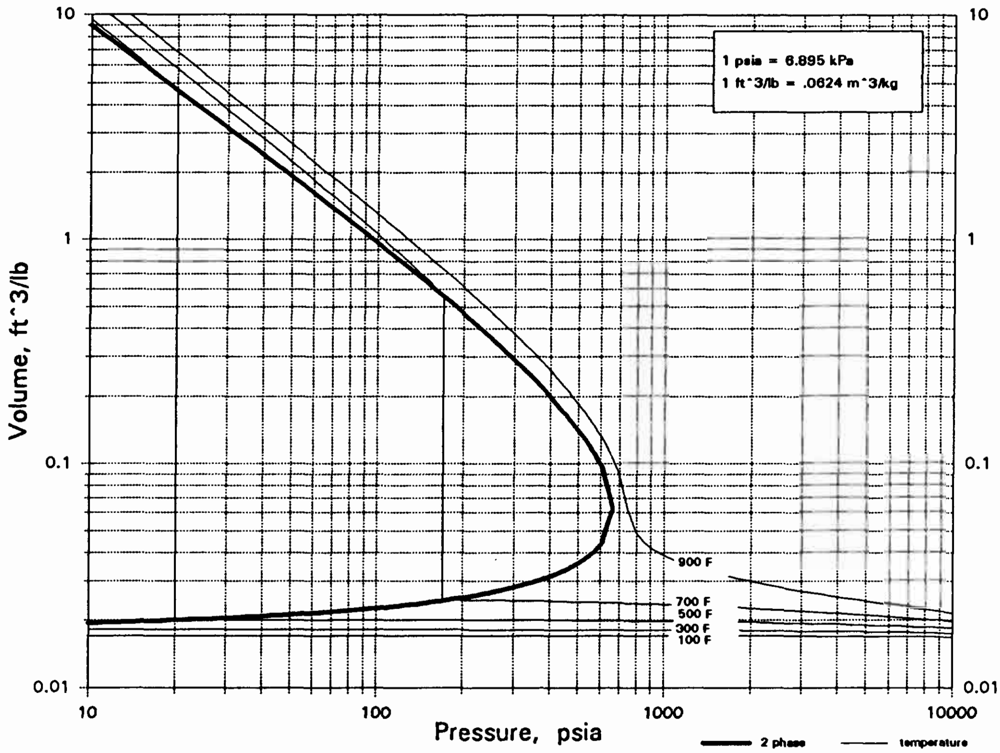
Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

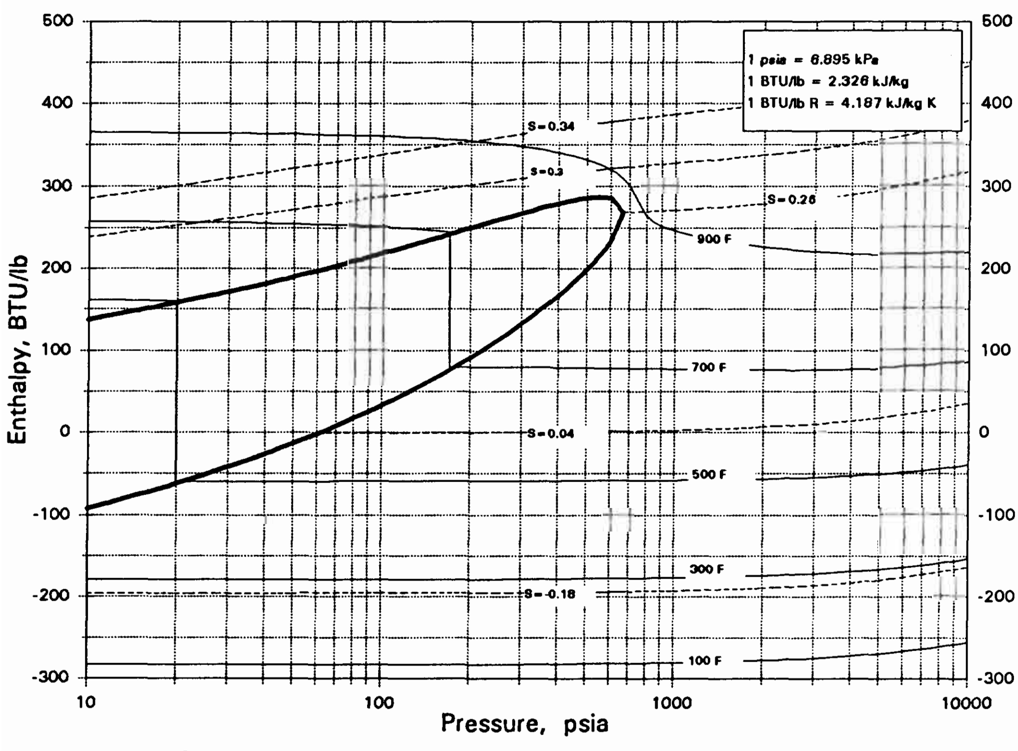
C4H10O2 2-ETHOXYETHANOL



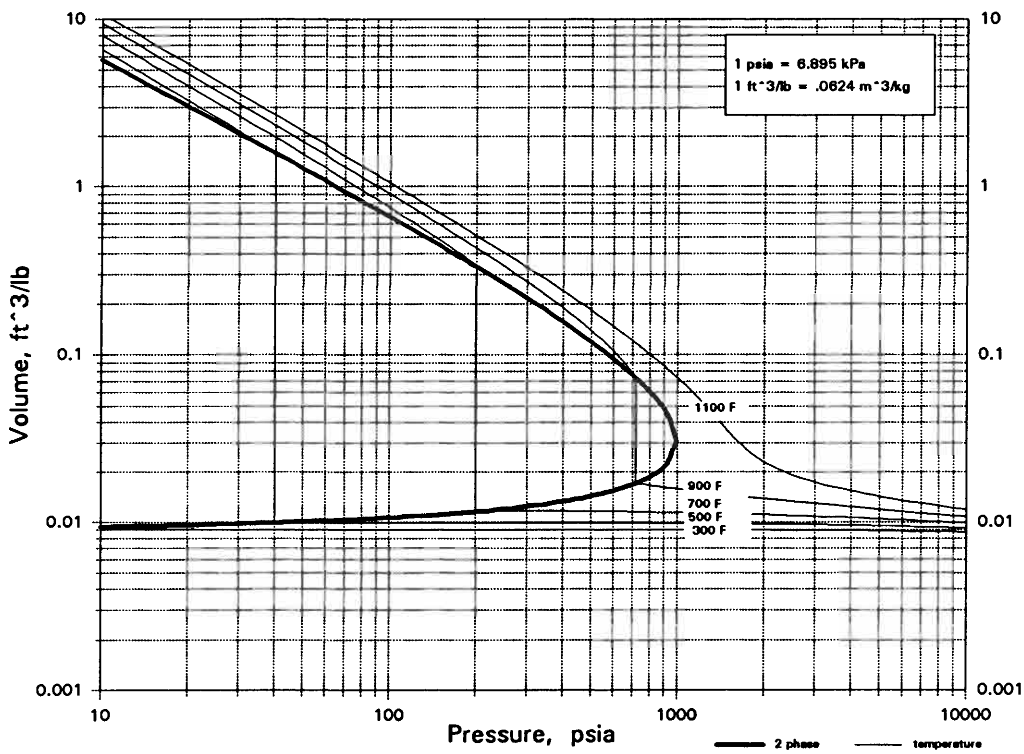


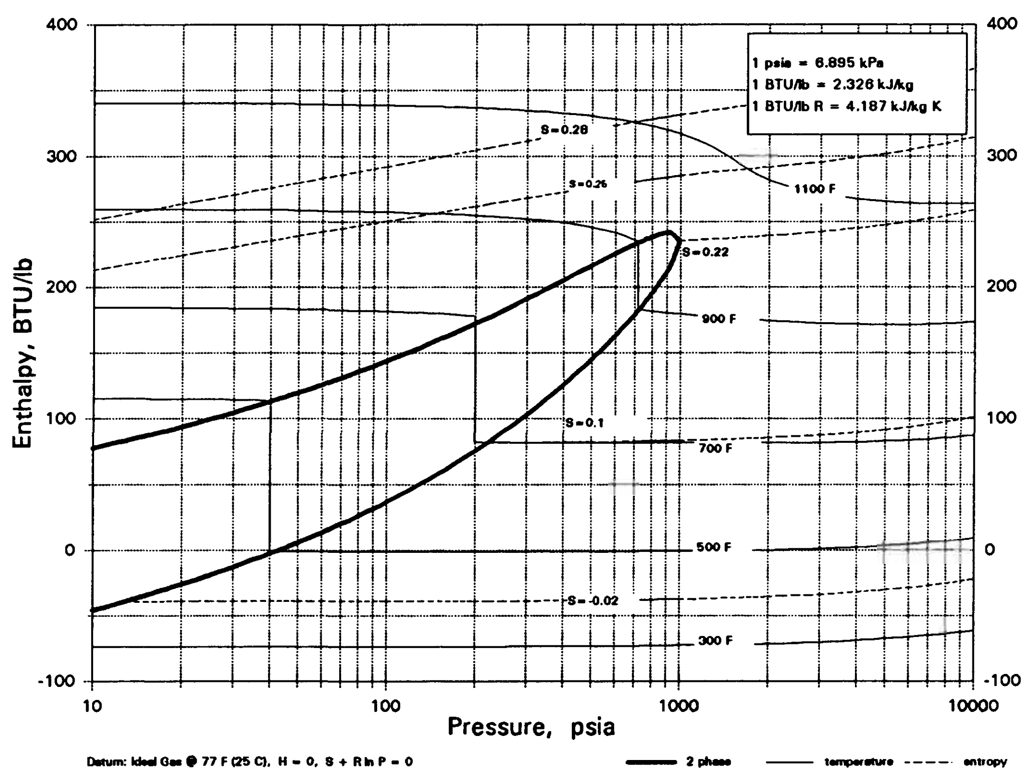
C4H10O3 DIETHYLENE GLYCOL



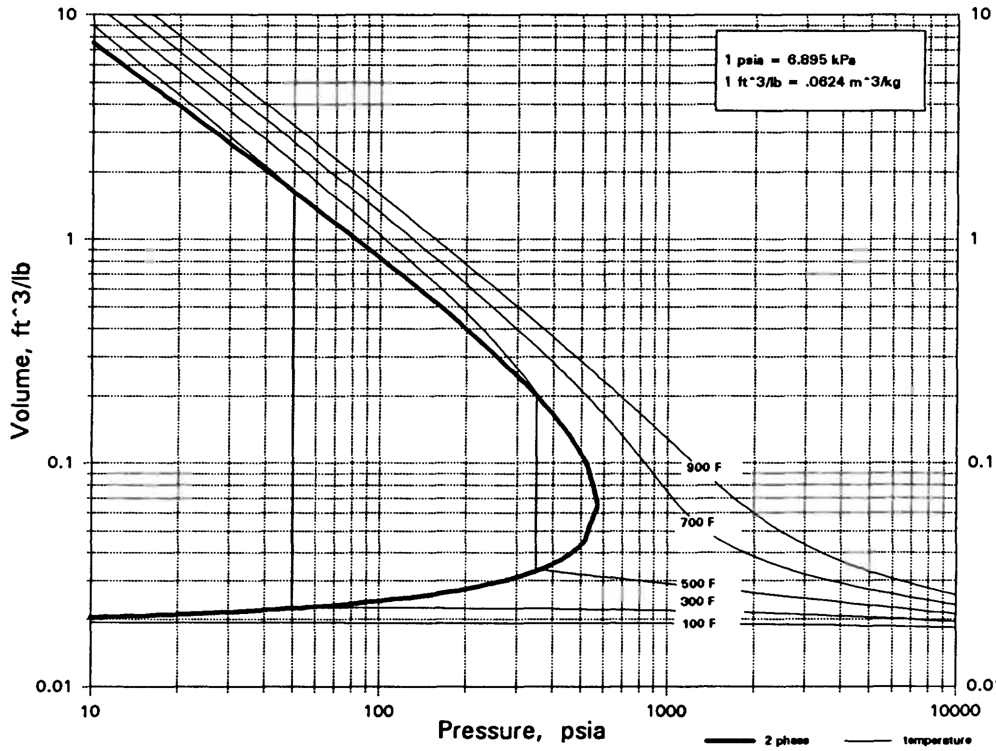


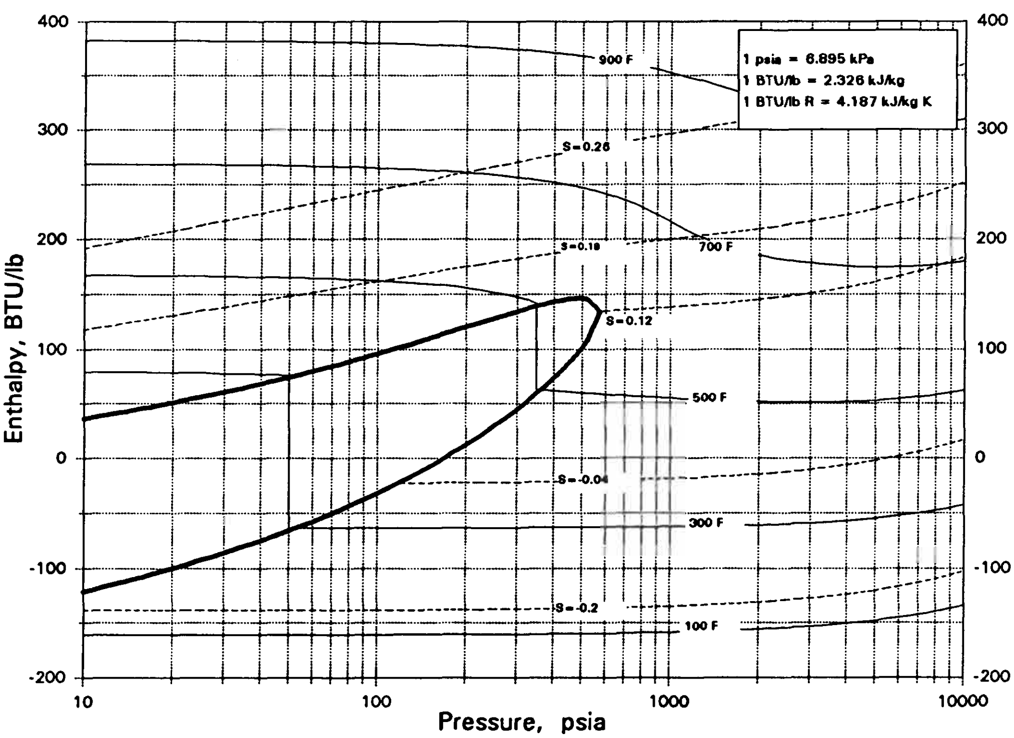
C4H10O4S DIETHYL SULFATE





C4H10S n-BUTYL MERCAPTAN





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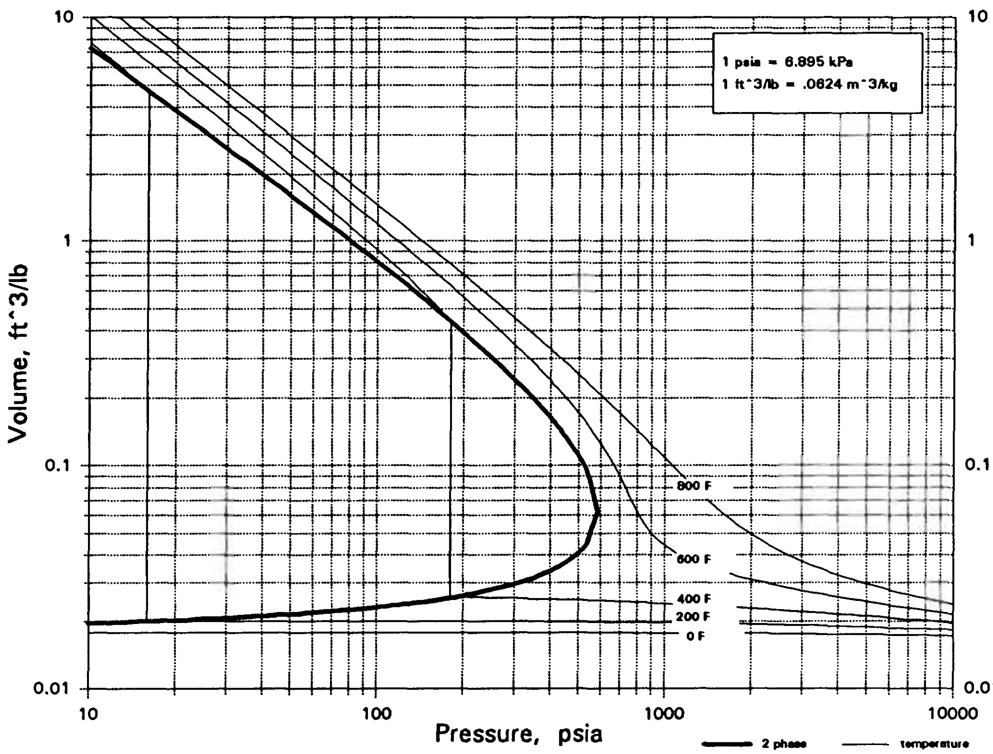
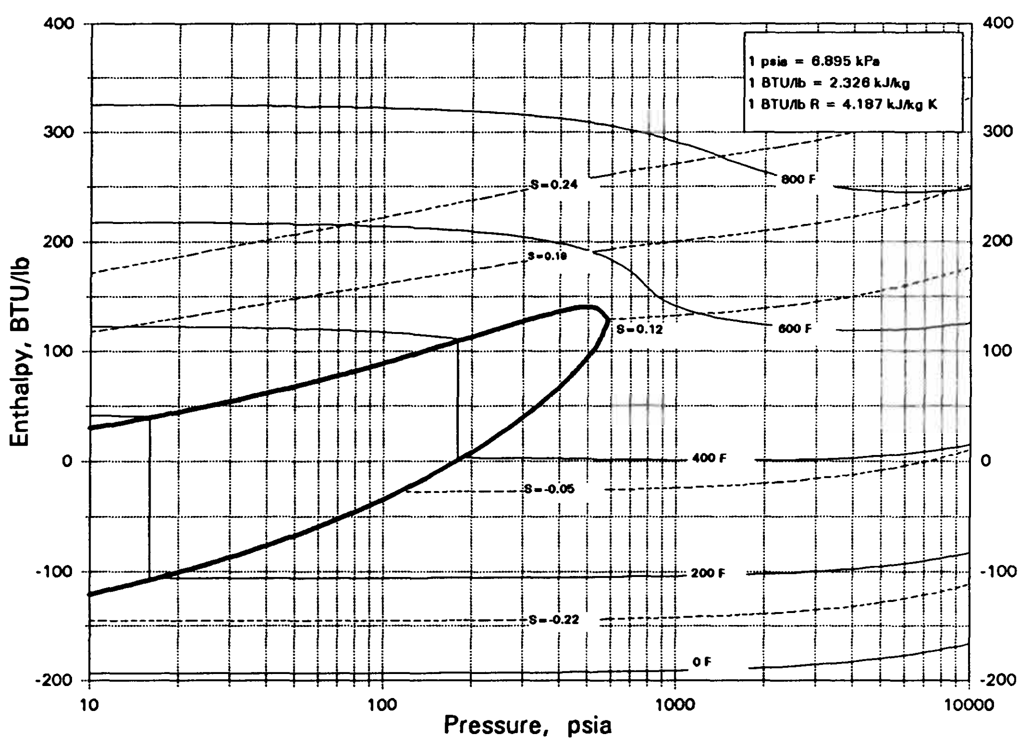
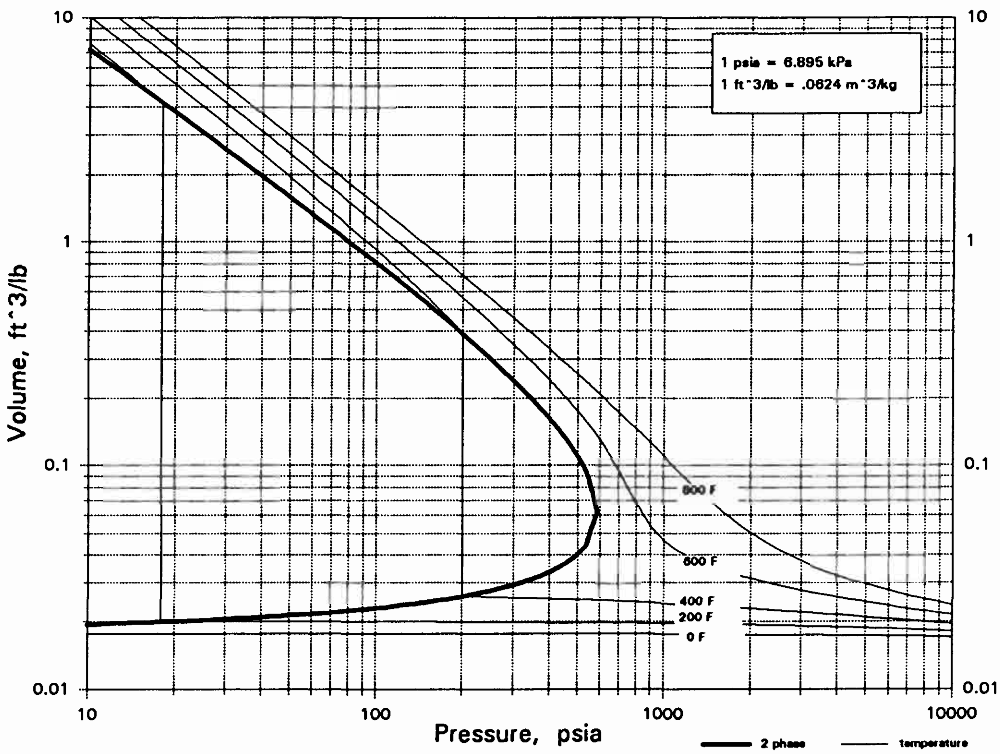
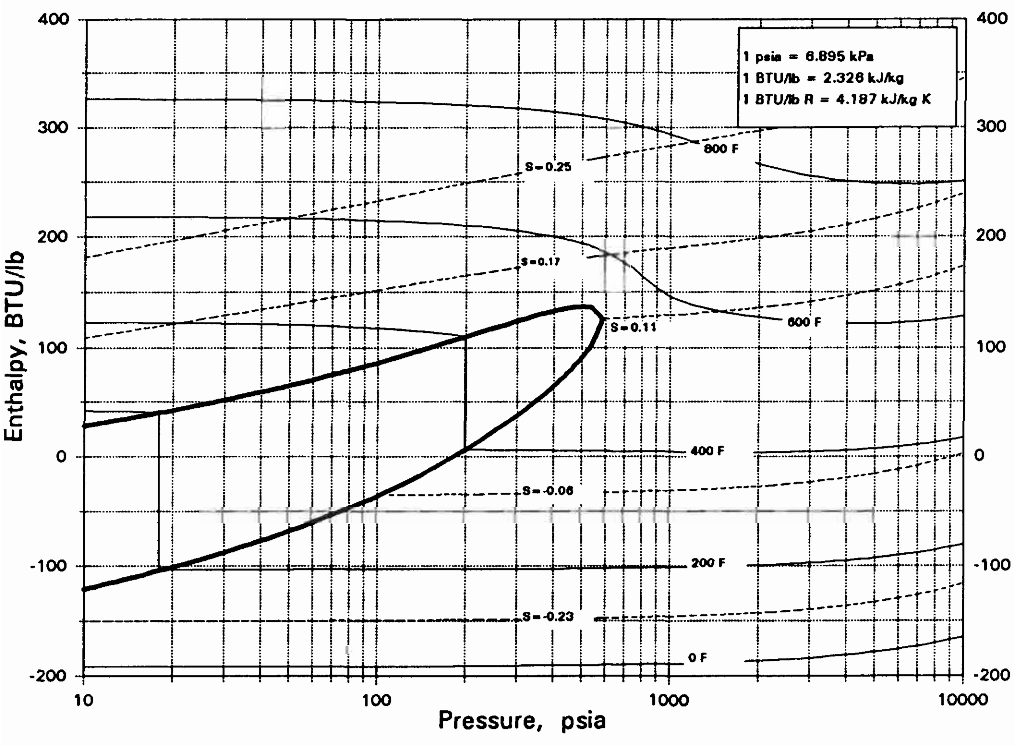
C4H10S ISOBUTYL MERCAPTAN



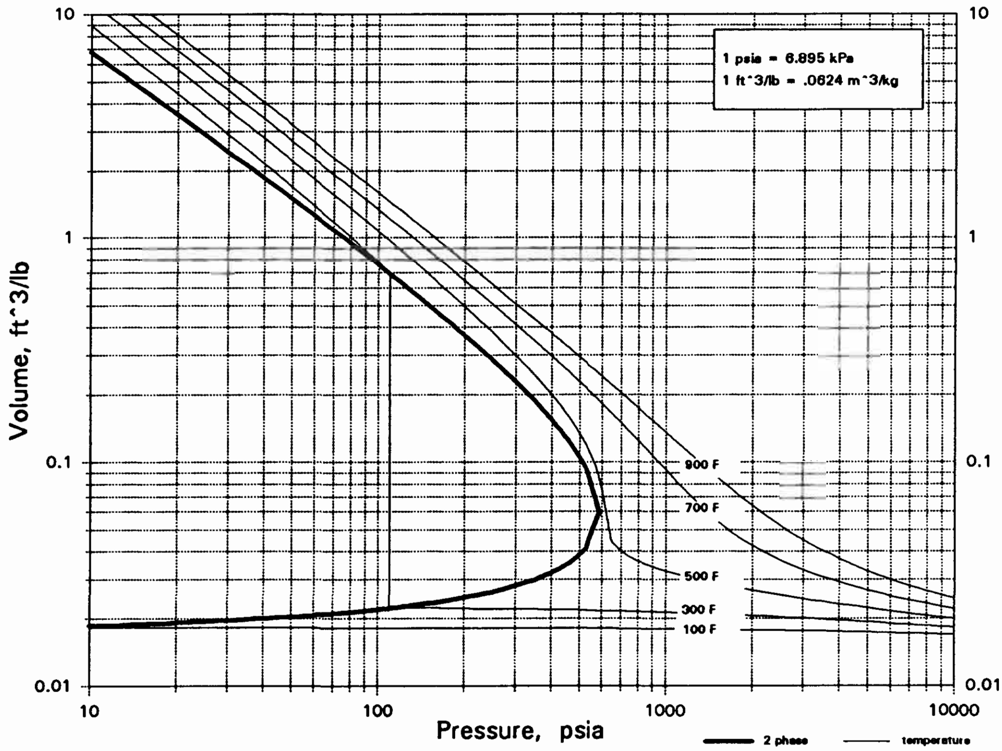


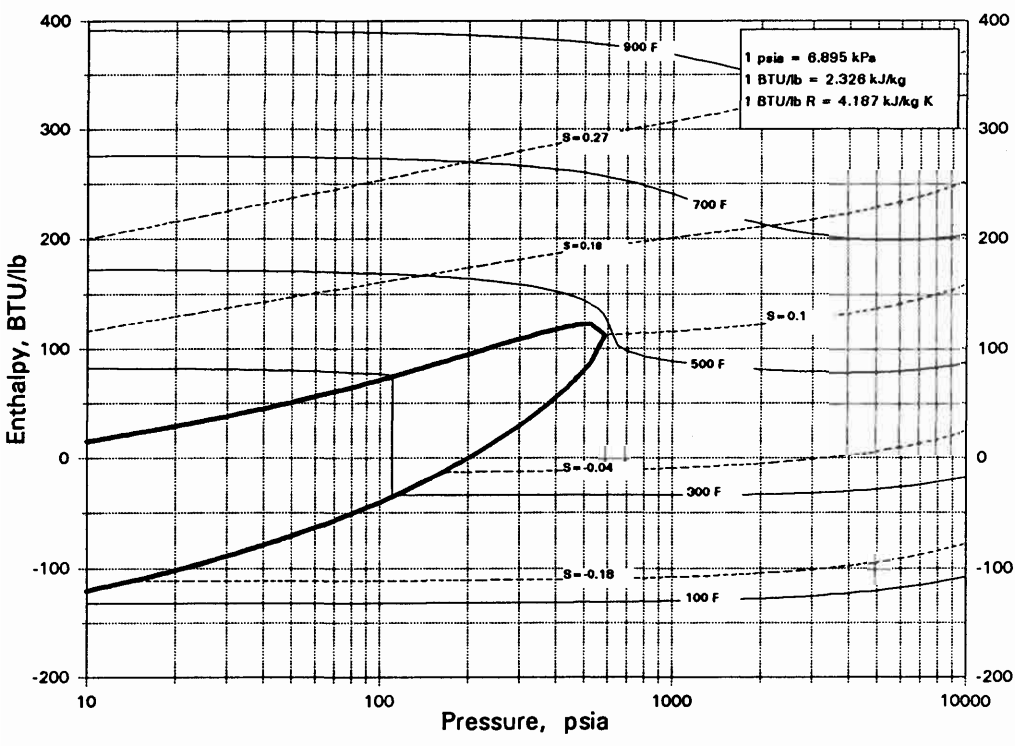
$C_4H_{10}S$ sec-BUTYL MERCAPTAN



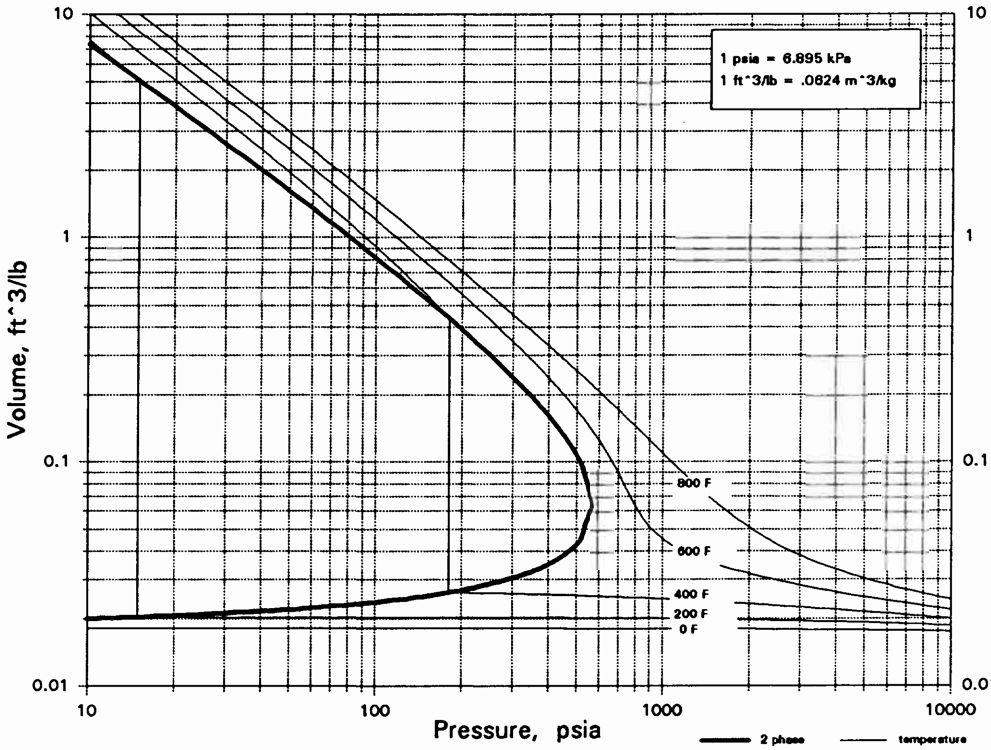


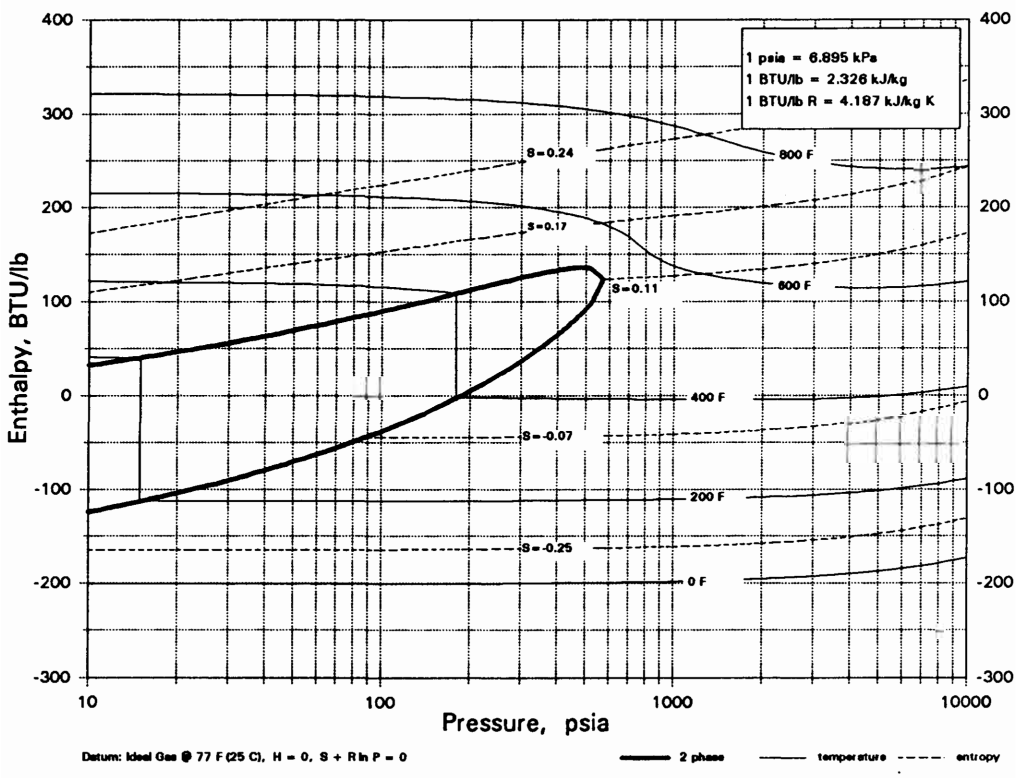
C4H10S tert-BUTYL MERCAPTAN



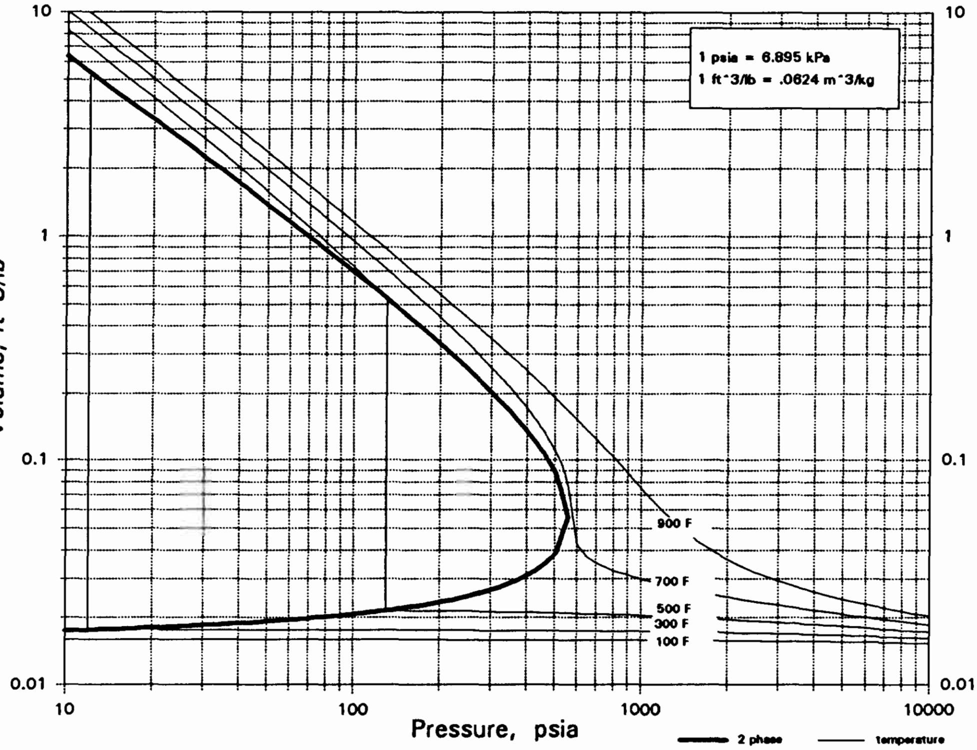


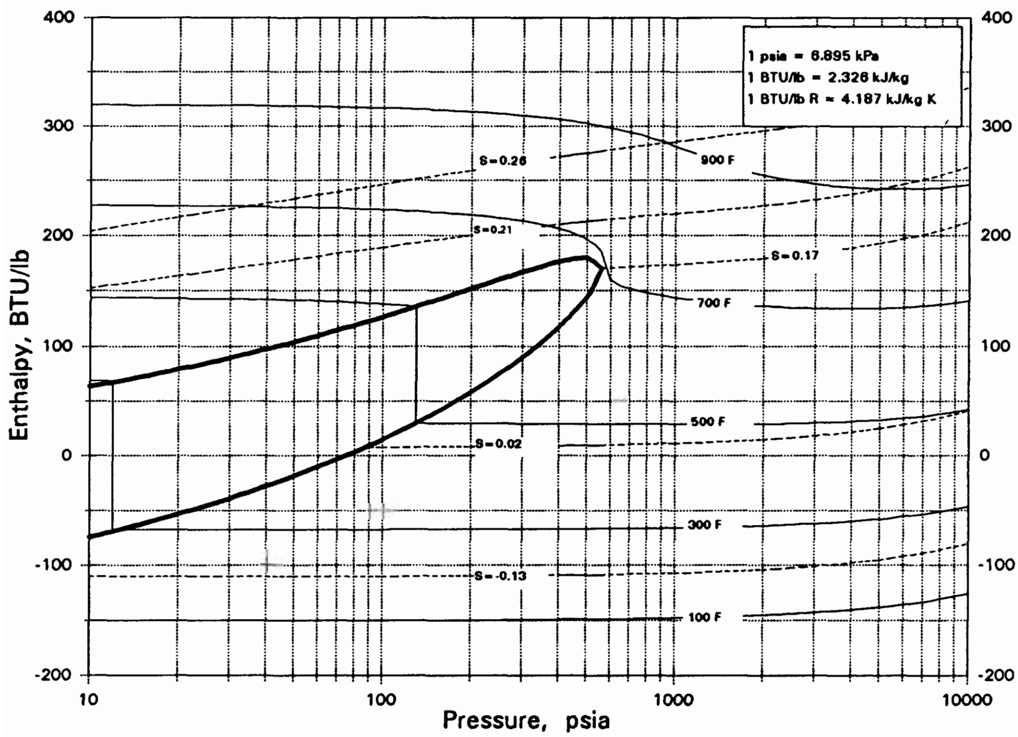
C4H10S DIETHYL SULFIDE





C4H10S2 DIETHYL DISULFIDE





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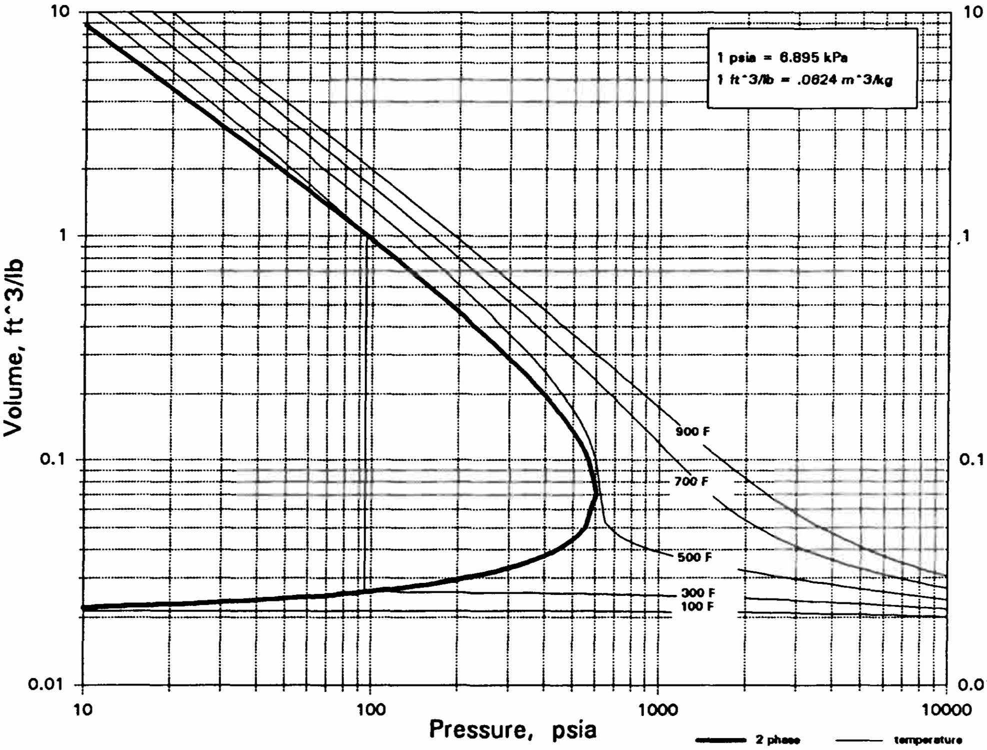
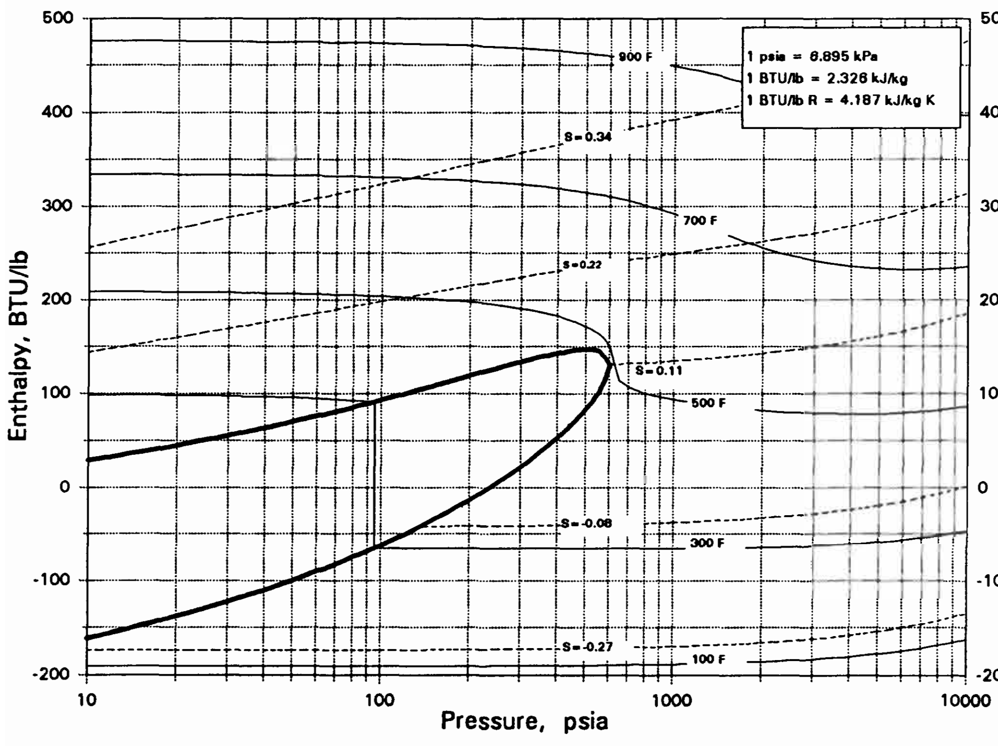
C4H11N n-BUTYLAMINE





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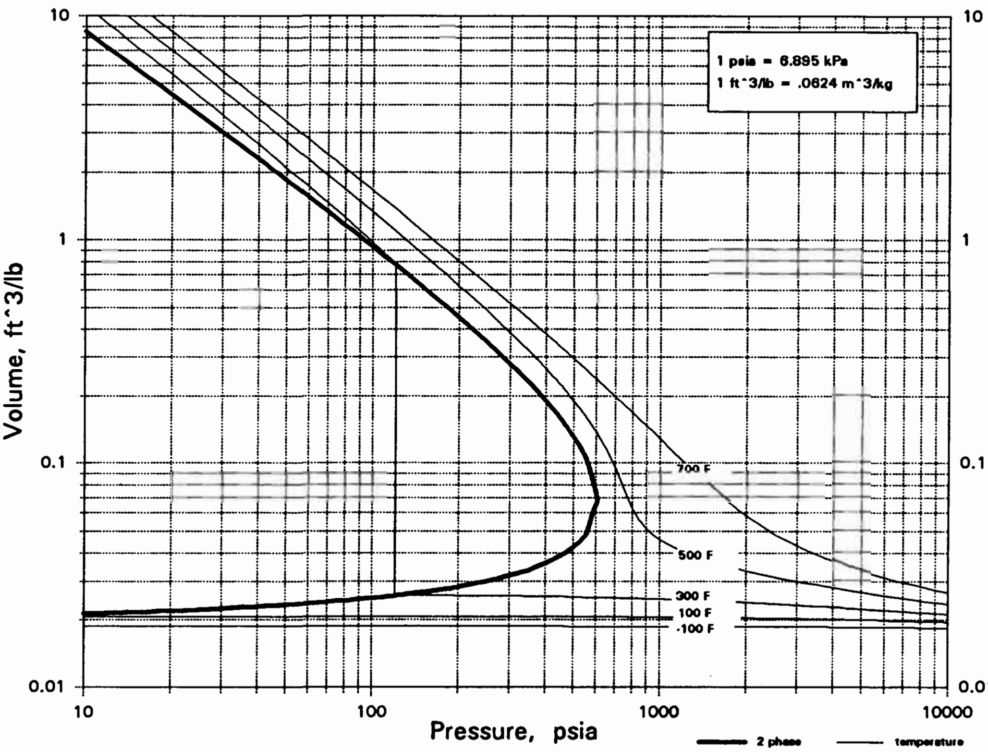
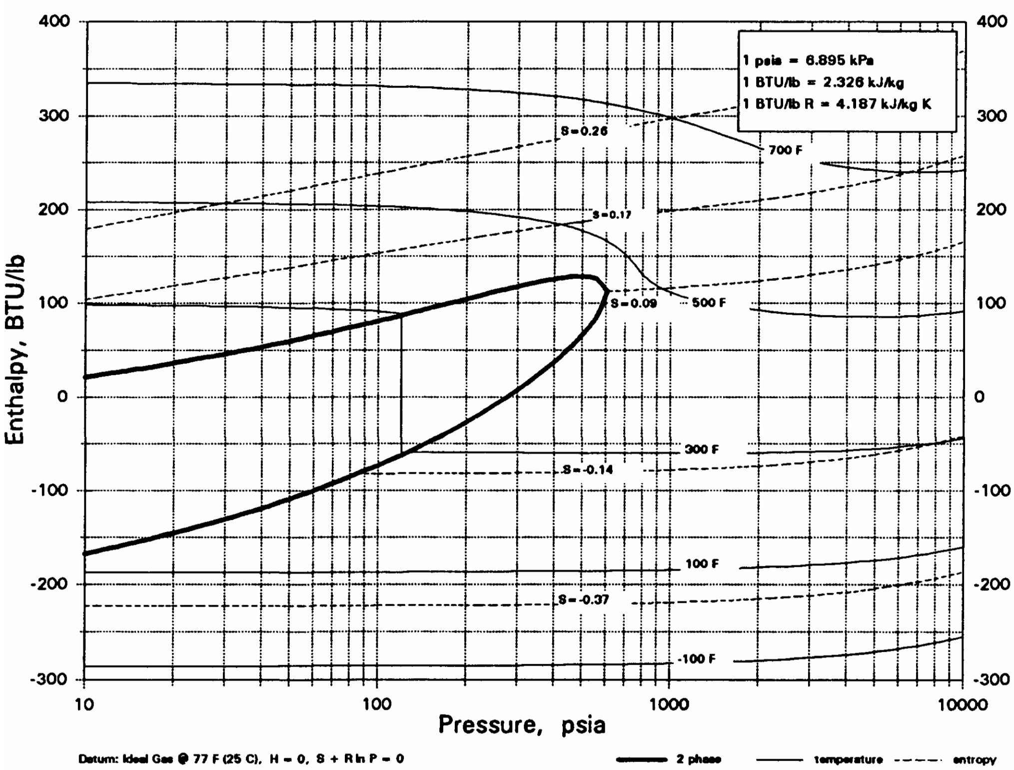
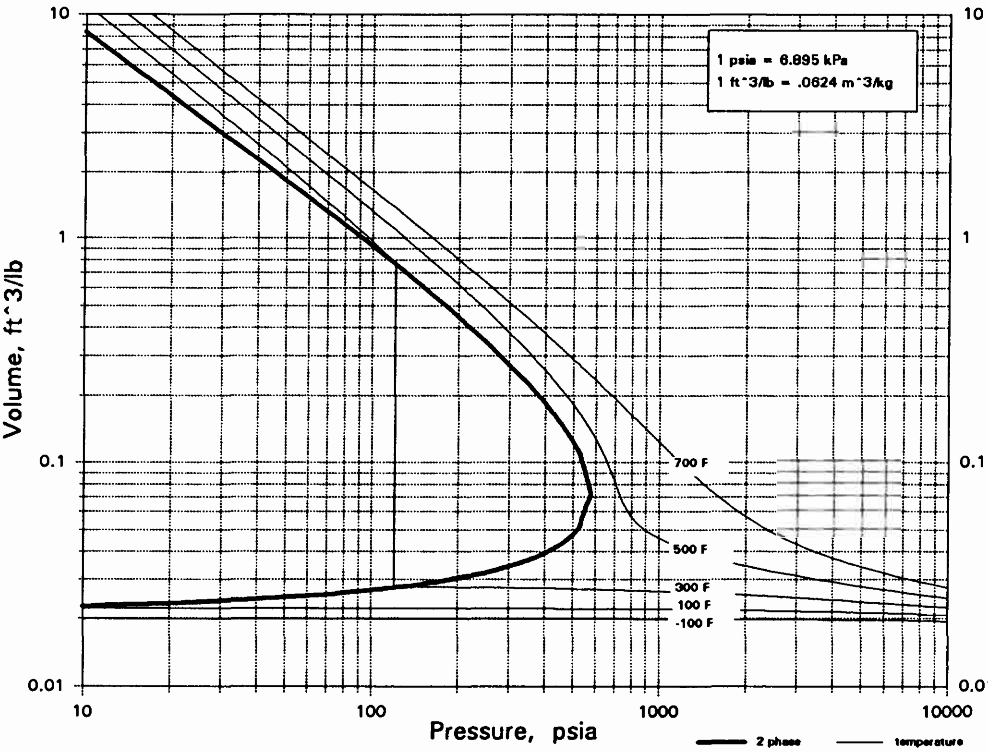
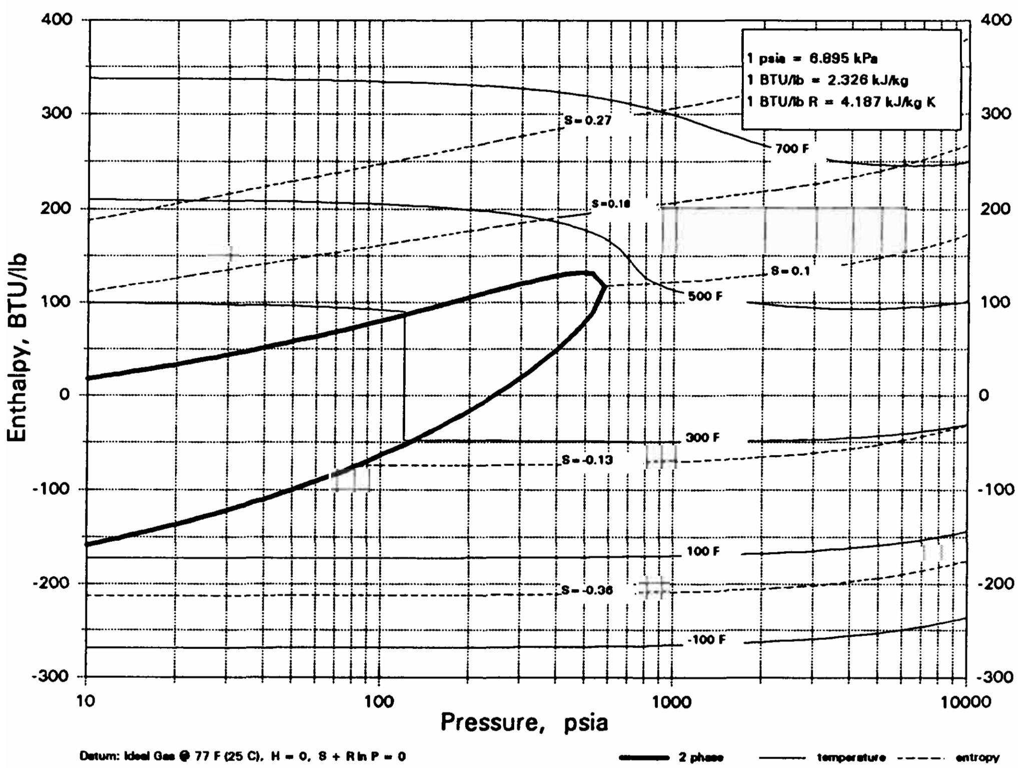
$C_4H_{11}N$ ISOBUTYLAMINE



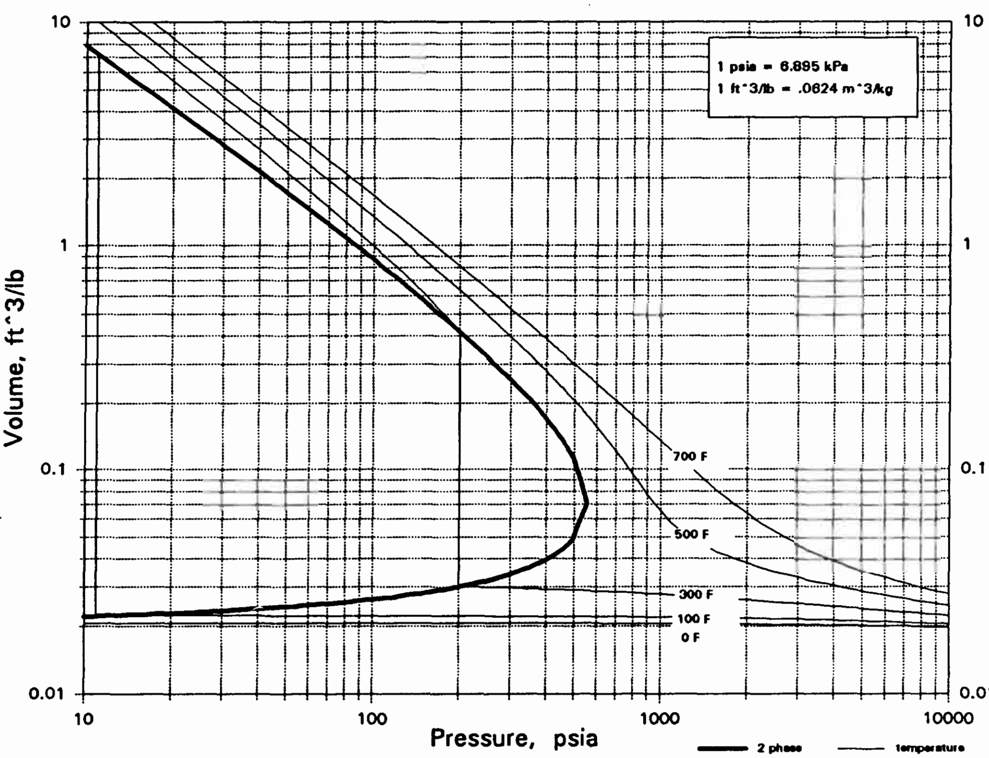


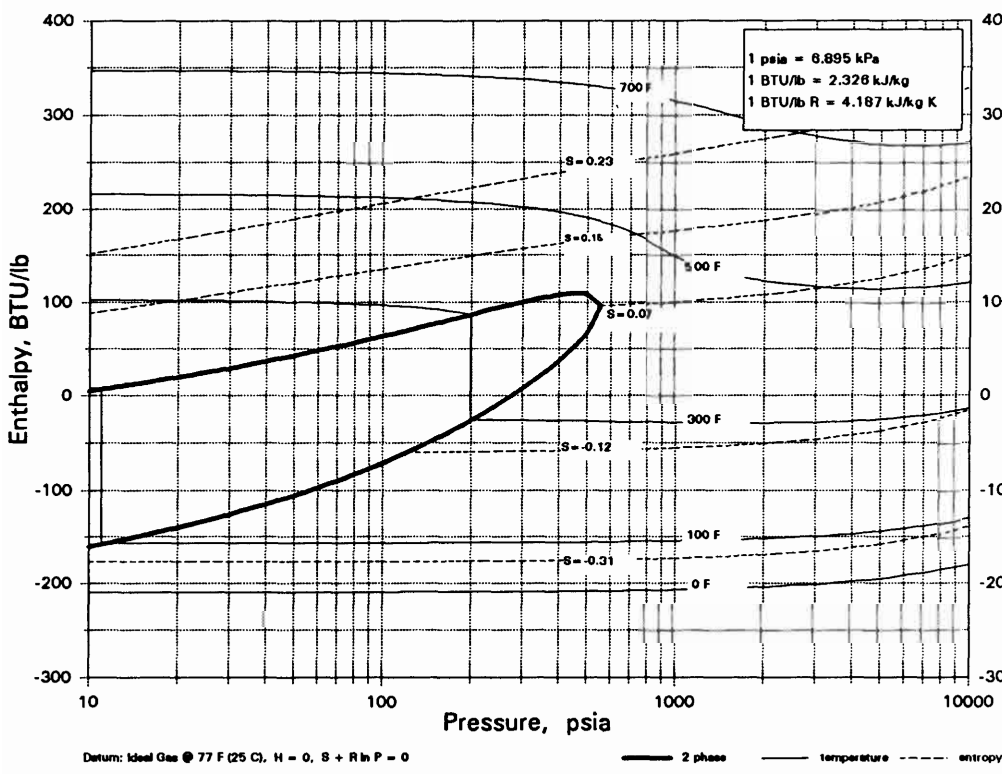
C4H11N	sec-BUTYLAMINE



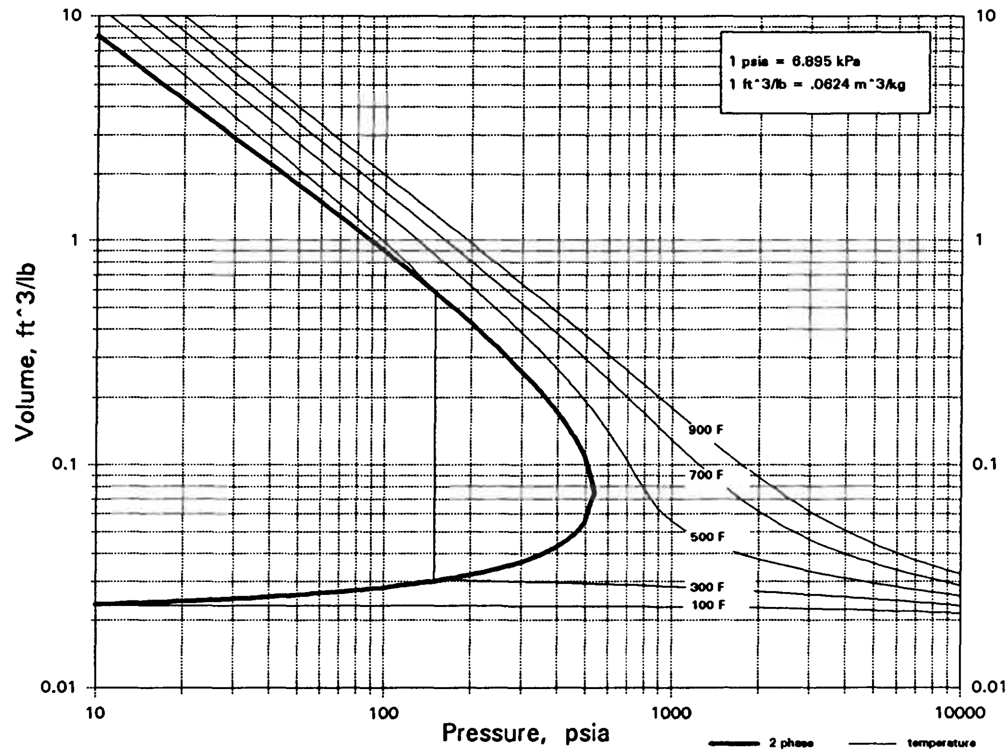


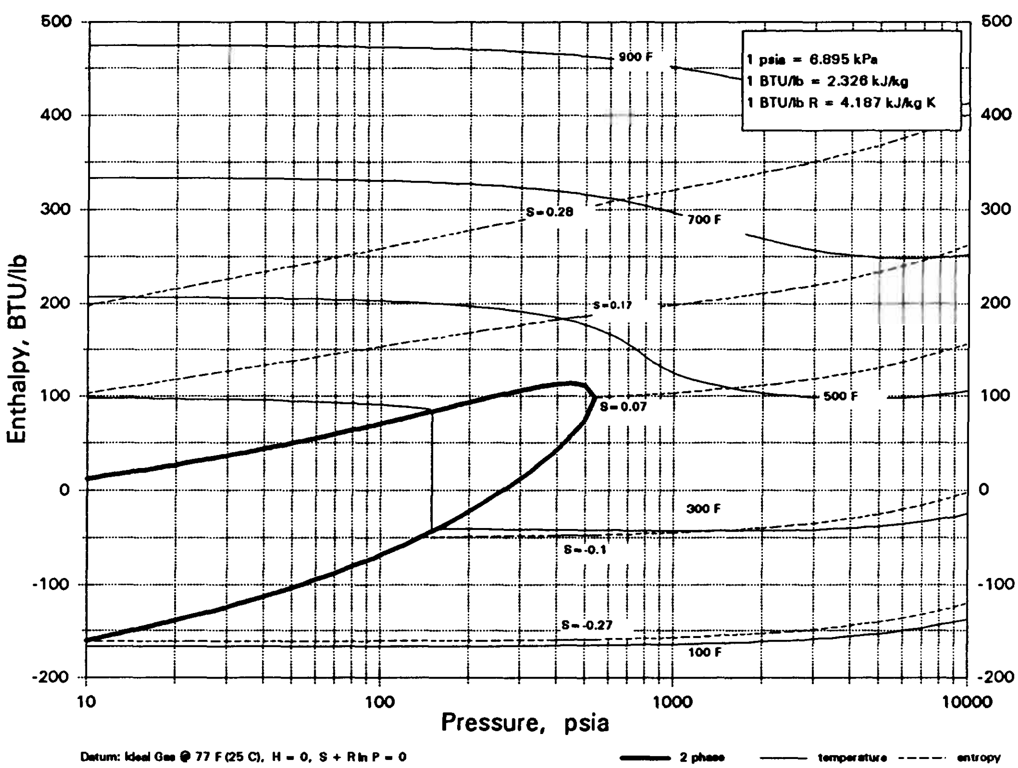
C4H11N tert-BUTYLAMINE



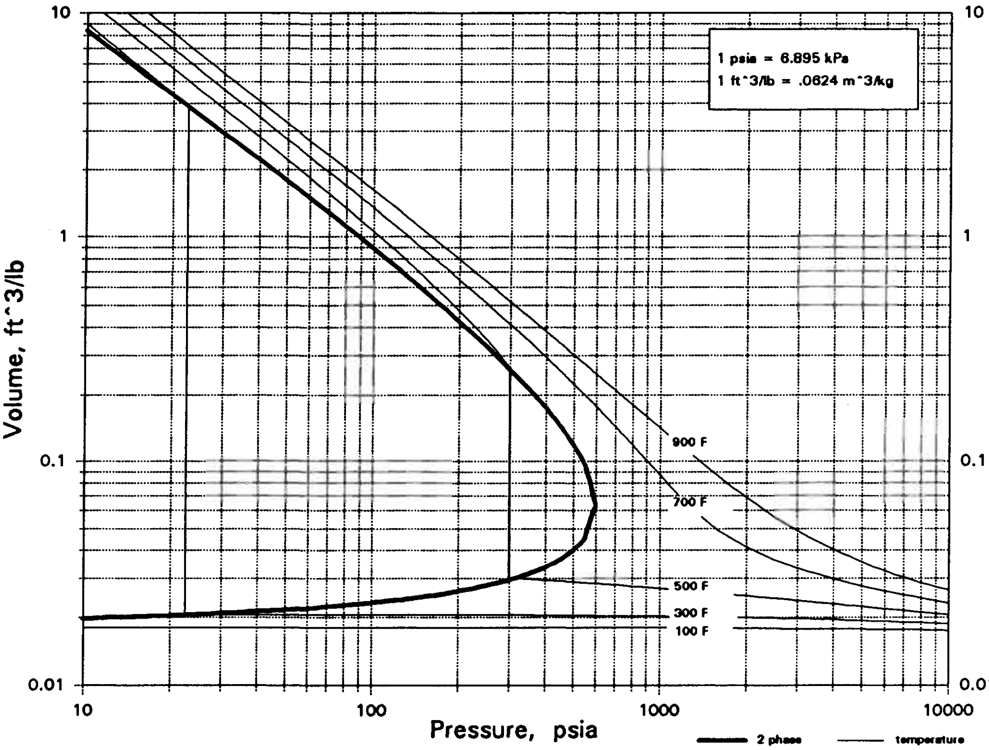


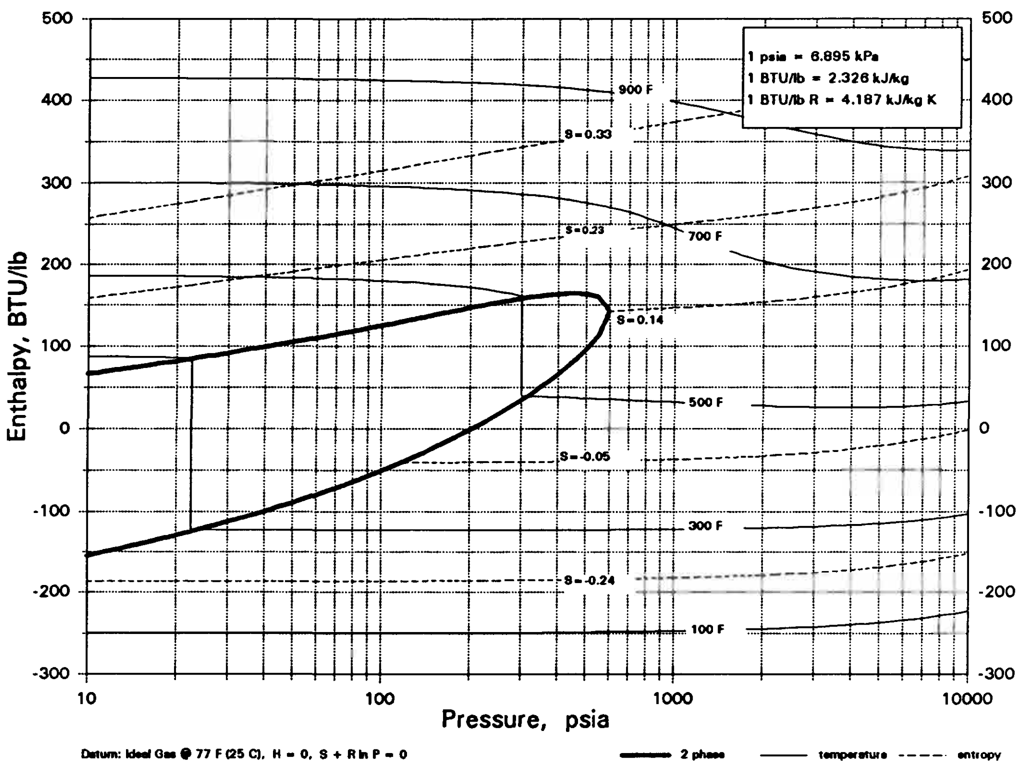
C4H11N DIETHYLAMINE



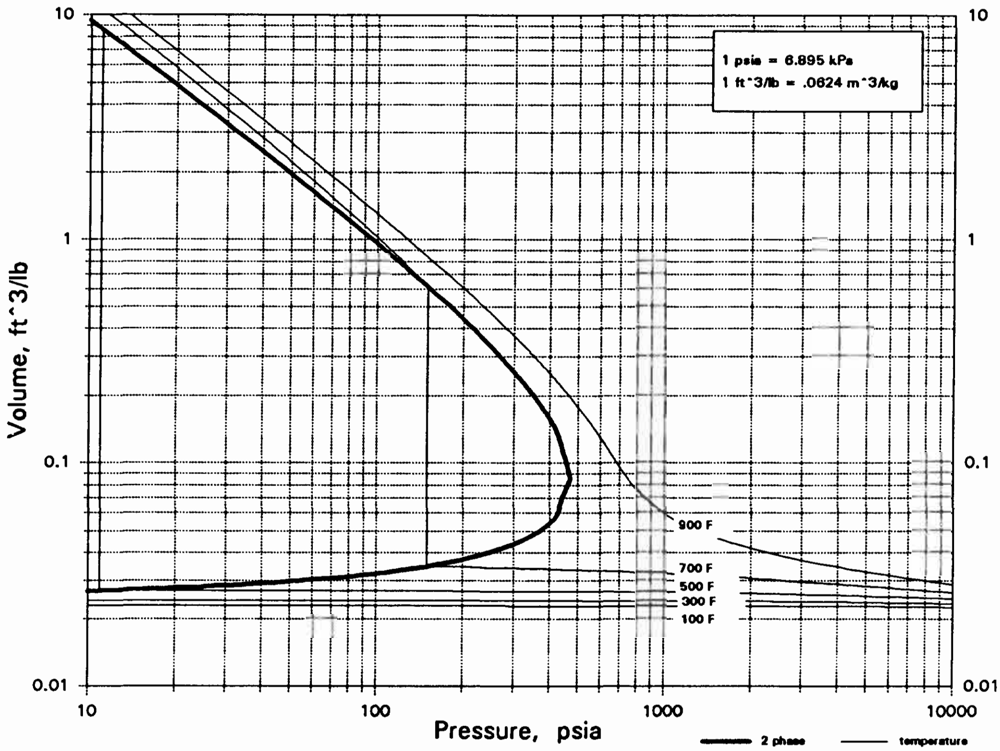


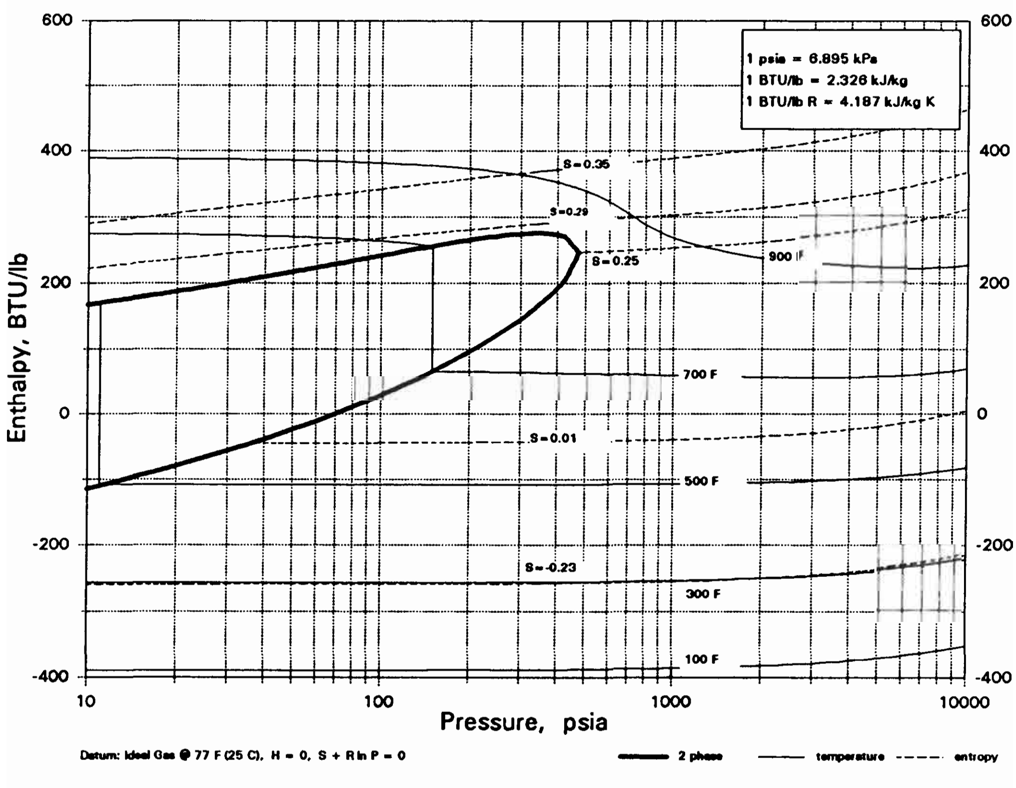
C4H11NO DIMETHYLETHANOLAMINE



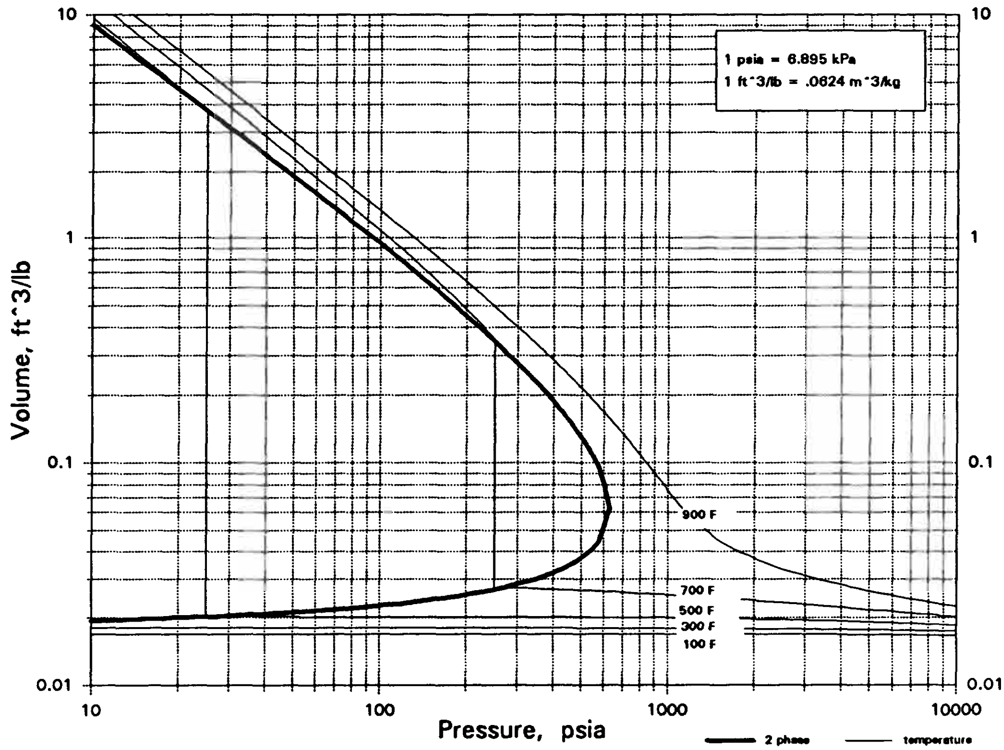


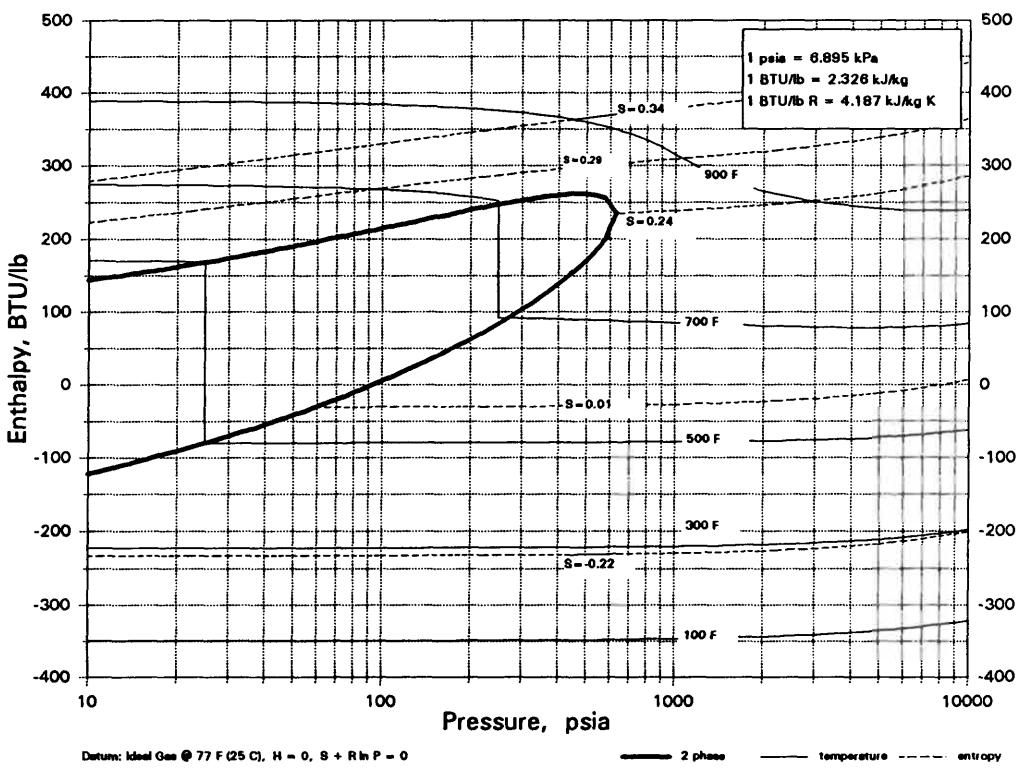
C4H11NO2 DIETHANOLAMINE



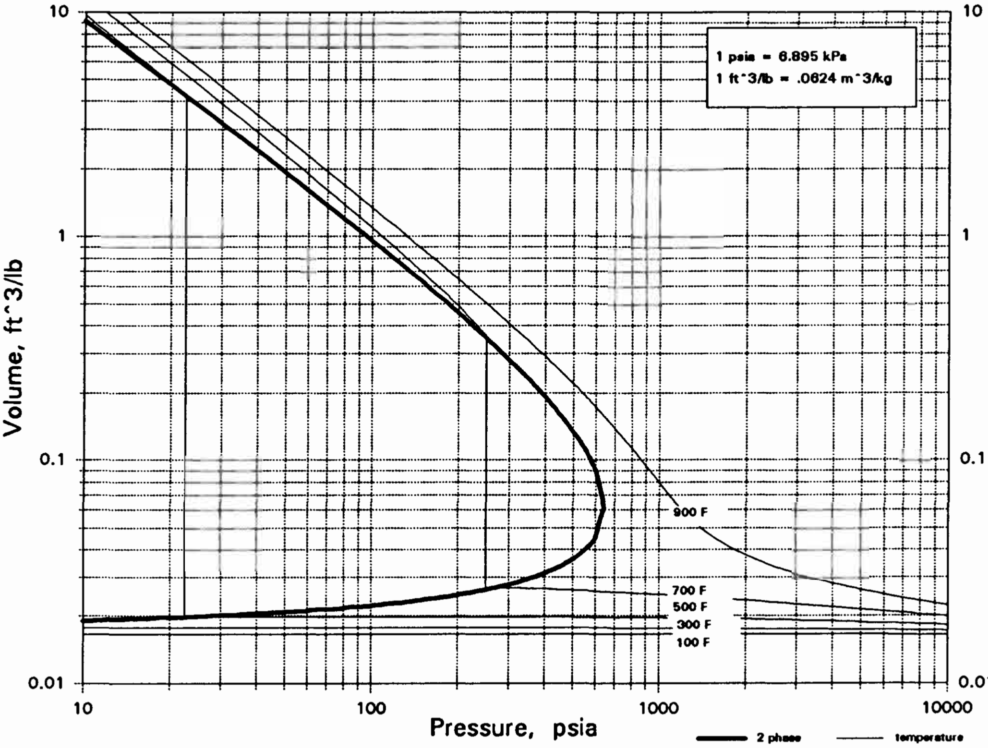


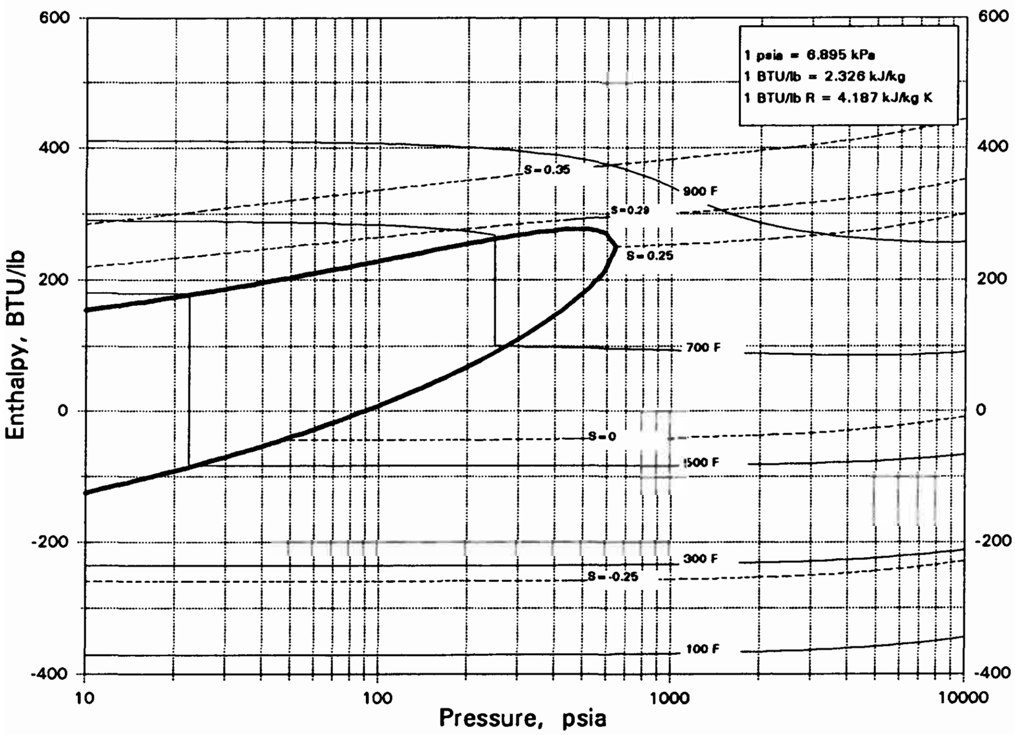
C4H11NO2 2-AMINOETHOXYETHANOL





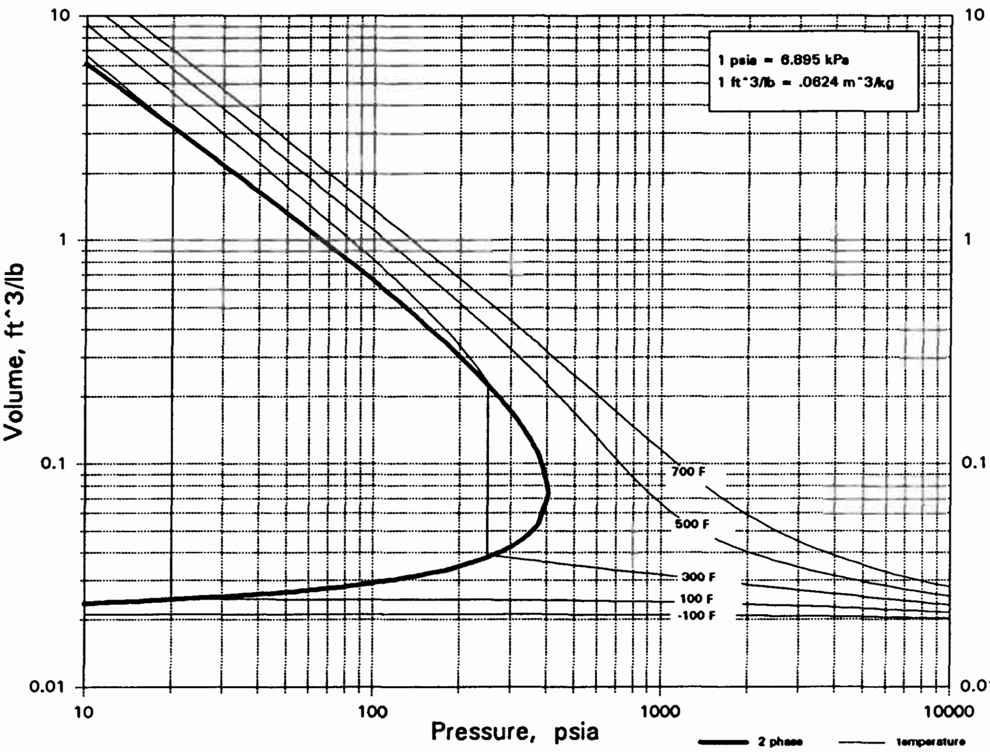
C4H12N2O N-AMINOETHYL ETHANOLAMINE

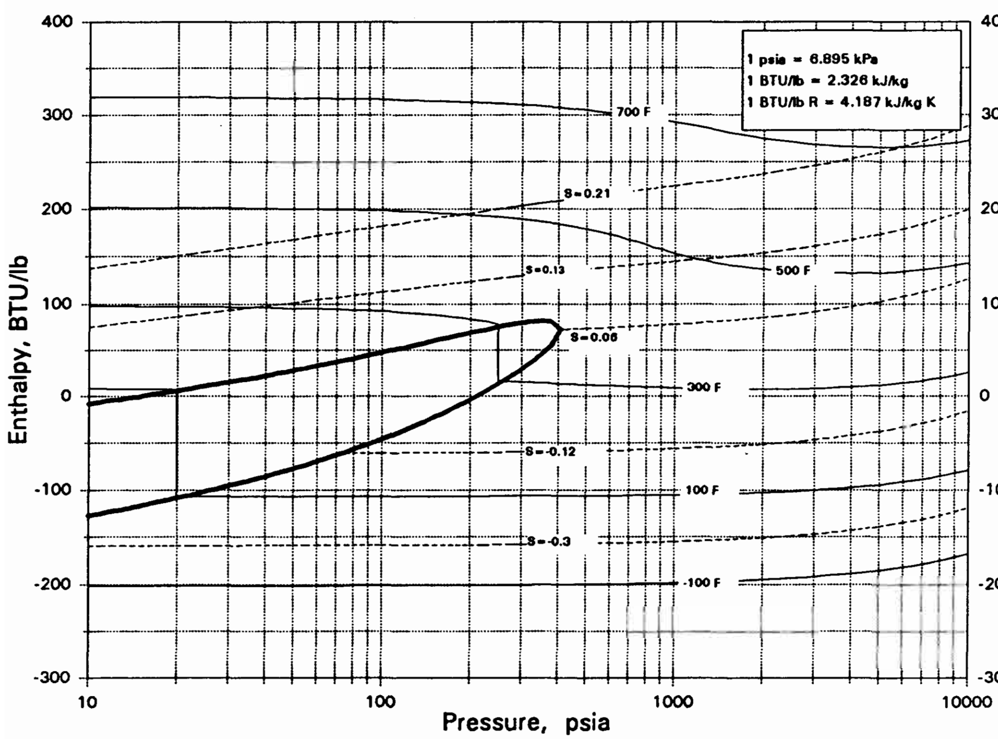




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

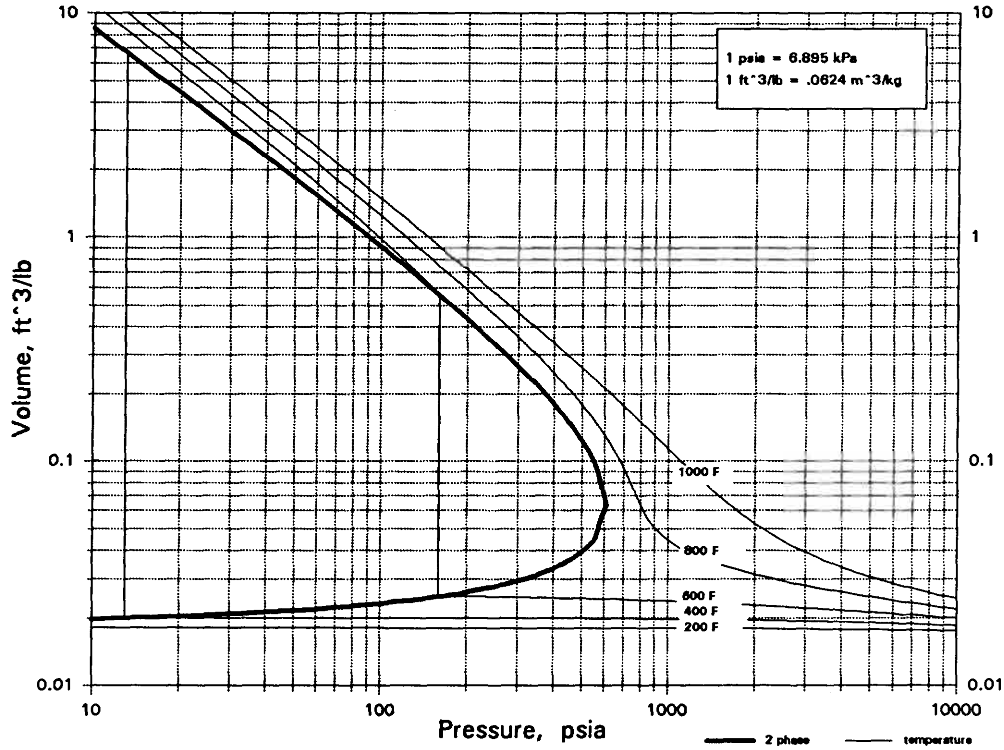
C4H12Si TETRAMETHYLSILANE

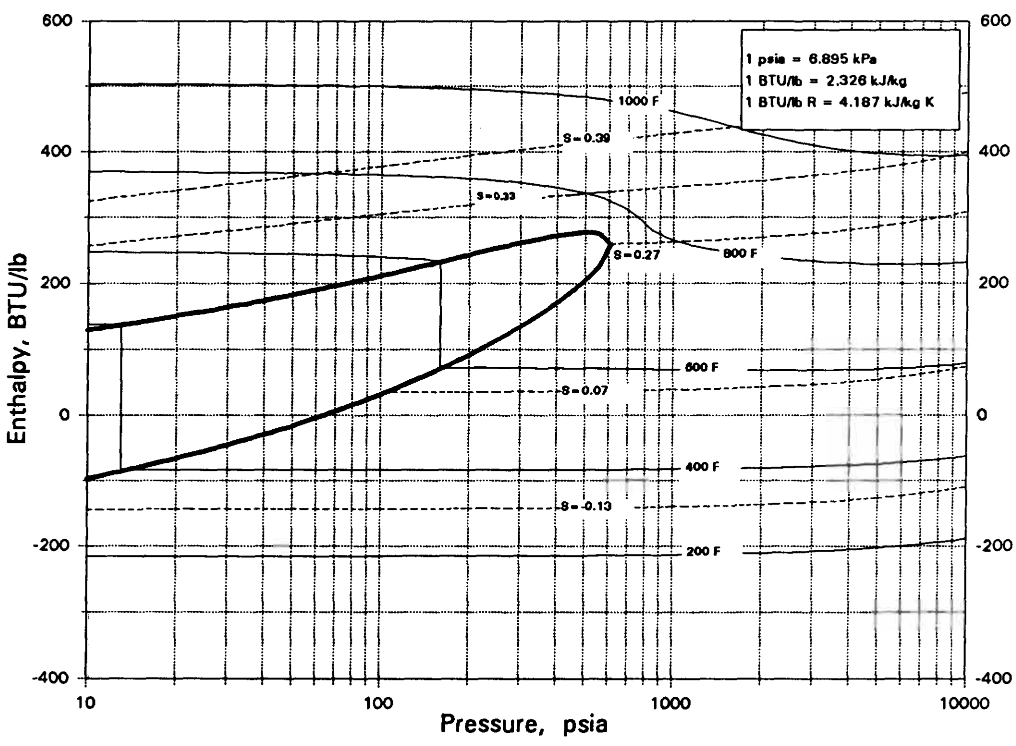




Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

C4H13N3 DIETHYLENE TRIAMINE





Datum: Ideal Gas @ 77 F (25 C), H = 0, S + R ln P = 0

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Appendix A

Equations for Thermodynamic Properties

Enthalpy

$$H = H_{ref} + \int_{T_{ref}}^{T} C_p \, dT - \Delta H^{resid} \tag{1}$$

Entropy

$$S = S_{ref} + \int_{T_{ref}}^{T} \frac{C_p}{T} \, dT - R \ln\left(\frac{P}{P_{ref}}\right) - \Delta S^{resid} \tag{2}$$

Internal Energy

$$U = H - P\,V \tag{3}$$

Helmholtz Energy

$$A = U - T\,S \tag{4}$$

Gibbs Energy

$$G = H - T\,S \tag{5}$$

Parameters

$$C_p = \textit{heat capacity of ideal gas} \tag{6}$$

$$H_{ref}\ ,\ S_{ref} = \textit{reference state for ideal gas} \tag{7}$$

$$T_{ref}\ ,P_{ref} = \textit{reference temperature , reference pressure} \tag{8}$$

$$\Delta H^{resid}\ ,\ \Delta S^{resid} = \textit{residual enthalpy , residual entropy} \tag{9}$$

Appendix B

Peng-Robinson Equation of State for Thermodynamic Properties

Equation of State

$$P = \frac{RT}{V - b} - \frac{a}{V(V + b) + b(V - b)} \tag{1}$$

Volume

$$V^3 + (b - \frac{RT}{P})V^2 + (\frac{a}{P} - 3b^2 - \frac{RT}{P}2b)V + (b^3 + \frac{RT}{P}b^2 - \frac{ab}{P}) = 0 \tag{2}$$

Compressibility Factor

$$Z^3 - (1 - B)Z^2 + (A - 3B^2 - 2B)Z - (AB - B^2 - B^3) = 0 \tag{3}$$

Fugacity Coefficient

$$\ln \phi = Z - 1 - \ln(Z - B) - \frac{A}{2\sqrt{2}B}\ln\left(\frac{Z + 2.414B}{Z - 0.414B}\right) \tag{4}$$

Residual Enthalpy

$$\frac{\Delta H^{resid}}{RT} = 1 - Z + \frac{A}{2\sqrt{2}B}(1 + \frac{D}{a})\ln\left(\frac{Z + 2.414B}{Z - 0.414B}\right) \tag{5}$$

Residual Entropy

$$\frac{\Delta S^{resid}}{R} = -\ln(Z - B) + \frac{AD}{2\sqrt{2}Ba}\ln\left(\frac{Z + 2.414B}{Z - 0.414B}\right) \tag{6}$$

Parameters

$$a = a_c\alpha \tag{7}$$

$$a_c = 0.45724R^2T_c^2/P_c \tag{8}$$

$$b = 0.07780RT_c/P_c \tag{9}$$

$$\alpha = [1 + m(1 - T_r^{1/2})]^2 \tag{10}$$

$$m = 0.37464 + 1.54226\Omega - 0.26992\Omega^2 \text{ (original PR)} \tag{11}$$

$$m = \text{see Stryjek , Vera (modified PR)} \tag{12}$$

$$A = aP/R^2T^2 = 0.45724\alpha P_r/T_r^2 = 0.45724\frac{(P/P_c)}{(T/T_c)^2}\alpha \tag{13}$$

$$B = bP/RT = 0.07780P_r/T_r = 0.07780\frac{(P/P_c)}{(T/T_c)} \tag{14}$$

$$D = -T\frac{da}{dT} = ma\sqrt{T_r/\alpha} \tag{15}$$

Appendix C

Examples for Thermodynamic Diagrams

Example 1 - Vessel Pressure

A vessel containing ethylene (C2H4) at 300 psia and 0 F is exposed to a fire in the process area. The temperature in the vessel is 600 F when the fire is extinguished. Estimate the final pressure in the vessel.

Since the vessel size does not change appreciably, this situation maybe approximated by a constant volume process. Using the thermodynamic diagram, the initial volume is about 0.43 ft^3/lb. At this same volume and final temperature of 600 F, the pressure is:

P_{final} = 900 psia

Example 2 - Reactor Size

A batch reactor is to contain 2,000 lb of ethylene (C2H4) at 1,000 psia and 200 F. Estimate the reactor size.

Using the thermodynamic diagram, the volume is about 0.2 ft^3/lb of ethylene at these conditions. Substitution of this into the equation below for the reactor size provides:

Reactor Size = (2,000 lb) (0.2 ft^3/lb) = 400 ft^3

Example 3 - Process Vessel Size

A process vessel is to contain 500 lb of ethylene (C2H4) at 200 psia and 0 F. Estimate the process vessel size.

Using the thermodynamic diagram, the volume is about 0.75 ft^3/lb of ethylene at these conditions. Substitution of this into the equation below for the process vessel size provides:

Vessel Size = (500 lb) (0.75 ft^3/lb) = 375 ft^3

Example 4 - Heat Exchanger Duty

Ethylene (C2H4, 30,000 lb/hr) at 1,000 psia and 0 F is heated to 600 F and then fed to a plug-flow reactor. Estimate the heat exchanger duty necessary to accomplish the heating.

Substitution of mass flow and enthalpies from the thermodynamic diagram into the equation below provides:

Heat Exchanger Duty = mass flow (H_2 - H_1) = (30,000 lb/hr)(240 - (-180)) BTU/lb

= 12.6 million BTU/hr

Example 5 - Compression

Ethylene ($C2H4$, 20,000 lb/hr) at 30 psia and 10 F is compressed to 3,000 psia. Estimate the change in enthalpy for the compression assuming adibatic and reversible conditions (constant entropy).

Substitution of mass flow and enthalpies from the thermodynamic diagram into the equation below provides:

Enthalpy Change = mass flow (H_2 - H_1) = (20,000 lb/hr)(200 - (-20)) BTU/lb

= 4.4 million BTU/hr

This change in enthalpy represents energy that is required to accomplish the compression under adibatic and reversible conditions. Under operating conditions, the actual energy that is required for the compression will be somewhat more depending on the efficiency.

Example 6 - Expansion

Ethylene ($C2H4$, 30,000 lb/hr) at 850 psia and 400 F is expanded to 10 psia. Estimate the change in enthalpy for the expansion assuming adibatic and reversible conditions (constant entropy).

Substitution of mass flow and enthalpies from the thermodynamic diagram into the equation below provides:

Enthalpy Change = mass flow (H_2 - H_1) = (30,000 lb/hr)(- 60 - 125) BTU/lb

= - 5.55 million BTU/hr

This change in enthalpy represents energy that is available from the expansion under adibatic and reversible conditions. Under operating conditions, the actual energy that is available for the expansion will be somewhat less depending on the efficiency.

Appendix D

CRITICAL CONSTANTS AND ACENTRIC FACTOR FOR C_1 TO C_4 COMPOUNDS

Carl L. Yaws
Lamar University, Beaumont, Texas

NO	FORMULA	NAME	MW g/mol	T_F K	T_B K	T_C K	P_C bar	V_C cm^3/mol	ρ_C g/cm^3	Z_C	ω
1	CBrClF2	BROMOCHLORODIFLUOROMETHANE	165.365	113.65	269.14	426.15	42.54	246.0	0.6722	0.295	0.187
2	CBrCl3	BROMOTRICHLOROMETHANE	198.273	252.15	378.05	606.00	49.70	284.0	0.6981	0.280	0.192
3	CBrF3	BROMOTRIFLUOROMETHANE	148.910	105.15	215.26	340.15	39.72	200.0	0.7446	0.281	0.173
4	CBr2F2	DIBROMODIFLUOROMETHANE	209.816	163.05	295.94	478.00	53.30	249.0	0.8426	0.334	0.200
5	CClF3	CHLOROTRIFLUOROMETHANE	104.459	92.15	191.74	301.96	39.46	180.3	0.5794	0.283	0.180
6	CClN	CYANOGEN CHLORIDE	61.470	266.65	286.00	449.00	59.90	163.0	0.3771	0.262	0.320
7	CCl2F2	DICHLORODIFLUOROMETHANE	120.913	115.15	243.36	384.95	41.25	217.0	0.5572	0.280	0.180
8	CCl2O	PHOSGENE	98.916	145.37	280.71	455.00	56.74	190.2	0.5200	0.285	0.201
9	CCl3F	TRICHLOROFLUOROMETHANE	137.368	162.04	296.97	471.20	44.08	248.0	0.5539	0.279	0.184
10	CCl4	CARBON TETRACHLORIDE	153.822	250.33	349.79	556.35	45.60	276.0	0.5573	0.272	0.193
11	CF2O	CARBONYL FLUORIDE	66.007	161.89	188.58	297.00	57.60	141.0	0.4681	0.329	0.283
12	CF4	CARBON TETRAFLUORIDE	88.005	89.56	145.09	227.50	37.39	140.0	0.6286	0.277	0.186
13	CHBr3	TRIBROMOMETHANE	252.731	281.20	422.35	696.00	60.90	286.0	0.8837	0.301	0.156
14	CHClF2	CHLORODIFLUOROMETHANE	86.468	115.73	232.32	369.30	49.71	166.0	0.5209	0.269	0.219
15	CHCl2F	DICHLOROFLUOROMETHANE	102.923	138.15	282.05	451.58	51.84	196.0	0.5251	0.271	0.207
16	CHCl3	CHLOROFORM	119.377	209.63	334.33	536.40	54.72	239.0	0.4995	0.293	0.213
17	CHF3	TRIFLUOROMETHANE	70.014	117.97	190.99	298.89	48.36	133.3	0.5252	0.259	0.267
18	CHN	HYDROGEN CYANIDE	27.026	259.91	298.85	456.65	53.91	138.6	0.1950	0.197	0.410
19	CH2BrCl	BROMOCHLOROMETHANE	129.384	185.20	341.20	557.00	68.10	188.0	0.6882	0.276	0.220
20	CH2Br2	DIBROMOMETHANE	173.835	220.60	370.10	611.00	71.70	223.0	0.7795	0.315	0.210
21	CH2Cl2	DICHLOROMETHANE	84.932	178.01	312.90	510.00	60.80	185.0	0.4591	0.265	0.192
22	CH2F2	DIFLUOROMETHANE	52.024	137.00	221.50	351.60	58.30	121.0	0.4300	0.241	0.276
23	CH2I2	DIIODOMETHANE	267.836	279.25	455.15	747.00	54.70	272.0	0.9847	0.240	0.141
24	CH2O	FORMALDEHYDE	30.026	181.15	254.05	408.00	65.86	105.0	0.2860	0.204	0.282
25	CH2O2	FORMIC ACID	46.026	281.55	373.71	580.00	73.90	125.0	0.3682	0.192	0.473
26	CH3Br	METHYL BROMIDE	94.939	179.55	276.71	467.00	80.00	156.0	0.6086	0.321	0.192
27	CH3Cl	METHYL CHLORIDE	50.488	175.45	248.93	416.25	66.79	139.0	0.3632	0.268	0.153
28	CH3Cl3Si	METHYL TRICHLOROSILANE	149.478	195.35	339.55	517.00	35.30	340.0	0.4396	0.279	0.263
29	CH3F	METHYL FLUORIDE	34.033	131.35	194.82	317.70	58.77	113.0	0.3012	0.251	0.204
30	CH3I	METHYL IODIDE	141.939	206.70	315.58	528.00	73.70	185.0	0.7672	0.311	0.193
31	CH3NO	FORMAMIDE	45.041	275.70	493.00	771.00	78.00	163.0	0.2763	0.198	0.453
32	CH3NO2	NITROMETHANE	61.040	244.60	374.35	588.15	63.13	173.4	0.3520	0.224	0.348
33	CH4	METHANE	16.043	90.67	111.66	190.58	46.04	99.3	0.1616	0.288	0.011
34	CH4Cl2Si	METHYL DICHLOROSILANE	115.034	182.55	314.70	483.00	39.50	289.0	0.3980	0.284	0.276
35	CH4O	METHANOL	32.042	175.47	337.85	512.58	80.96	117.8	0.2720	0.224	0.566
36	CH4O3S	METHANESULFONIC ACID	96.107	292.81	561.00	---	---	220.0	0.4369	---	---
37	CH4S	METHYL MERCAPTAN	48.109	150.18	279.11	469.95	72.35	145.0	0.3318	0.268	0.146
38	CH5ClSi	METHYL CHLOROSILANE	80.589	139.05	281.85	442.00	41.70	246.0	0.3276	0.279	0.225
39	CH5N	METHYLAMINE	31.057	179.69	266.82	430.05	74.58	154.0	0.2017	0.321	0.281
40	CH6Si	METHYL SILANE	46.144	116.34	216.25	352.50	48.40	205.0	0.2251	0.339	0.139
41	CN4O8	TETRANITROMETHANE	196.033	287.05	398.85	540.00	17.40	468.0	0.4189	0.181	0.516
42	CO	CARBON MONOXIDE	28.010	68.15	81.70	132.92	34.99	93.1	0.3009	0.295	0.066
43	COS	CARBONYL SULFIDE	60.076	134.35	223.00	378.80	63.49	135.1	0.4447	0.272	0.097
44	CO2	CARBON DIOXIDE	44.010	216.58	194.67	304.19	73.82	94.0	0.4682	0.274	0.228
45	CS2	CARBON DISULFIDE	76.143	161.58	319.37	552.00	79.03	160.0	0.4759	0.276	0.108
46	C2BrF3	BROMOTRIFLUOROETHYLENE	160.921	---	270.65	432.00	44.80	239.0	0.6733	0.298	0.175
47	C2Br2F4	1-2-DIBROMOTETRAFLUOROETHANE	259.824	162.65	320.41	487.80	33.93	341.0	0.7619	0.285	0.250
48	C2ClF3	CHLOROTRIFLUOROETHYLENE	116.470	115.00	245.30	379.15	40.53	212.0	0.5494	0.273	0.264
49	C2ClF5	CHLOROPENTAFLUOROETHANE	154.467	173.71	234.04	353.15	31.57	252.0	0.6130	0.271	0.251
50	C2Cl2F4	1-2-DICHLOROTETRAFLUOROETHANE	170.921	179.15	276.92	418.85	32.63	293.7	0.5820	0.275	0.252
51	C2Cl3F3	1-1-2-TRICHLOROTRIFLUOROETHANE	187.375	238.15	320.75	487.25	34.15	325.3	0.5760	0.274	0.255
52	C2Cl4	TETRACHLOROETHYLENE	165.833	250.80	394.40	620.00	44.90	248.0	0.6687	0.216	0.214
53	C2Cl4F2	1-1-2-2-TETRACHLORODIFLUOROETHANE	203.830	299.15	366.00	551.00	33.40	351.0	0.5807	0.264	0.291
54	C2Cl4O	TRICHLOROACETYL CHLORIDE	181.832	---	391.15	590.00	41.00	332.0	0.5477	0.277	0.348
55	C2Cl6	HEXACHLOROETHANE	236.738	459.95	460.00	698.00	33.40	412.0	0.5746	0.237	0.221
56	C2F4	TETRAFLUOROETHYLENE	100.016	142.00	197.51	306.45	39.44	172.0	0.5815	0.266	0.226
57	C2F6	HEXAFLUOROETHANE	138.012	172.45	194.95	292.80	29.79	224.0	0.6161	0.274	0.245
58	C2HBrClF3	HALOTHANE	197.382	---	323.35	521.00	39.20	296.0	0.6668	0.268	0.091
59	C2HClF2	2-CHLORO-1-1-DIFLUOROETHYLENE	98.479	134.65	254.55	400.55	44.58	197.0	0.4999	0.264	0.219
60	C2HCl3	TRICHLOROETHYLENE	131.388	188.40	360.10	571.00	49.10	256.0	0.5132	0.265	0.217
61	C2HCl3O	DICHLOROACETYL CHLORIDE	147.387	---	382.15	579.00	46.10	288.0	0.5118	0.276	0.371
62	C2HCl3O	TRICHLOROACETALDEHYDE	147.387	216.00	370.85	565.00	44.10	288.0	0.5118	0.270	0.332
63	C2HCl5	PENTACHLOROETHANE	202.293	244.15	433.03	665.00	36.80	369.0	0.5482	0.246	0.246

NO	FORMULA	NAME	MW g/mol	T_F K	T_B K	T_C K	P_C bar	V_C cm^3/mol	ρ_C g/cm^3	Z_C	ω
64	C2HF3O2	TRIFLUOROACETIC ACID	114.024	257.90	344.95	491.25	32.58	204.0	0.5589	0.163	0.524
65	C2HF5	PENTAFLUOROETHANE	120.022	170.15	225.15	342.00	34.40	216.0	0.5557	0.261	0.259
66	C2H2	ACETYLENE	26.038	192.40	189.00	308.32	61.39	113.0	0.2305	0.271	0.187
67	C2H2Br4	1-1-2-2-TETRABROMOETHANE	345.654	273.15	516.65	824.00	46.00	401.0	0.8620	0.269	0.177
68	C2H2Cl2	1-1-DICHLOROETHYLENE	96.943	150.65	304.71	482.00	51.90	224.0	0.4328	0.290	0.272
69	C2H2Cl2	cis-1-2-DICHLOROETHYLENE	96.943	193.15	333.65	527.00	51.90	224.0	0.4328	0.265	0.264
70	C2H2Cl2	trans-1-2-DICHLOROETHYLENE	96.943	223.35	320.85	508.00	51.90	224.0	0.4328	0.275	0.264
71	C2H2Cl2O	CHLOROACETYL CHLORIDE	112.943	251.15	379.15	581.00	51.10	245.0	0.4610	0.259	0.358
72	C2H2Cl2O	DICHLOROACETALDEHYDE	112.943	223.00	362.00	555.00	49.50	245.0	0.4610	0.263	0.344
73	C2H2Cl2O2	DICHLOROACETIC ACID	128.942	286.55	467.15	686.00	51.70	265.0	0.4866	0.240	0.555
74	C2H2Cl3F	1-1-1-TRICHLOROFLUOROETHANE	151.394	---	366.00	565.00	39.90	294.0	0.5149	0.250	0.250
75	C2H2Cl4	1-1-1-2-TETRACHLOROETHANE	167.849	202.94	403.65	624.00	40.20	325.0	0.5165	0.252	0.242
76	C2H2Cl4	1-1-2-2-TETRACHLOROETHANE	167.849	229.35	418.25	645.00	40.90	325.0	0.5165	0.248	0.259
77	C2H2F2	1-1-DIFLUOROETHYLENE	64.035	129.15	187.50	302.80	44.58	154.0	0.4158	0.273	0.139
78	C2H2F4	1-1-1-2-TETRAFLUOROETHANE	102.031	172.15	247.15	380.00	36.90	203.0	0.5026	0.237	0.239
79	C2H2O	KETENE	42.037	122.00	223.34	370.00	58.10	144.0	0.2919	0.272	0.126
80	C2H2O4	OXALIC ACID	90.036	462.65	569.00	804.00	70.20	205.0	0.4392	0.215	0.918
81	C2H3Br	VINYL BROMIDE	106.950	135.35	288.95	473.00	71.80	200.0	0.5348	0.365	0.282
82	C2H3Cl	VINYL CHLORIDE	62.499	119.36	259.78	432.00	56.70	179.0	0.3492	0.283	0.101
83	C2H3ClF2	1-CHLORO-1-1-DIFLUOROETHANE	100.495	142.35	263.14	410.20	41.24	231.0	0.4350	0.279	0.237
84	C2H3ClO	ACETYL CHLORIDE	78.498	160.30	323.90	508.00	57.40	196.0	0.4005	0.266	0.334
85	C2H3ClO	CHLOROACETALDEHYDE	78.498	---	358.00	555.00	53.70	201.0	0.3905	0.234	0.330
86	C2H3ClO2	CHLOROACETIC ACID	94.497	333.15	462.50	686.00	57.80	221.0	0.4276	0.224	0.551
87	C2H3ClO2	METHYL CHLOROFORMATE	94.497	---	344.00	525.00	53.60	221.0	0.4276	0.271	0.393
88	C2H3Cl3	1-1-1-TRICHLOROETHANE	133.404	242.75	347.23	545.00	42.96	281.0	0.4747	0.266	0.216
89	C2H3Cl3	1-1-2-TRICHLOROETHANE	133.404	236.50	387.00	602.00	44.80	281.0	0.4747	0.252	0.260
90	C2H3F	VINYL FLUORIDE	46.044	112.65	200.95	327.80	52.39	144.0	0.3198	0.277	0.189
91	C2H3F3	1-1-1-TRIFLUOROETHANE	84.041	161.85	225.75	346.25	37.58	194.0	0.4332	0.253	0.253
92	C2H3N	ACETONITRILE	41.053	229.32	354.75	545.50	48.33	173.0	0.2373	0.184	0.338
93	C2H3NO	METHYL ISOCYANATE	57.052	256.15	312.00	505.00	51.90	190.0	0.3003	0.235	0.175
94	C2H4	ETHYLENE	28.054	104.01	169.47	282.36	50.32	129.1	0.2174	0.277	0.085
95	C2H4Br2	1-1-DIBROMOETHANE	187.862	210.15	381.15	628.00	60.30	276.0	0.6807	0.319	0.125
96	C2H4Br2	1-2-DIBROMOETHANE	187.862	282.94	404.51	650.15	54.77	261.6	0.7182	0.265	0.207
97	C2H4Cl2	1-1-DICHLOROETHANE	98.959	176.19	330.45	523.00	50.66	240.0	0.4123	0.280	0.244
98	C2H4Cl2	1-2-DICHLOROETHANE	98.959	237.49	356.59	561.00	53.70	220.0	0.4498	0.253	0.288
99	C2H4Cl2O	BIS(CHLOROMETHYL)ETHER	114.959	231.65	378.00	579.00	45.80	258.0	0.4456	0.245	0.324
100	C2H4F2	1-1-DIFLUOROETHANE	66.051	156.15	247.35	386.60	44.99	181.0	0.3649	0.253	0.263
101	C2H4F2	1-2-DIFLUOROETHANE	66.051	---	303.65	476.00	43.40	202.0	0.3270	0.222	0.224
102	C2H4O	ACETALDEHYDE	44.053	150.15	293.55	461.00	55.50	157.0	0.2806	0.227	0.317
103	C2H4O	ETHYLENE OXIDE	44.053	161.45	283.85	469.15	71.94	140.3	0.3140	0.259	0.198
104	C2H4O2	ACETIC ACID	60.053	289.81	391.05	592.71	57.86	171.0	0.3512	0.201	0.462
105	C2H4O2	METHYL FORMATE	60.053	174.15	304.90	487.20	59.98	172.0	0.3491	0.255	0.254
106	C2H5Br	BROMOETHANE	108.966	154.55	311.50	503.80	62.32	214.9	0.5070	0.320	0.183
107	C2H5Cl	ETHYL CHLORIDE	64.514	136.75	285.42	460.35	52.69	200.0	0.3226	0.275	0.204
108	C2H5ClO	2-CHLOROETHANOL	80.514	205.65	401.75	585.00	59.20	212.0	0.3798	0.258	0.637
109	C2H5F	ETHYL FLUORIDE	48.060	129.95	235.45	375.31	50.28	164.0	0.2930	0.264	0.209
110	C2H5I	ETHYL IODIDE	155.966	162.05	345.45	561.00	59.90	238.0	0.6553	0.306	1.137
111	C2H5N	ETHYLENEIMINE	43.068	195.20	329.00	537.00	68.50	173.0	0.2489	0.265	0.089
112	C2H5NO	ACETAMIDE	59.068	354.15	494.30	761.00	66.00	215.0	0.2747	0.224	0.189
113	C2H5NO	N-METHYLFORMAMIDE	59.068	269.35	472.66	721.00	56.20	215.0	0.2747	0.202	0.192
114	C2H5NO2	NITROETHANE	75.067	183.63	387.22	593.00	51.60	236.0	0.3181	0.247	0.265
115	C2H6	ETHANE	30.070	90.35	184.55	305.42	48.80	147.9	0.2033	0.284	0.099
116	C2H6AlCl	DIMETHYLALUMINUM CHLORIDE	92.054	252.15	399.15	619.00	36.20	320.0	0.2877	0.225	0.183
117	C2H6O	DIMETHYL ETHER	46.069	131.66	248.31	400.10	53.70	170.0	0.2710	0.274	0.204
118	C2H6O	ETHANOL	46.069	159.05	351.44	516.25	63.84	166.9	0.2760	0.248	0.637
119	C2H6OS	DIMETHYL SULFOXIDE	78.135	291.67	462.15	726.00	56.50	227.0	0.3442	0.212	0.209
120	C2H6O2	ETHYLENE GLYCOL	62.068	260.15	470.45	645.00	75.30	191.0	0.3250	0.268	1.137
121	C2H6O4S	DIMETHYL SULFATE	126.133	241.35	461.95	758.00	51.60	293.0	0.4305	0.240	0.089
122	C2H6S	DIMETHYL SULFIDE	62.136	174.88	310.48	503.04	55.30	200.9	0.3093	0.266	0.189
123	C2H6S	ETHYL MERCAPTAN	62.136	125.26	308.15	499.15	54.90	207.0	0.3002	0.274	0.192
124	C2H6S2	DIMETHYL DISULFIDE	94.202	188.44	382.90	606.00	53.60	252.0	0.3738	0.268	0.265
125	C2H7N	DIMETHYLAMINE	45.084	180.96	280.03	437.65	53.09	187.0	0.2411	0.273	0.294
126	C2H7N	ETHYLAMINE	45.084	192.15	289.73	456.15	56.24	182.0	0.2477	0.270	0.285
127	C2H7NO	MONOETHANOLAMINE	61.084	283.65	444.15	638.00	68.70	225.0	0.2715	0.291	0.797
128	C2H8N2	ETHYLENEDIAMINE	60.099	284.29	390.41	593.00	62.90	264.0	0.2276	0.337	0.479
129	C2H8Si	DIMETHYL SILANE	60.171	122.93	253.55	402.00	35.60	258.0	0.2332	0.275	0.132
130	C2N2	CYANOGEN	52.036	245.25	252.00	400.15	59.78	195.0	0.2669	0.350	0.279
131	C3F6	HEXAFLUOROPROPYLENE	150.023	116.65	243.55	368.00	29.00	268.0	0.5598	0.254	0.204
132	C3F6O	HEXAFLUOROACETONE	166.023	151.15	245.88	357.14	28.37	329.0	0.5046	0.314	0.364
133	C3F8	OCTAFLUOROPROPANE	188.020	125.46	236.40	345.05	26.80	299.0	0.6288	0.279	0.326
134	C3H2N2	MALONONITRILE	66.062	304.90	491.50	715.00	40.40	248.0	0.2664	0.169	0.509
135	C3H3Cl	PROPARGYL CHLORIDE	74.510	---	331.00	541.00	53.00	211.0	0.3531	0.249	0.152
136	C3H3N	ACRYLONITRILE	53.064	189.63	350.50	535.00	44.80	212.0	0.2503	0.214	0.350

NO	FORMULA	NAME	MW g/mol	T_F K	T_B K	T_C K	P_C bar	V_C cm^3/mol	ρ_C g/cm^3	Z_C	ω
137	C3H3NO	OXAZOLE	69.063	---	342.65	554.00	63.20	237.0	0.2914	0.325	0.233
138	C3H4	METHYLACETYLENE	40.065	170.45	249.94	402.39	56.28	164.0	0.2443	0.276	0.216
139	C3H4	PROPADIENE	40.065	136.87	238.65	393.15	54.70	162.0	0.2473	0.271	0.160
140	C3H4Cl2	2-3-DICHLOROPROPENE	110.970	191.50	365.75	577.00	43.80	277.0	0.4006	0.253	0.206
141	C3H4O	ACROLEIN	56.064	185.45	325.84	506.00	50.00	197.0	0.2846	0.234	0.320
142	C3H4O	PROPARGYL ALCOHOL	56.064	221.35	386.75	580.00	65.30	176.0	0.3185	0.238	0.555
143	C3H4O2	ACRYLIC ACID	72.064	286.65	414.15	615.00	56.60	208.0	0.3465	0.230	0.518
144	C3H4O2	beta-PROPIOLACTONE	72.064	239.75	435.15	686.00	69.10	195.0	0.3696	0.236	0.345
145	C3H4O2	VINYL FORMATE	72.064	---	320.00	498.00	50.20	217.0	0.3321	0.263	0.285
146	C3H4O3	ETHYLENE CARBONATE	88.063	309.55	511.15	790.00	67.70	193.0	0.4563	0.199	0.416
147	C3H4O3	PYRUVIC ACID	88.063	286.75	438.15	634.52	56.50	239.0	0.3685	0.256	0.670
148	C3H5Cl	2-CHLOROPROPENE	76.525	135.75	295.80	478.00	47.10	234.0	0.3270	0.277	0.153
149	C3H5Cl	3-CHLOROPROPENE	76.525	138.65	318.11	514.15	47.10	234.0	0.3270	0.258	0.154
150	C3H5ClO	alpha-EPICHLOROHYDRIN	92.525	215.95	389.26	610.00	49.00	233.0	0.3971	0.225	0.256
151	C3H5ClO2	METHYL CHLOROACETATE	108.524	241.03	402.97	600.00	45.00	270.0	0.4019	0.244	0.434
152	C3H5ClO2	ETHYL CHLOROFORMATE	108.524	192.00	366.00	508.15	45.00	274.0	0.3961	0.292	0.835
153	C3H5Cl3	1-2-3-TRICHLOROPROPANE	147.431	258.45	430.00	652.00	38.70	334.0	0.4414	0.238	0.306
154	C3H5N	PROPIONITRILE	55.079	180.26	370.50	564.40	41.85	229.0	0.2405	0.204	0.325
155	C3H5NO	ACRYLAMIDE	71.079	357.65	465.75	710.00	57.30	260.0	0.2734	0.252	0.196
156	C3H5NO	HYDRACRYLONITRILE	71.079	227.15	494.15	690.00	48.90	243.0	0.2925	0.207	0.826
157	C3H5NO	LACTONITRILE	71.079	233.00	457.00	643.00	50.30	243.0	0.2925	0.229	0.796
158	C3H5N3O9	NITROGLYCERINE	227.088	286.15	523.00	680.00	30.00	419.0	0.5420	0.222	1.184
159	C3H6	CYCLOPROPANE	42.081	145.73	240.37	397.91	55.75	162.8	0.2585	0.274	0.134
160	C3H6	PROPYLENE	42.081	87.90	225.43	364.76	46.13	181.0	0.2325	0.275	0.142
161	C3H6Cl2	1-1-DICHLOROPROPANE	112.986	---	361.25	560.00	42.40	291.0	0.3883	0.265	0.253
162	C3H6Cl2	1-2-DICHLOROPROPANE	112.986	172.71	369.52	572.00	42.40	291.0	0.3883	0.259	0.251
163	C3H6Cl2	1-3-DICHLOROPROPANE	112.987	173.65	393.55	603.00	41.50	291.0	0.3883	0.241	0.292
164	C3H6O	ACETONE	58.080	178.45	329.44	508.20	47.02	209.0	0.2779	0.233	0.306
165	C3H6O	ALLYL ALCOHOL	58.080	144.15	370.23	545.05	56.20	208.0	0.2792	0.258	0.572
166	C3H6O	METHYL VINYL ETHER	58.080	151.15	278.65	437.00	46.70	210.0	0.2766	0.270	0.237
167	C3H6O	n-PROPIONALDEHYDE	58.080	193.15	321.15	496.00	46.60	210.0	0.2766	0.237	0.302
168	C3H6O	1-2-PROPYLENE OXIDE	58.080	161.22	307.05	482.25	49.24	186.0	0.3123	0.228	0.271
169	C3H6O	1-3-PROPYLENE OXIDE	58.080	---	321.00	520.00	57.50	188.0	0.3089	0.250	0.201
170	C3H6O2	ETHYL FORMATE	74.079	193.55	327.46	508.40	47.42	229.0	0.3235	0.257	0.285
171	C3H6O2	METHYL ACETATE	74.079	175.15	330.09	506.80	46.90	228.0	0.3249	0.254	0.325
172	C3H6O2	PROPIONIC ACID	74.079	252.45	414.32	604.00	45.30	230.0	0.3221	0.207	0.536
173	C3H6O2S	3-MERCAPTOPROPIONIC ACID	106.145	290.65	501.00	729.00	50.20	281.0	0.3777	0.233	0.587
174	C3H6O3	LACTIC ACID	90.079	291.15	447.00	616.00	59.65	216.9	0.4153	0.253	1.035
175	C3H6O3	METHOXYACETIC ACID	90.079	281.00	478.26	691.00	49.80	251.0	0.3589	0.218	0.630
176	C3H6O3	TRIOXANE	90.079	334.65	387.65	604.00	58.20	206.0	0.4373	0.239	0.334
177	C3H7Br	1-BROMOPROPANE	122.993	163.15	344.15	544.00	53.90	266.0	0.4624	0.317	0.285
178	C3H7Br	2-BROMOPROPANE	122.993	184.15	332.56	532.00	55.10	266.0	0.4624	0.331	0.243
179	C3H7Cl	ISOPROPYL CHLORIDE	78.541	155.97	308.85	489.00	45.40	247.0	0.3180	0.276	0.224
180	C3H7Cl	n-PROPYL CHLORIDE	78.541	150.35	319.67	503.15	45.80	247.0	0.3180	0.270	0.228
181	C3H7I	ISOPROPYL IODIDE	169.993	183.15	362.65	578.00	51.20	290.0	0.5862	0.309	0.238
182	C3H7I	n-PROPYL IODIDE	169.993	171.85	375.60	593.00	50.30	290.0	0.5862	0.296	0.258
183	C3H7N	ALLYLAMINE	57.095	184.95	326.45	505.00	51.70	247.0	0.2312	0.304	0.327
184	C3H7N	PROPYLENEIMINE	57.095	229.00	334.00	529.00	54.20	208.0	0.2745	0.256	0.257
185	C3H7NO	N-N-DIMETHYLFORMAMIDE	73.095	212.72	426.15	647.00	44.20	267.0	0.2738	0.219	0.376
186	C3H7NO	N-METHYLACETAMIDE	73.095	301.15	478.15	718.00	49.80	267.0	0.2738	0.223	0.435
187	C3H7NO2	1-NITROPROPANE	89.094	169.16	404.33	605.00	43.50	288.0	0.3094	0.249	0.412
188	C3H7NO2	2-NITROPROPANE	89.094	181.83	393.40	594.00	44.50	288.0	0.3094	0.260	0.376
189	C3H8	PROPANE	44.096	85.46	231.11	369.82	42.49	202.9	0.2174	0.280	0.152
190	C3H8O	ISOPROPANOL	60.096	185.28	355.41	508.31	47.64	220.1	0.2730	0.248	0.669
191	C3H8O	METHYL ETHYL ETHER	60.096	160.00	280.50	437.80	43.98	221.0	0.2719	0.267	0.219
192	C3H8O	n-PROPANOL	60.096	146.95	370.35	536.71	51.70	218.5	0.2750	0.253	0.628
193	C3H8O2	2-METHOXYETHANOL	76.095	188.05	397.55	564.00	50.10	242.0	0.3144	0.259	0.731
194	C3H8O2	METHYLAL	76.095	168.35	315.00	480.60	39.52	213.0	0.3573	0.211	0.290
195	C3H8O2	1-2-PROPYLENE GLYCOL	76.095	213.15	460.75	626.00	61.00	239.0	0.3184	0.280	1.107
196	C3H8O2	1-3-PROPYLENE GLYCOL	76.095	246.45	487.55	658.00	59.20	217.0	0.3507	0.235	1.152
197	C3H8O3	GLYCEROL	92.095	291.33	563.15	723.00	40.00	264.0	0.3488	0.176	1.320
198	C3H8S	n-PROPYLMERCAPTAN	76.163	159.95	340.87	536.00	46.30	254.0	0.2999	0.264	0.235
199	C3H8S	ISOPROPYL MERCAPTAN	76.163	142.61	325.71	517.00	47.50	254.0	0.2999	0.281	0.212
200	C3H9N	n-PROPYLAMINE	59.111	190.15	321.65	496.95	47.42	260.0	0.2274	0.298	0.296
201	C3H9N	ISOPROPYLAMINE	59.111	177.95	305.55	471.85	45.39	221.0	0.2675	0.256	0.279
202	C3H9N	TRIMETHYLAMINE	59.111	156.08	276.02	433.25	40.73	254.0	0.2327	0.287	0.209
203	C3H9NO	1-AMINO-2-PROPANOL	75.111	274.89	432.61	614.00	56.70	278.0	0.2702	0.309	0.794
204	C3H9NO	3-AMINO-1-PROPANOL	75.111	284.15	460.65	649.00	55.00	278.0	0.2702	0.283	0.830
205	C3H9NO	METHYLETHANOLAMINE	75.111	268.65	431.15	630.00	52.20	253.0	0.2969	0.252	0.586
206	C3H9O4P	TRIMETHYL PHOSPHATE	140.076	227.00	465.85	764.00	85.00	---	---	---	---
207	C3H10N2	1-2-PROPANEDIAMINE	74.126	236.53	392.45	587.00	52.70	316.0	0.2346	0.341	0.474
208	C3H10Si	TRIMETHYL SILANE	74.198	137.26	279.85	432.00	31.90	311.0	0.2386	0.276	0.175
209	C4Cl4S	TETRACHLOROTHIOPHENE	221.921	301.97	506.54	753.00	36.70	428.0	0.5185	0.251	0.361

NO	FORMULA	NAME	MW g/mol	T_F K	T_B K	T_C K	P_C bar	V_C cm^3/mol	ρ_C g/cm^3	Z_C	ω
210	C4Cl6	HEXACHLORO-1-3-BUTADIENE	260.760	252.15	488.15	741.00	28.40	491.0	0.5311	0.226	0.155
211	C4F8	OCTAFLUORO-2-BUTENE	200.031	138.15	270.36	392.00	23.30	347.0	0.5765	0.248	0.291
212	C4F8	OCTAFLUOROCYCLOBUTANE	200.031	232.96	267.17	388.37	27.78	324.8	0.6159	0.279	0.356
213	C4F10	DECAFLUOROBUTANE	238.028	144.95	271.15	386.35	23.23	397.0	0.5996	0.287	0.372
214	C4H2O3	MALEIC ANHYDRIDE	98.058	326.00	475.15	721.00	72.80	219.0	0.4478	0.266	0.546
215	C4H4	VINYLACETYLENE	52.076	---	278.25	454.00	48.60	205.0	0.2540	0.264	0.118
216	C4H4N2	SUCCINONITRILE	80.089	331.30	540.15	770.00	35.40	300.0	0.2670	0.166	0.559
217	C4H4O	FURAN	68.075	187.55	304.50	490.15	55.02	218.2	0.3120	0.295	0.200
218	C4H4O2	DIKETENE	84.075	266.65	399.20	616.00	59.60	234.0	0.3593	0.272	0.382
219	C4H4O3	SUCCINIC ANHYDRIDE	100.074	393.00	536.58	811.00	67.30	223.0	0.4488	0.223	0.530
220	C4H4O4	FUMARIC ACID	116.073	560.15	563.15	771.00	49.80	297.0	0.3908	0.231	0.989
221	C4H4O4	MALEIC ACID	116.073	403.45	565.00	773.00	49.90	297.0	0.3908	0.231	0.998
222	C4H4S	THIOPHENE	84.142	234.94	357.31	579.35	56.90	219.0	0.3842	0.259	0.193
223	C4H5Cl	CHLOROPRENE	88.536	143.15	332.55	525.00	42.60	273.0	0.3243	0.266	0.193
224	C4H5N	trans-CROTONITRILE	67.090	222.00	394.38	586.00	38.80	282.0	0.2379	0.225	0.398
225	C4H5N	cis-CROTONITRILE	67.090	200.55	380.60	568.00	38.80	265.0	0.2532	0.218	0.379
226	C4H5N	METHACRYLONITRILE	67.090	237.35	363.45	554.00	38.80	265.0	0.2532	0.223	0.301
227	C4H5N	PYRROLE	67.090	249.74	403.00	639.75	62.10	230.0	0.2917	0.269	0.288
228	C4H5N	VINYLACETONITRILE	67.090	186.15	391.67	584.00	38.80	259.0	0.2590	0.207	0.378
229	C4H5NO2	METHYL CYANOACETATE	99.089	260.08	478.24	687.00	38.10	305.0	0.3249	0.203	0.549
230	C4H6	1-2-BUTADIENE	54.092	136.95	284.00	444.00	45.00	219.0	0.2470	0.267	0.251
231	C4H6	1-3-BUTADIENE	54.092	164.25	268.74	425.37	43.30	220.8	0.2449	0.270	0.193
232	C4H6	DIMETHYLACETYLENE	54.092	240.91	300.13	488.15	50.80	221.0	0.2448	0.277	0.130
233	C4H6	ETHYLACETYLENE	54.092	147.43	281.22	443.20	49.50	222.0	0.2437	0.298	0.247
234	C4H6Cl2	1-3-DICHLORO-trans-2-BUTENE	124.997	---	402.00	618.00	37.80	325.0	0.3846	0.239	0.242
235	C4H6Cl2	1-4-DICHLORO-cis-2-BUTENE	124.997	225.15	425.65	640.00	37.80	343.0	0.3644	0.244	0.331
236	C4H6Cl2	1-4-DICHLORO-trans-2-BUTENE	124.997	274.15	429.26	646.00	37.80	330.0	0.3788	0.232	0.333
237	C4H6Cl2	3-4-DICHLORO-1-BUTENE	124.997	212.00	388.00	589.00	38.50	330.0	0.3788	0.259	0.300
238	C4H6O	trans-CROTONALDEHYDE	70.091	196.65	377.25	571.00	42.50	250.0	0.2804	0.224	0.346
239	C4H6O	2-5-DIHYDROFURAN	70.091	---	339.00	542.00	55.00	216.0	0.3245	0.264	0.229
240	C4H6O	DIVINYL ETHER	70.091	172.05	301.45	463.00	42.50	250.0	0.2804	0.276	0.291
241	C4H6O	METHACROLEIN	70.091	192.15	341.15	530.00	42.50	250.0	0.2804	0.241	0.246
242	C4H6O2	2-BUTYNE-1-4-DIOL	86.090	331.00	511.15	695.00	58.60	256.0	0.3363	0.260	1.134
243	C4H6O2	gamma-BUTYROLACTONE	86.090	229.78	477.15	739.00	59.40	265.0	0.3249	0.256	0.369
244	C4H6O2	cis-CROTONIC ACID	86.090	288.65	445.05	647.00	47.00	270.0	0.3189	0.236	0.572
245	C4H6O2	trans-CROTONIC ACID	86.090	344.55	458.15	666.00	47.00	270.0	0.3189	0.229	0.578
246	C4H6O2	METHACRYLIC ACID	86.090	288.15	434.15	643.00	47.00	270.0	0.3189	0.237	0.468
247	C4H6O2	METHYL ACRYLATE	86.090	196.32	353.35	536.00	42.50	270.0	0.3189	0.258	0.348
248	C4H6O2	VINYL ACETATE	86.090	180.35	345.65	524.00	42.50	270.0	0.3189	0.263	0.338
249	C4H6O3	ACETIC ANHYDRIDE	102.090	200.15	411.78	569.15	46.81	290.0	0.3520	0.287	0.840
250	C4H6O4	SUCCINIC ACID	118.089	461.15	591.00	806.00	47.10	300.0	0.3936	0.211	0.991
251	C4H6O5	DIGLYCOLIC ACID	134.089	421.15	610.00	820.00	44.20	331.0	0.4051	0.215	1.081
252	C4H6O5	MALIC ACID	134.089	403.15	602.00	781.00	50.70	331.0	0.4051	0.258	1.530
253	C4H6O6	TARTARIC ACID	150.088	479.15	660.00	828.00	51.80	305.0	0.4921	0.230	2.011
254	C4H7N	n-BUTYRONITRILE	69.106	161.25	390.75	582.25	37.90	278.0	0.2486	0.218	0.371
255	C4H7N	ISOBUTYRONITRILE	69.106	201.70	376.76	565.00	37.60	278.0	0.2486	0.223	0.338
256	C4H7NO	ACETONE CYANOHYDRIN	85.106	253.15	463.00	647.00	42.50	296.0	0.2875	0.234	0.733
257	C4H7NO	2-METHACRYLAMIDE	85.106	383.65	488.00	741.00	54.50	298.0	0.2856	0.264	0.421
258	C4H7NO	3-METHOXYPROPIONITRILE	85.106	210.12	439.00	638.00	36.30	324.0	0.2627	0.222	0.465
259	C4H7NO	2-PYRROLIDONE	85.106	298.15	518.15	792.00	61.70	264.0	0.3224	0.247	0.434
260	C4H8	1-BUTENE	56.107	87.80	266.90	419.59	40.20	239.9	0.2338	0.276	0.187
261	C4H8	cis-2-BUTENE	56.107	134.26	276.87	435.58	42.06	234.0	0.2398	0.272	0.203
262	C4H8	trans-2-BUTENE	56.107	167.62	274.03	428.63	41.02	238.2	0.2356	0.274	0.218
263	C4H8	CYCLOBUTANE	56.107	182.48	285.66	459.93	49.85	210.2	0.2670	0.274	0.187
264	C4H8	ISOBUTENE	56.107	132.81	266.25	417.90	39.99	238.9	0.2349	0.275	0.189
265	C4H8Cl2	1-4-DICHLOROBUTANE	127.013	235.85	427.05	641.00	36.10	343.0	0.3703	0.232	0.322
266	C4H8O	n-BUTYRALDEHYDE	72.107	176.75	347.95	525.00	40.00	263.0	0.2742	0.241	0.345
267	C4H8O	ISOBUTYRALDEHYDE	72.107	208.15	337.25	507.00	41.00	263.0	0.2742	0.256	0.370
268	C4H8O	1-2-EPOXYBUTANE	72.107	123.15	336.57	526.00	43.90	258.0	0.2795	0.259	0.235
269	C4H8O	METHYL ETHYL KETONE	72.107	186.48	352.79	535.50	41.54	267.0	0.2701	0.249	0.324
270	C4H8O	ETHYL VINYL ETHER	72.107	157.35	308.70	475.15	40.73	263.0	0.2742	0.271	0.266
271	C4H8O	TETRAHYDROFURAN	72.107	164.65	338.00	540.15	51.88	223.9	0.3220	0.259	0.226
272	C4H8O2	cis-2-BUTENE-1-4-DIOL	88.106	284.15	508.15	677.88	52.00	279.0	0.3158	0.257	1.174
273	C4H8O2	trans-2-BUTENE-1-4-DIOL	88.106	300.45	510.00	681.00	52.00	279.0	0.3158	0.256	1.174
274	C4H8O2	ISOBUTYRIC ACID	88.106	227.15	427.85	609.15	40.53	292.0	0.3017	0.234	0.618
275	C4H8O2	n-BUTYRIC ACID	88.106	267.95	436.42	628.00	44.20	283.0	0.3113	0.240	0.604
276	C4H8O2	1-4-DIOXANE	88.106	284.95	374.47	587.00	52.08	238.0	0.3702	0.254	0.280
277	C4H8O2	ETHYL ACETATE	88.106	189.60	350.21	523.30	38.80	286.0	0.3081	0.255	0.366
278	C4H8O2	METHYL PROPIONATE	88.106	185.65	352.60	530.60	40.04	282.0	0.3124	0.256	0.353
279	C4H8O2	n-PROPYL FORMATE	88.106	180.25	353.97	538.00	40.63	285.0	0.3091	0.259	0.318
280	C4H8O2S	SULFOLANE	120.172	300.75	558.15	849.00	50.30	300.0	0.4006	0.214	0.382
281	C4H8S	TETRAHYDROTHIOPHENE	88.173	176.99	394.27	631.95	51.60	249.0	0.3541	0.245	0.199
282	C4H9Br	1-BROMOBUTANE	137.019	160.75	374.75	577.00	45.40	319.0	0.4295	0.302	0.323

NO	FORMULA	NAME	MW g/mol	T_F K	T_B K	T_C K	P_C bar	V_C cm^3/mol	ρ_C g/cm^3	Z_C	ω
283	C4H9Br	2-BROMOBUTANE	137.019	161.25	364.37	567.00	46.30	320.0	0.4282	0.314	0.268
284	C4H9Cl	n-BUTYL CHLORIDE	92.568	150.05	351.58	537.00	38.20	300.0	0.3086	0.257	0.274
285	C4H9Cl	sec-BUTYL CHLORIDE	92.568	141.85	341.25	520.60	39.00	300.0	0.3086	0.270	0.291
286	C4H9Cl	tert-BUTYL CHLORIDE	92.568	247.75	323.75	507.00	39.00	300.0	0.3086	0.278	0.194
287	C4H9N	PYRROLIDINE	71.122	215.31	359.72	568.55	56.13	248.7	0.2860	0.295	0.275
288	C4H9NO	N-N-DIMETHYLACETAMIDE	87.122	253.15	439.25	658.00	40.30	321.0	0.2714	0.236	0.364
289	C4H9NO	MORPHOLINE	87.122	270.05	401.15	618.00	53.40	276.0	0.3157	0.287	0.358
290	C4H10	n-BUTANE	58.123	134.86	272.65	425.18	37.97	254.9	0.2280	0.274	0.199
291	C4H10	ISOBUTANE	58.123	113.54	261.43	408.14	36.48	262.7	0.2213	0.282	0.177
292	C4H10N2	PIPERAZINE	86.137	379.15	419.15	638.00	55.30	310.0	0.2779	0.323	0.414
293	C4H10O	n-BUTANOL	74.123	183.85	390.81	562.93	44.13	274.5	0.2700	0.259	0.595
294	C4H10O	sec-BUTANOL	74.123	158.45	372.70	536.01	41.94	268.0	0.2766	0.252	0.571
295	C4H10O	tert-BUTANOL	74.123	298.97	355.57	506.20	39.72	275.0	0.2695	0.260	0.616
296	C4H10O	DIETHYL ETHER	74.123	156.85	307.58	466.70	36.38	280.0	0.2647	0.262	0.285
297	C4H10O	METHYL ISOPROPYL ETHER	74.123	127.93	303.92	464.50	38.80	276.0	0.2686	0.277	0.279
298	C4H10O	ISOBUTANOL	74.123	165.15	380.81	547.73	42.95	272.0	0.2725	0.257	0.589
299	C4H10O2	1-3-BUTANEDIOL	90.122	196.15	480.15	643.00	50.00	292.0	0.3086	0.273	1.146
300	C4H10O2	1-4-BUTANEDIOL	90.122	293.05	501.15	667.00	48.80	297.0	0.3034	0.261	1.189
301	C4H10O2	2-3-BUTANEDIOL	90.122	280.75	453.85	611.00	51.30	267.0	0.3375	0.270	1.106
302	C4H10O2	t-BUTYL HYDROPEROXIDE	90.122	277.45	405.50	576.00	43.40	290.0	0.3108	0.263	0.668
303	C4H10O2	1-2-DIMETHOXYETHANE	90.122	215.15	357.20	536.15	38.70	270.6	0.3330	0.235	0.346
304	C4H10O2	2-ETHOXYETHANOL	90.122	---	408.15	569.00	42.40	294.0	0.3065	0.264	0.759
305	C4H10O3	DIETHYLENE GLYCOL	106.122	262.70	518.15	744.60	46.00	312.0	0.3401	0.232	0.621
306	C4H10O4S	DIETHYL SULFATE	154.187	248.00	483.00	792.00	68.90	398.0	0.3874	0.416	0.162
307	C4H10S	n-BUTYL MERCAPTAN	90.189	157.46	371.61	569.00	39.70	307.0	0.2938	0.258	0.278
308	C4H10S	ISOBUTYL MERCAPTAN	90.189	128.31	361.64	559.00	40.60	307.0	0.2938	0.268	0.252
309	C4H10S	sec-BUTYL MERCAPTAN	90.189	133.02	358.13	554.00	40.60	307.0	0.2938	0.271	0.248
310	C4H10S	tert-BUTYL MERCAPTAN	90.189	274.26	337.37	530.00	40.60	307.0	0.2938	0.273	0.191
311	C4H10S	DIETHYL SULFIDE	90.189	169.20	365.25	557.15	39.62	318.0	0.2836	0.272	0.294
312	C4H10S2	DIETHYL DISULFIDE	122.255	171.63	427.13	642.00	38.70	358.0	0.3415	0.260	0.346
313	C4H11N	n-BUTYLAMINE	73.138	224.05	350.55	531.90	42.00	313.0	0.2337	0.297	0.330
314	C4H11N	ISOBUTYLAMINE	73.138	188.55	340.88	513.73	42.15	312.0	0.2344	0.308	0.363
315	C4H11N	sec-BUTYLAMINE	73.138	168.65	336.15	514.30	40.00	310.0	0.2359	0.290	0.282
316	C4H11N	tert-BUTYLAMINE	73.138	206.19	317.55	483.90	38.40	293.0	0.2496	0.280	0.275
317	C4H11N	DIETHYLAMINE	73.138	223.35	328.60	496.60	37.09	301.0	0.2430	0.270	0.304
318	C4H11NO	DIMETHYLETHANOLAMINE	89.137	214.15	407.15	571.82	41.40	300.0	0.2971	0.261	0.711
319	C4H11NO2	DIETHANOLAMINE	105.137	301.15	542.04	715.00	32.70	349.0	0.3013	0.192	1.046
320	C4H11NO2	2-AMINOETHOXYETHANOL	105.137	---	514.00	699.00	43.60	330.0	0.3186	0.248	0.969
321	C4H12N2O	N-AMINOETHYL ETHANOLAMINE	104.152	---	517.00	698.00	44.60	387.0	0.2691	0.297	1.050
322	C4H12Si	TETRAMETHYLSILANE	88.225	174.07	299.80	450.40	28.14	357.0	0.2471	0.268	0.224
323	C4H13N3	DIETHYLENE TRIAMINE	103.167	234.15	480.25	676.00	42.20	342.0	0.3017	0.257	0.700

Appendix E

GAS HEAT CAPACITY FOR C_1 TO C_4 COMPOUNDS

Carl L. Yaws
Lamar University, Beaumont, Texas

$C_p = A + B\,T + C\,T^2 + D\,T^3 + E\,T^4$ (C_p - joule/g-mol K, T - K)

NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
1	CBrClF2	BROMOCHLORODIFLUOROMETHANE	18.387	2.7933E-01	-3.7127E-04	2.2889E-07	-5.3229E-11	100	1500
2	CBrCl3	BROMOTRICHLOROMETHANE	24.484	3.2024E-01	-4.9096E-04	3.3359E-07	-8.2982E-11	100	1500
3	CBrF3	BROMOTRIFLUOROMETHANE	17.208	2.4770E-01	-2.9181E-04	1.6247E-07	-3.4765E-11	100	1500
4	CBr2F2	DIBROMODIFLUOROMETHANE	22.399	2.7403E-01	-3.7433E-04	2.3638E-07	-5.6067E-11	100	1500
5	CClF3	CHLOROTRIFLUOROMETHANE	13.762	2.4951E-01	-2.8194E-04	1.4962E-07	-3.0450E-11	100	1500
6	CClN	CYANOGEN CHLORIDE	21.270	1.1915E-01	-1.6822E-04	1.1457E-07	-2.9210E-11	100	1500
7	CCl2F2	DICHLORODIFLUOROMETHANE	14.877	2.8292E-01	-3.6295E-04	2.1591E-07	-4.8619E-11	100	1500
8	CCl2O	PHOSGENE	20.747	1.7972E-01	-2.3242E-04	1.4224E-07	-3.3087E-11	100	1500
9	CCl3F	TRICHLOROFLUOROMETHANE	16.636	3.1336E-01	-4.4426E-04	2.8612E-07	-6.8556E-11	89	1500
10	CCl4	CARBON TETRACHLORIDE	19.816	3.3311E-01	-5.0511E-04	3.4057E-07	-8.4249E-11	100	1500
11	CF2O	CARBONYL FLUORIDE	23.640	8.9853E-02	-2.4575E-05	-2.8140E-08	1.4023E-11	100	1500
12	CF4	CARBON TETRAFLUORIDE	15.278	1.9916E-01	-1.6369E-04	5.1686E-08	-3.1820E-12	100	1500
13	CHBr3	TRIBROMOMETHANE	33.356	1.7475E-01	-1.9516E-04	1.0725E-07	-2.3180E-11	100	1500
14	CHClF2	CHLORODIFLUOROMETHANE	20.519	1.4746E-01	-9.2440E-05	1.4379E-08	3.4356E-12	100	1500
15	CHCl2F	DICHLOROFLUOROMETHANE	33.078	1.0473E-01	-2.2510E-05	-3.8822E-08	1.8245E-11	100	1500
16	CHCl3	CHLOROFORM	22.487	1.9823E-01	-2.1676E-04	1.1636E-07	-2.4555E-11	100	1500
17	CHF3	TRIFLUOROMETHANE	23.287	9.5385E-02	2.0049E-05	-7.4432E-08	2.7428E-11	100	1500
18	CHN	HYDROGEN CYANIDE	25.766	3.7969E-02	-1.2416E-05	-3.2240E-09	2.2610E-12	100	1500
19	CH2BrCl	BROMOCHLOROMETHANE	27.752	9.1021E-02	-8.2541E-06	-3.7449E-08	1.5156E-11	100	1500
20	CH2Br2	DIBROMOMETHANE	28.305	1.0581E-01	-4.7966E-05	-2.6711E-09	5.1497E-12	100	1500
21	CH2Cl2	DICHLOROMETHANE	26.694	8.3984E-02	8.9712E-06	-5.0924E-08	1.8726E-11	100	1500
22	CH2F2	DIFLUOROMETHANE	30.323	1.1176E-02	1.5809E-04	-1.6323E-07	4.7955E-11	100	1500
23	CH2I2	DIIODOMETHANE	28.918	1.1739E-01	-7.3808E-05	1.7055E-08	1.2051E-14	100	1500
24	CH2O	FORMALDEHYDE	34.428	-2.9779E-02	1.5104E-04	-1.2733E-07	3.3887E-11	50	1500
25	CH2O2	FORMIC ACID	31.745	7.4234E-03	1.8791E-04	-1.9475E-07	5.7613E-11	50	1500
26	CH3Br	METHYL BROMIDE	29.146	2.4374E-02	1.0655E-04	-1.1324E-07	3.3241E-11	100	1500
27	CH3Cl	METHYL CHLORIDE	27.385	2.6036E-02	1.0320E-04	-1.0887E-07	3.1642E-11	150	1500
28	CH3Cl3Si	METHYL TRICHLOROSILANE	56.670	2.0066E-01	-1.6721E-04	7.2533E-08	-1.2684E-11	200	1500
29	CH3F	METHYL FLUORIDE	34.077	-3.5019E-02	2.2031E-04	-1.9566E-07	5.4104E-11	100	1500
30	CH3I	METHYL IODIDE	25.635	6.6836E-02	1.2292E-05	-3.6742E-08	1.2301E-11	100	1500
31	CH3NO	FORMAMIDE	30.911	1.4363E-02	1.9281E-04	-1.9805E-07	5.8262E-11	150	1500
32	CH3NO2	NITROMETHANE	41.136	3.4367E-03	2.6380E-04	-2.6898E-07	7.9503E-11	100	1500
33	CH4	METHANE	34.942	-3.9957E-02	1.9184E-04	-1.5303E-07	3.9321E-11	50	1500
34	CH4Cl2Si	METHYL DICHLOROSILANE	37.250	2.3327E-01	-1.9952E-04	9.1473E-08	-1.7387E-11	200	1500
35	CH4O	METHANOL	40.046	-3.8287E-02	2.4529E-04	-2.1679E-07	5.9909E-11	100	1500
36	CH4O3S	METHANESULFONIC ACID	65.450	-1.0363E-01	6.2784E-04	-6.7194E-07	2.3114E-10	298	1000
37	CH4S	METHYL MERCAPTAN	40.307	-3.6753E-03	1.8400E-04	-1.7596E-07	5.0137E-11	100	1500
38	CH5ClSi	METHYL CHLOROSILANE	25.886	2.1064E-01	-1.3055E-04	3.6499E-08	-3.0118E-12	200	1500
39	CH5N	METHYLAMINE	40.039	-1.5108E-02	2.5012E-04	-2.3336E-07	6.5582E-11	100	1500
40	CH6Si	METHYL SILANE	25.277	1.2988E-01	5.9803E-05	-1.2080E-07	4.0036E-11	100	1500
41	CN4O8	TETRANITROMETHANE	23.733	5.5312E-01	-4.5854E-04	1.5286E-07	-1.3967E-11	298	1500
42	CO	CARBON MONOXIDE	29.556	-6.5807E-03	2.0130E-05	-1.2227E-08	2.2617E-12	60	1500
43	COS	CARBONYL SULFIDE	20.913	9.2794E-02	-9.7014E-05	5.0943E-08	-1.0615E-11	100	1500
44	CO2	CARBON DIOXIDE	27.437	4.2315E-02	-1.9555E-05	3.9968E-09	-2.9872E-13	50	5000
45	CS2	CARBON DISULFIDE	20.461	1.2299E-01	-1.6184E-04	1.0199E-07	-2.4444E-11	100	1500
46	C2BrF3	BROMOTRIFLUOROETHYLENE	33.956	2.3803E-01	-2.5448E-04	1.3108E-07	-2.6462E-11	300	1200
47	C2Br2F4	1,2-DIBROMOTETRAFLUOROETHANE	50.542	3.7777E-01	-4.8770E-04	3.1054E-07	-7.8174E-11	298	1200
48	C2ClF3	CHLOROTRIFLUOROETHYLENE	28.388	2.5871E-01	-2.9010E-04	1.5876E-07	-3.3880E-11	300	1500
49	C2ClF5	CHLOROPENTAFLUOROETHANE	24.663	3.8598E-01	-3.8927E-04	1.7751E-07	-2.9992E-11	200	1500
50	C2Cl2F4	1,2-DICHLOROTETRAFLUOROETHANE	17.183	4.8507E-01	-5.9368E-04	3.3494E-07	-7.1705E-11	273	1500
51	C2Cl3F3	1,1,2-TRICHLOROTRIFLUOROETHANE	42.456	4.0973E-01	-5.0045E-04	2.8463E-07	-6.1623E-11	200	1500
52	C2Cl4	TETRACHLOROETHYLENE	34.627	3.1065E-01	-4.5258E-04	3.2734E-07	-9.4234E-11	298	1000
53	C2Cl4F2	1,1,2,2-TETRACHLORODIFLUOROETHANE	3.788	6.9339E-01	-1.0927E-03	7.6080E-07	-1.9434E-10	298	1000
54	C2Cl4O	TRICHLOROACETYL CHLORIDE	55.547	2.5821E-01	-2.9449E-04	1.6054E-07	-3.3869E-11	298	1500
55	C2Cl6	HEXACHLOROETHANE	48.475	4.4117E-01	-5.9638E-04	3.6922E-07	-8.5631E-11	150	1500
56	C2F4	TETRAFLUOROETHYLENE	30.934	2.1587E-01	-1.9110E-04	7.5713E-08	-1.0493E-11	100	1500
57	C2F6	HEXAFLUOROETHANE	13.604	4.3503E-01	-4.8166E-04	2.4841E-07	-4.8897E-11	100	1500
58	C2HBrClF3	HALOTHANE	65.307	1.2411E-01	8.8736E-05	-1.7716E-07	6.3268E-11	100	1500
59	C2HClF2	2-CHLORO-1,1-DIFLUOROETHYLENE	19.530	2.4576E-01	-2.5701E-04	1.3429E-07	-2.7612E-11	298	1500
60	C2HCl3	TRICHLOROETHYLENE	40.879	1.6218E-01	-1.0399E-04	1.3310E-08	5.9103E-12	100	1500

$C_P = A + B\,T + C\,T^2 + D\,T^3 + E\,T^4$ (C_P - joule/g-mol K, T - K)

NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
61	C2HCl3O	DICHLOROACETYL CHLORIDE	38.143	2.3343E-01	-1.9070E-04	5.6320E-08	-2.5489E-12	298	1500
62	C2HCl3O	TRICHLOROACETALDEHYDE	46.176	2.3126E-01	-2.3659E-04	1.2539E-07	-2.7197E-11	298	1200
63	C2HCl5	PENTACHLOROETHANE	28.297	4.3657E-01	-5.5684E-04	3.3877E-07	-7.8834E-11	100	1500
64	C2HF3O2	TRIFLUOROACETIC ACID	9.274	3.9410E-01	-4.3755E-04	2.4769E-07	-5.7309E-11	298	1200
65	C2HF5	PENTAFLUOROETHANE	40.370	2.0895E-01	-4.5524E-05	-8.2827E-08	3.9062E-11	100	1500
66	C2H2	ACETYLENE	19.360	1.1519E-01	-1.2374E-04	7.2370E-08	-1.6590E-11	200	1500
67	C2H2Br4	1,1,2,2-TETRABROMOETHANE	49.111	2.5471E-01	-2.1340E-04	7.7534E-08	-9.0356E-12	150	1500
68	C2H2Cl2	1,1-DICHLOROETHYLENE	21.272	2.0394E-01	-1.8292E-04	8.2561E-08	-1.4802E-11	200	1500
69	C2H2Cl2	cis-1,2-DICHLOROETHYLENE	11.376	2.4489E-01	-2.5183E-04	1.3368E-07	-2.8416E-11	200	1500
70	C2H2Cl2	trans-1,2-DICHLOROETHYLENE	19.666	2.0908E-01	-1.9503E-04	9.4941E-08	-1.8848E-11	200	1500
71	C2H2Cl2O	CHLOROACETYL CHLORIDE	29.566	2.1377E-01	-1.8076E-04	7.9913E-08	-1.4782E-11	298	1500
72	C2H2Cl2O	DICHLOROACETALDEHYDE	39.761	1.3843E-01	9.8425E-06	-1.0396E-07	4.4962E-11	298	1200
73	C2H2Cl2O2	DICHLOROACETIC ACID	48.334	1.7165E-01	-6.2134E-05	-3.6029E-08	2.3198E-11	298	1200
74	C2H2Cl3F	1,1,1-TRICHLOROFLUOROETHANE	20.183	3.8754E-01	-4.6141E-04	2.7663E-07	-6.5842E-11	298	1200
75	C2H2Cl4	1,1,1,2-TETRACHLOROETHANE	27.227	3.4932E-01	-3.7793E-04	2.0496E-07	-4.3937E-11	200	1500
76	C2H2Cl4	1,1,2,2-TETRACHLOROETHANE	20.427	3.6839E-01	-4.0365E-04	2.2067E-07	-4.7303E-11	298	1500
77	C2H2F2	1,1-DIFLUOROETHYLENE	24.354	1.2196E-01	1.1084E-05	-7.9704E-08	3.0820E-11	100	1500
78	C2H2F4	1,1,1,2-TETRAFLUOROETHANE	8.429	3.4966E-01	-3.3281E-04	1.5603E-07	-2.8939E-11	200	1500
79	C2H2O	KETENE	-14.704	3.1238E-01	-4.3385E-04	2.9499E-07	-7.5221E-11	200	1500
80	C2H2O4	OXALIC ACID	-5.565	1.3496E-01	1.3737E-05	-1.9105E-07	1.1311E-10	298	1000
81	C2H3Br	VINYL BROMIDE	19.032	1.4697E-01	-7.2736E-05	4.7354E-09	4.4305E-12	200	1500
82	C2H3Cl	VINYL CHLORIDE	17.193	1.4564E-01	-6.4281E-05	-3.2385E-09	6.7882E-12	200	1500
83	C2H3ClF2	1-CHLORO-1,1-DIFLUOROETHANE	20.964	2.6700E-01	-2.0774E-04	7.5759E-08	-9.7753E-12	200	1500
84	C2H3ClO	ACETYL CHLORIDE	37.484	1.0683E-01	1.3035E-05	-5.7327E-08	1.9960E-11	200	1500
85	C2H3ClO	CHLOROACETALDEHYDE	25.272	1.5004E-01	-3.4110E-05	-4.1182E-08	2.0993E-11	298	1200
86	C2H3ClO2	CHLOROACETIC ACID	9.327	2.9997E-01	-2.6947E-04	1.2616E-07	-2.4406E-11	298	1500
87	C2H3ClO2	METHYL CHLOROFORMATE	13.353	2.7827E-01	-2.0298E-04	3.2225E-08	1.9750E-11	298	900
88	C2H3Cl3	1,1,1-TRICHLOROETHANE	18.674	3.3443E-01	-3.4963E-04	1.8764E-07	-4.0744E-11	100	1500
89	C2H3Cl3	1,1,2-TRICHLOROETHANE	28.881	2.4893E-01	-1.7639E-04	5.2632E-08	-3.5668E-12	200	1500
90	C2H3F	VINYL FLUORIDE	27.617	5.4052E-02	1.3093E-04	-1.6220E-07	5.0829E-11	100	1500
91	C2H3F3	1,1,1-TRIFLUOROETHANE	33.444	1.5361E-01	3.3402E-05	-1.1974E-07	4.4424E-11	100	1500
92	C2H3N	ACETONITRILE	36.947	2.2085E-02	1.4661E-04	-1.5012E-07	4.3482E-11	100	1500
93	C2H3NO	METHYL ISOCYANATE	21.328	8.5385E-02	7.8504E-05	-1.0050E-07	2.9508E-11	298	1500
94	C2H4	ETHYLENE	32.083	-1.4831E-02	2.4774E-04	-2.3766E-07	6.8274E-11	60	1500
95	C2H4Br2	1,1-DIBROMOETHANE	21.084	2.5090E-01	-2.0060E-04	8.4960E-08	-1.5026E-11	200	1500
96	C2H4Br2	1,2-DIBROMOETHANE	47.739	1.3553E-01	1.0414E-05	-6.8462E-08	2.5192E-11	200	1500
97	C2H4Cl2	1,1-DICHLOROETHANE	15.730	2.6124E-01	-2.1489E-04	9.5761E-08	-1.8004E-11	200	1500
98	C2H4Cl2	1,2-DICHLOROETHANE	37.275	1.4362E-01	1.0378E-05	-7.8305E-08	2.8872E-11	200	1500
99	C2H4Cl2O	BIS(CHLOROMETHYL)ETHER	3.763	3.6729E-01	-3.5749E-04	1.8325E-07	-3.7910E-11	298	1500
100	C2H4F2	1,1-DIFLUOROETHANE	36.271	7.8276E-02	1.6310E-04	-2.0396E-07	6.3814E-11	100	1500
101	C2H4F2	1,2-DIFLUOROETHANE	18.309	2.0288E-01	-6.1613E-05	-3.8781E-08	2.0688E-11	200	1500
102	C2H4O	ACETALDEHYDE	34.140	4.0020E-02	1.5634E-04	-1.6445E-07	4.7248E-11	100	1500
103	C2H4O	ETHYLENE OXIDE	30.827	-7.6041E-03	3.2347E-04	-3.2747E-07	9.7271E-11	50	1500
104	C2H4O2	ACETIC ACID	34.850	3.7626E-02	2.8311E-04	-3.0767E-07	9.2646E-11	50	1500
105	C2H4O2	METHYL FORMATE	5.795	2.5072E-01	-1.7515E-04	6.0565E-08	-8.1015E-12	250	1500
106	C2H5Br	BROMOETHANE	26.552	1.1837E-01	6.7525E-05	-1.1655E-07	3.7186E-11	100	1500
107	C2H5Cl	ETHYL CHLORIDE	35.946	5.2294E-02	2.0321E-04	-2.2795E-07	6.9123E-11	100	1500
108	C2H5ClO	2-CHLOROETHANOL	12.997	2.5587E-01	-1.6553E-04	5.2292E-08	-6.5812E-12	298	1500
109	C2H5F	ETHYL FLUORIDE	21.452	1.2080E-01	7.8409E-05	-1.2578E-07	3.9184E-11	150	1500
110	C2H5I	ETHYL IODIDE	27.759	1.1915E-01	5.9726E-05	-1.0756E-07	3.4157E-11	100	1500
111	C2H5N	ETHYLENEIMINE	12.316	1.1833E-01	1.2598E-04	-1.8322E-07	5.8831E-11	150	1500
112	C2H5NO	ACETAMIDE	17.748	1.3627E-01	1.0668E-04	-1.8647E-07	6.2842E-11	100	1500
113	C2H5NO	N-METHYLFORMAMIDE	43.449	-1.0054E-01	7.2412E-04	-8.6224E-07	3.2724E-10	298	1000
114	C2H5NO2	NITROETHANE	17.726	2.2334E-01	-2.1690E-05	-8.0889E-08	3.2223E-11	200	1500
115	C2H6	ETHANE	28.146	4.3447E-02	1.8946E-04	-1.9082E-07	5.3349E-11	100	1500
116	C2H6AlCl	DIMETHYLALUMINUM CHLORIDE	13.870	3.1526E-01	-2.4008E-04	9.9159E-08	-1.7228E-11	298	1500
117	C2H6O	DIMETHYL ETHER	34.668	7.0293E-02	1.6530E-04	-1.7675E-07	4.9313E-11	100	1500
118	C2H6O	ETHANOL	27.091	1.1055E-01	1.0957E-04	-1.5046E-07	4.6601E-11	100	1500
119	C2H6OS	DIMETHYL SULFOXIDE	27.816	2.4839E-01	-1.3176E-04	2.3843E-08	1.6501E-12	200	1500
120	C2H6O2	ETHYLENE GLYCOL	48.218	1.9073E-01	-6.6117E-05	-1.8834E-08	1.2555E-11	200	1500
121	C2H6O4S	DIMETHYL SULFATE	23.800	3.7920E-01	-2.0385E-04	2.4893E-08	8.1594E-12	200	1500
122	C2H6S	DIMETHYL SULFIDE	35.994	1.2381E-01	5.0871E-05	-9.1708E-08	2.8274E-11	200	1500
123	C2H6S	ETHYL MERCAPTAN	47.034	4.1940E-02	2.3486E-04	-2.5035E-07	7.4049E-11	100	1500
124	C2H6S2	DIMETHYL DISULFIDE	50.010	1.4793E-01	4.2325E-05	-9.9087E-08	3.2173E-11	200	1500
125	C2H7N	DIMETHYLAMINE	30.638	1.0737E-01	1.5824E-04	-1.9418E-07	5.8509E-11	200	1500
126	C2H7N	ETHYLAMINE	30.983	1.2458E-01	1.0966E-04	-1.5256E-07	4.6640E-11	200	1500
127	C2H7NO	MONOETHANOLAMINE	-0.555	3.7003E-01	-3.1976E-04	1.5834E-07	-3.2344E-11	298	1500
128	C2H8N2	ETHYLENEDIAMINE	10.429	3.2490E-01	-1.9912E-04	6.3557E-08	-8.7124E-12	298	1500
129	C2H8Si	DIMETHYL SILANE	27.940	2.2419E-01	-4.0022E-06	-9.9567E-08	3.6936E-11	100	1500
130	C2N2	CYANOGEN	22.445	1.6837E-01	-2.3212E-04	1.5784E-07	-4.0479E-11	100	1500
131	C3F6	HEXAFLUOROPROPYLENE	-3.108	5.2270E-01	-4.6521E-04	1.9228E-07	-2.9928E-11	200	1500
132	C3F6O	HEXAFLUOROACETONE	0.451	5.2201E-01	-4.5370E-04	1.6725E-07	-1.9476E-11	200	1500

$C_P = A + B\,T + C\,T^2 + D\,T^3 + E\,T^4$ (C_P - joule/g-mol K, T - K)

NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
133	C3F8	OCTAFLUOROPROPANE	14.695	6.1745E-01	-6.7174E-04	3.4675E-07	-6.9257E-11	273	1500
134	C3H2N2	MALONONITRILE	27.389	1.6397E-01	-3.8642E-05	-5.4165E-08	2.7216E-11	298	1200
135	C3H3Cl	PROPARGYL CHLORIDE	20.366	2.2487E-01	-1.9722E-04	9.5424E-08	-1.9480E-11	298	1500
136	C3H3N	ACRYLONITRILE	18.425	1.8336E-01	-1.0072E-04	1.8747E-08	9.1114E-13	200	1500
137	C3H3NO	OXAZOLE	25.962	5.5802E-02	3.1816E-04	-3.7323E-07	1.1787E-10	50	1500
138	C3H4	METHYLACETYLENE	27.565	1.2037E-01	-6.0666E-06	-4.0713E-08	1.5078E-11	200	1500
139	C3H4	PROPADIENE	28.504	8.1576E-02	1.0896E-04	-1.4641E-07	4.5759E-11	50	1500
140	C3H4Cl2	2,3-DICHLOROPROPENE	29.854	2.6319E-01	-2.1492E-04	9.6796E-08	-1.8613E-11	298	1200
141	C3H4O	ACROLEIN	109.243	-5.0952E-01	1.7059E-03	-1.8068E-06	6.5983E-10	298	1000
142	C3H4O	PROPARGYL ALCOHOL	20.577	2.0827E-01	-1.1794E-04	2.3926E-08	1.9047E-13	298	1500
143	C3H4O2	ACRYLIC ACID	7.755	2.9386E-01	-2.0878E-04	7.1591E-08	-9.0960E-12	250	1500
144	C3H4O2	beta-PROPIOLACTONE	9.108	2.3694E-01	-5.7117E-05	-5.5709E-08	2.6215E-11	200	1500
145	C3H4O2	VINYL FORMATE	-19.250	4.1753E-01	-4.2109E-04	2.2583E-07	-4.7796E-11	298	1500
146	C3H4O3	ETHYLENE CARBONATE	---	---	---	---	---	--	--
147	C3H4O3	PYRUVIC ACID	5.045	3.7767E-01	-3.4222E-04	1.6758E-07	-3.3836E-11	298	1500
148	C3H5Cl	2-CHLOROPROPENE	33.157	1.7339E-01	-4.0298E-05	-3.2447E-08	1.4113E-11	298	1500
149	C3H5Cl	3-CHLOROPROPENE	24.507	1.8758E-01	-2.1732E-05	-6.0427E-08	2.4116E-11	200	1500
150	C3H5ClO	alpha-EPICHLOROHYDRIN	-27.780	5.1614E-01	-5.6307E-04	3.2430E-07	-7.2399E-11	298	1500
151	C3H5ClO2	METHYL CHLOROACETATE	-13.590	5.2003E-01	-5.7146E-04	3.3108E-07	-7.4031E-11	298	1500
152	C3H5ClO2	ETHYL CHLOROFORMATE	32.231	2.5311E-01	-6.0013E-05	-5.0872E-08	2.2667E-11	100	1500
153	C3H5Cl3	1,2,3-TRICHLOROPROPANE	45.369	2.7047E-01	-1.3637E-04	1.1641E-08	7.2782E-12	200	1500
154	C3H5N	PROPIONITRILE	17.618	2.2119E-01	-1.0707E-04	1.7352E-08	1.0610E-12	200	1500
155	C3H5NO	ACRYLAMIDE	13.165	2.6213E-01	-8.5250E-05	-3.5101E-08	2.0435E-11	200	1500
156	C3H5NO	HYDRACRYLONITRILE	8.904	3.1056E-01	-2.0843E-04	6.3273E-08	-6.1415E-12	298	1500
157	C3H5NO	LACTONITRILE	30.071	2.3651E-01	-1.0389E-04	1.4435E-08	1.2163E-12	298	1500
158	C3H5N3O9	NITROGLYCERINE	---	---	---	---	---	--	--
159	C3H6	CYCLOPROPANE	21.172	6.3106E-02	2.9197E-04	-3.2708E-07	9.9730E-11	100	1500
160	C3H6	PROPYLENE	31.298	7.2449E-02	1.9481E-04	-2.1582E-07	6.2974E-11	90	1500
161	C3H6Cl2	1,1-DICHLOROPROPANE	36.554	2.2898E-01	-2.1999E-05	-8.4949E-08	3.4171E-11	150	1500
162	C3H6Cl2	1,2-DICHLOROPROPANE	34.575	2.4270E-01	-5.7726E-05	-4.9517E-08	2.3275E-11	200	1500
163	C3H6Cl2	1,3-DICHLOROPROPANE	37.917	2.3441E-01	-5.7287E-05	-4.5766E-08	2.1530E-11	200	1500
164	C3H6O	ACETONE	35.918	9.3896E-02	1.8730E-04	-2.1643E-07	6.3174E-11	100	1500
165	C3H6O	ALLYL ALCOHOL	18.528	2.1287E-01	-2.8839E-05	-6.5014E-08	2.6352E-11	200	1500
166	C3H6O	METHYL VINYL ETHER	15.321	2.3596E-01	-9.9256E-05	7.6893E-09	3.3293E-12	298	1500
167	C3H6O	n-PROPIONALDEHYDE	58.911	4.8385E-03	3.3514E-04	-3.0509E-07	8.3305E-11	200	1500
168	C3H6O	1,2-PROPYLENE OXIDE	29.501	9.2545E-02	2.5626E-04	-2.9921E-07	9.0294E-11	50	1500
169	C3H6O	1,3-PROPYLENE OXIDE	-32.684	4.0929E-01	-3.6377E-04	2.0140E-07	-4.5037E-11	298	1500
170	C3H6O2	ETHYL FORMATE	36.654	1.4922E-01	1.3957E-04	-1.9500E-07	5.9055E-11	100	1500
171	C3H6O2	METHYL ACETATE	-22.287	4.8275E-01	-4.6631E-04	2.3286E-07	-4.3094E-11	298	1200
172	C3H6O2	PROPIONIC ACID	-0.970	3.8307E-01	-3.0872E-04	1.3886E-07	-2.6720E-11	298	1500
173	C3H6O2S	3-MERCAPTOPROPIONIC ACID	26.577	3.7025E-01	-2.9565E-04	1.5526E-07	-4.2314E-11	298	1200
174	C3H6O3	LACTIC ACID	4.890	4.2659E-01	-3.5416E-04	1.5688E-07	-2.9209E-11	298	1500
175	C3H6O3	METHOXYACETIC ACID	-42.782	7.8675E-01	-1.3648E-03	1.3336E-06	-5.0983E-10	298	900
176	C3H6O3	TRIOXANE	4.910	2.6407E-01	6.9003E-05	-1.9208E-07	6.6054E-11	200	1500
177	C3H7Br	1-BROMOPROPANE	24.209	2.2956E-01	-2.9974E-05	-6.7459E-08	2.6960E-11	200	1500
178	C3H7Br	2-BROMOPROPANE	28.602	2.1902E-01	-4.6160E-06	-9.1820E-08	3.4572E-11	200	1500
179	C3H7Cl	ISOPROPYL CHLORIDE	45.660	9.5434E-02	2.4116E-04	-2.8322E-07	8.6109E-11	100	1500
180	C3H7Cl	n-PROPYL CHLORIDE	16.153	2.6543E-01	-9.2380E-05	-1.9679E-08	1.4135E-11	200	1500
181	C3H7I	ISOPROPYL IODIDE	29.083	2.2383E-01	-1.7102E-05	-8.1396E-08	3.1643E-11	200	1500
182	C3H7I	n-PROPYL IODIDE	17.653	2.7777E-01	-1.1961E-04	-7.5057E-10	9.3394E-12	200	1500
183	C3H7N	ALLYLAMINE	18.274	2.6583E-01	-1.2102E-04	1.3458E-08	3.2317E-12	298	1500
184	C3H7N	PROPYLENEIMINE	-38.561	4.9894E-01	-4.5377E-04	2.2334E-07	-4.4943E-11	298	1500
185	C3H7NO	N,N-DIMETHYLFORMAMIDE	29.310	2.0837E-01	1.0912E-04	-2.1506E-07	7.2177E-11	200	1500
186	C3H7NO	N-METHYLACETAMIDE	-1.339	2.8413E-01	-7.2490E-05	-3.9834E-08	1.8761E-11	298	1500
187	C3H7NO2	1-NITROPROPANE	28.505	2.6062E-01	2.4779E-05	-1.4204E-07	5.0913E-11	200	1500
188	C3H7NO2	2-NITROPROPANE	18.837	3.1000E-01	-5.2946E-05	-9.1409E-08	3.8968E-11	200	1500
189	C3H8	PROPANE	28.277	1.1600E-01	1.9597E-04	-2.3271E-07	6.8669E-11	100	1500
190	C3H8O	ISOPROPANOL	25.535	2.1203E-01	5.3492E-05	-1.4727E-07	4.9406E-11	100	1500
191	C3H8O	METHYL ETHYL ETHER	35.289	1.7427E-01	9.4277E-05	-1.4826E-07	4.3296E-11	100	1500
192	C3H8O	n-PROPANOL	31.507	2.3082E-01	-7.8983E-05	6.3696E-09	8.6908E-13	100	2980
193	C3H8O2	2-METHOXYETHANOL	11.416	3.4693E-01	-1.7874E-04	3.1146E-08	1.1718E-12	298	1500
194	C3H8O2	METHYLAL	39.490	2.4609E-02	7.8528E-04	-1.0921E-06	4.5093E-10	298	1000
195	C3H8O2	1,2-PROPYLENE GLYCOL	14.404	3.2565E-01	-7.8741E-05	-1.2420E-07	7.4776E-11	298	1000
196	C3H8O2	1,3-PROPYLENE GLYCOL	7.340	3.5920E-01	-1.5544E-04	-4.8543E-08	4.6374E-11	298	1200
197	C3H8O3	GLYCEROL	9.656	4.2826E-01	-2.6797E-04	3.1794E-08	2.7745E-11	298	1200
198	C3H8S	n-PROPYLMERCAPTAN	37.035	1.9064E-01	7.2562E-05	-1.4440E-07	4.6182E-11	200	1500
199	C3H8S	ISOPROPYL MERCAPTAN	31.652	2.2715E-01	1.2837E-05	-1.0474E-07	3.6662E-11	200	1500
200	C3H9N	n-PROPYLAMINE	7.637	3.3741E-01	-1.6070E-04	2.3836E-08	2.3647E-12	298	1500
201	C3H9N	ISOPROPYLAMINE	-4.758	4.0947E-01	-2.8998E-04	1.1548E-07	-2.0187E-11	298	1500
202	C3H9N	TRIMETHYLAMINE	26.377	2.1496E-01	1.0135E-04	-1.8839E-07	5.9860E-11	200	1500
203	C3H9NO	1-AMINO-2-PROPANOL	-8.396	5.1026E-01	-4.5822E-04	2.3361E-07	-4.9093E-11	298	1500
204	C3H9NO	3-AMINO-1-PROPANOL	7.276	4.0342E-01	-2.5533E-04	8.2617E-08	-1.1842E-11	298	1500

$C_P = A + B\,T + C\,T^2 + D\,T^3 + E\,T^4$ (C_P - joule/g-mol K, T - K)

NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
205	C3H9NO	METHYLETHANOLAMINE	-10.405	4.7860E-01	-3.7360E-04	1.6992E-07	-3.5477E-11	298	1200
206	C3H9O4P	TRIMETHYL PHOSPHATE	---	---	---	---	---	--	--
207	C3H10N2	1,2-PROPANEDIAMINE	3.612	4.5467E-01	-3.0830E-04	1.1190E-07	-1.7969E-11	298	1500
208	C3H10Si	TRIMETHYL SILANE	95.333	-3.8565E-02	4.8559E-04	-4.2881E-07	1.1555E-10	298	1500
209	C4Cl4S	TETRACHLOROTHIOPHENE	11.496	5.2672E-01	-6.0693E-04	3.2882E-07	-6.8095E-11	298	1500
210	C4Cl6	HEXACHLORO-1,3-BUTADIENE	101.108	2.8291E-01	-3.0609E-04	1.5800E-07	-3.1695E-11	298	1500
211	C4F8	OCTAFLUORO-2-BUTENE	-17.951	5.6720E-01	-7.4536E-04	4.9173E-07	-1.3124E-10	298	1000
212	C4F8	OCTAFLUOROCYCLOBUTANE	45.579	4.9467E-01	-4.0808E-04	1.3789E-07	-1.1769E-11	200	1500
213	C4F10	DECAFLUOROBUTANE	38.645	6.1357E-01	-3.5155E-04	-1.2037E-07	1.2661E-10	298	1000
214	C4H2O3	MALEIC ANHYDRIDE	-72.015	1.0423E+00	-1.8716E-03	1.6527E-06	-5.5647E-10	298	1000
215	C4H4	VINYLACETYLENE	19.335	2.2308E-01	-1.3739E-04	3.5667E-08	-1.7996E-12	200	1500
216	C4H4N2	SUCCINONITRILE	15.172	3.2583E-01	-2.2170E-04	5.1492E-08	7.0991E-12	298	1200
217	C4H4O	FURAN	-13.779	3.3489E-01	-2.2273E-04	6.9360E-08	-8.1619E-12	200	2980
218	C4H4O2	DIKETENE	14.704	2.8851E-01	-1.3307E-04	-3.2283E-09	1.3066E-11	298	1200
219	C4H8O3	SUCCINIC ANHYDRIDE	5.950	5.3900E-01	-7.4225E-04	6.0553E-07	-2.0505E-10	298	1000
220	C4H4O4	FUMARIC ACID	15.759	5.9932E-01	-7.0854E-04	4.2980E-07	-1.0058E-10	298	1500
221	C4H4O4	MALEIC ACID	-15.115	5.8902E-01	-6.4675E-04	3.6810E-07	-8.0001E-11	298	1500
222	C4H4S	THIOPHENE	22.037	1.2481E-01	2.4505E-04	-3.3887E-07	1.1175E-10	50	1500
223	C4H5Cl	CHLOROPRENE	20.268	3.1369E-01	-2.4207E-04	9.3958E-08	-1.5001E-11	298	1500
224	C4H5N	trans-CROTONITRILE	-1.466	3.4012E-01	-2.3532E-04	7.3984E-08	-8.2896E-12	250	1500
225	C4H5N	cis-CROTONITRILE	-1.780	3.2415E-01	-2.0418E-04	5.2998E-08	-3.0376E-12	298	1500
226	C4H5N	METHACRYLONITRILE	27.067	2.4619E-01	-1.0446E-04	-2.9851E-10	7.0951E-12	298	1600
227	C4H5N	PYRROLE	-7.680	3.1201E-01	-1.1806E-04	-2.7912E-08	2.1314E-11	200	1500
228	C4H5N	VINYLACETONITRILE	21.519	2.5405E-01	-1.2044E-04	1.1212E-08	4.5239E-12	298	1500
229	C4H5NO2	METHYL CYANOACETATE	-29.108	6.1090E-01	-6.3826E-04	3.0816E-07	-4.1498E-11	298	1200
230	C4H6	1,2-BUTADIENE	30.240	1.5688E-01	6.7668E-05	-1.2597E-07	3.9234E-11	100	1500
231	C4H6	1,3-BUTADIENE	18.835	2.0473E-01	6.2485E-05	-1.7148E-07	6.0858E-11	100	1500
232	C4H6	DIMETHYLACETYLENE	41.071	1.0010E-01	1.4966E-04	-1.7838E-07	5.2575E-11	200	1500
233	C4H6	ETHYLACETYLENE	29.857	1.8734E-01	-7.0968E-06	-6.8287E-08	2.5343E-11	200	1500
234	C4H6Cl2	1,3-DICHLORO-trans-2-BUTENE	33.873	3.2586E-01	-2.1702E-04	7.3722E-08	-1.0497E-11	298	1500
235	C4H6Cl2	1,4-DICHLORO-cis-2-BUTENE	0.724	5.0324E-01	-4.5246E-04	2.3322E-07	-5.1035E-11	298	1200
236	C4H6Cl2	1,4-DICHLORO-trans-2-BUTENE	7.205	4.3947E-01	-3.8703E-04	1.8893E-07	-3.8658E-11	298	1500
237	C4H6Cl2	3,4-DICHLORO-1-BUTENE	50.561	2.2753E-01	-4.3374E-05	-1.6965E-08	-4.1852E-12	298	1000
238	C4H6O	trans-CROTONALDEHYDE	11.591	3.2301E-01	-1.3067E-04	1.0791E-08	3.1192E-12	298	1500
239	C4H6O	2,5-DIHYDROFURAN	-11.125	3.4203E-01	-1.4489E-04	-1.3031E-08	1.7017E-11	200	1500
240	C4H6O	DIVINYL ETHER	1.254	3.5057E-01	-2.4183E-04	8.7375E-08	-1.3414E-11	298	1500
241	C4H6O	METHACROLEIN	14.506	1.5922E-01	3.1118E-04	-4.2100E-07	1.4222E-10	298	1200
242	C4H6O2	2-BUTYNE-1,4-DIOL	27.892	3.0363E-01	-1.5388E-04	1.4828E-08	8.3391E-12	298	1200
243	C4H6O2	gamma-BUTYROLACTONE	22.370	1.7297E-01	2.4826E-04	-3.3530E-07	1.0555E-10	100	1500
244	C4H6O2	cis-CROTONIC ACID	0.446	4.7569E-01	-4.4446E-04	2.3234E-07	-5.0122E-11	298	1500
245	C4H6O2	trans-CROTONIC ACID	-5.229	4.5048E-01	-3.8771E-04	1.8280E-07	-3.5447E-11	298	1500
246	C4H6O2	METHACRYLIC ACID	-28.131	5.4744E-01	-5.3877E-04	2.8583E-07	-6.0864E-11	298	1200
247	C4H6O2	METHYL ACRYLATE	1.222	4.0619E-01	-2.8529E-04	9.7153E-08	-1.4073E-11	298	1200
248	C4H6O2	VINYL ACETATE	27.664	2.3366E-01	6.2106E-05	-1.6972E-07	5.7917E-11	100	1500
249	C4H6O3	ACETIC ANHYDRIDE	9.500	3.4425E-01	-8.6736E-05	-7.6769E-08	3.6721E-11	200	1500
250	C4H6O4	SUCCINIC ACID	23.417	4.7462E-01	-3.9265E-04	1.7354E-07	-3.2804E-11	298	1500
251	C4H6O5	DIGLYCOLIC ACID	0.721	6.0311E-01	-5.4772E-04	2.6192E-07	-5.2115E-11	298	1500
252	C4H6O5	MALIC ACID	13.117	5.8833E-01	-5.5236E-04	2.7180E-07	-5.5122E-11	298	1500
253	C4H6O6	TARTARIC ACID	4.526	6.8876E-01	-6.8590E-04	3.5082E-07	-7.2249E-11	298	1500
254	C4H7N	n-BUTYRONITRILE	14.849	3.4077E-01	-2.0780E-04	6.2989E-08	-7.5521E-12	200	1500
255	C4H7N	ISOBUTYRONITRILE	29.844	2.3992E-01	-5.0570E-06	-9.7993E-08	3.6314E-11	200	1500
256	C4H7NO	ACETONE CYANOHYDRIN	14.424	4.1722E-01	-3.1414E-04	1.2671E-07	-2.1994E-11	298	1500
257	C4H7NO	2-METHACRYLAMIDE	-18.333	5.8643E-01	-6.4763E-04	4.4441E-07	-1.2776E-10	298	1200
258	C4H7NO	3-METHOXYPROPIONITRILE	9.316	3.9156E-01	-2.3090E-04	5.4563E-08	-2.5331E-12	298	1500
259	C4H7NO	2-PYRROLIDONE	14.880	2.0967E-01	2.3448E-04	-3.3759E-07	1.0745E-10	100	1500
260	C4H8	1-BUTENE	24.915	2.0648E-01	5.9828E-05	-1.4166E-07	4.7053E-11	200	1500
261	C4H8	cis-2-BUTENE	29.137	1.4008E-01	1.9109E-04	-2.3717E-07	7.0962E-11	200	1500
262	C4H8	trans-2-BUTENE	40.312	1.3472E-01	1.6877E-04	-2.1140E-07	6.3263E-11	200	1500
263	C4H8	CYCLOBUTANE	22.621	8.8506E-02	3.9106E-04	-4.3201E-07	1.2970E-10	100	1500
264	C4H8	ISOBUTENE	32.918	1.8546E-01	7.7876E-05	-1.4645E-07	4.6867E-11	200	1500
265	C4H8Cl2	1,4-DICHLOROBUTANE	0.074	5.1333E-01	-4.3439E-04	2.0527E-07	-4.1398E-11	298	1500
266	C4H8O	n-BUTYRALDEHYDE	64.374	6.4776E-02	3.5143E-04	-3.5371E-07	1.0082E-10	200	1500
267	C4H8O	ISOBUTYRALDEHYDE	-1.360	4.0519E-01	-2.5176E-04	6.0505E-08	6.4389E-12	298	1200
268	C4H8O	1,2-EPOXYBUTANE	6.590	3.4252E-01	-1.2004E-04	-3.3075E-08	2.1868E-11	200	1500
269	C4H8O	METHYL ETHYL KETONE	37.369	2.3045E-01	5.7387E-06	-8.8168E-08	2.9637E-11	200	1500
270	C4H8O	ETHYL VINYL ETHER	-0.946	4.0720E-01	-2.8730E-04	1.1776E-07	-2.1862E-11	298	1500
271	C4H8O	TETRAHYDROFURAN	32.887	2.4554E-02	6.0226E-04	-6.2385E-07	1.8528E-10	50	1500
272	C4H8O2	cis-2-BUTENE-1,4-DIOL	0.759	4.0598E-01	-2.1465E-04	4.8876E-08	-9.9659E-12	298	1000
273	C4H8O2	trans-2-BUTENE-1,4-DIOL	10.706	4.0048E-01	-2.5577E-04	1.1699E-07	-3.9430E-11	298	1000
274	C4H8O2	ISOBUTYRIC ACID	-32.990	5.9238E-01	-5.0629E-04	2.0791E-07	-2.4372E-11	298	1000
275	C4H8O2	n-BUTYRIC ACID	14.368	3.9591E-01	-1.8906E-04	-7.6462E-09	2.0812E-11	298	1200
276	C4H8O2	1,4-DIOXANE	-46.223	5.7263E-01	-3.8800E-04	1.1392E-07	-9.0669E-12	298	1500

$C_P = A + B\,T + C\,T^2 + D\,T^3 + E\,T^4$ (C_P - joule/g-mol K, T - K)

NO	FORMULA	NAME	A	B	C	D	E	TMIN	TMAX
277	C4H8O2	ETHYL ACETATE	69.848	8.2338E-02	3.7159E-04	-4.1129E-07	1.2369E-10	200	1500
278	C4H8O2	METHYL PROPIONATE	-131.953	1.3767E+00	-2.4790E-03	2.2378E-06	-7.6784E-10	298	1000
279	C4H8O2	n-PROPYL FORMATE	-23.921	5.9124E-01	-5.6041E-04	2.9107E-07	-6.1164E-11	298	1500
280	C4H8O2S	SULFOLANE	2.498	4.2069E-01	-9.2595E-05	-1.1878E-07	5.2922E-11	298	1500
281	C4H8S	TETRAHYDROTHIOPHENE	-6.161	3.7746E-01	-1.3544E-04	-3.9013E-08	2.5996E-11	200	1500
282	C4H9Br	1-BROMOBUTANE	29.412	2.9219E-01	-2.6578E-05	-9.7812E-08	3.7812E-11	200	1500
283	C4H9Br	2-BROMOBUTANE	-2.986	4.7747E-01	-3.5869E-04	1.4697E-07	-2.5768E-11	298	1500
284	C4H9Cl	n-BUTYL CHLORIDE	42.595	2.0225E-01	1.5618E-04	-2.4192E-07	7.7385E-11	150	1500
285	C4H9Cl	sec-BUTYL CHLORIDE	41.573	2.1551E-01	1.3137E-04	-2.2399E-07	7.2509E-11	150	1500
286	C4H9Cl	tert-BUTYL CHLORIDE	18.882	3.8038E-01	-1.9282E-04	2.7361E-08	5.0124E-12	200	1500
287	C4H9N	PYRROLIDINE	-8.802	3.1151E-01	6.6087E-05	-2.0528E-07	7.1304E-11	200	1500
288	C4H9NO	N,N-DIMETHYLACETAMIDE	-21.561	5.5114E-01	-4.1728E-04	1.8505E-07	-3.6554E-11	298	1500
289	C4H9NO	MORPHOLINE	-35.984	6.7041E-01	-6.1690E-04	3.0813E-07	-6.3936E-11	298	1500
290	C4H10	n-BUTANE	20.056	2.8153E-01	-1.3143E-05	-9.4571E-08	3.4149E-11	200	1500
291	C4H10	ISOBUTANE	6.772	3.4147E-01	-1.0271E-04	-3.6849E-08	2.0429E-11	200	1500
292	C4H10N2	PIPERAZINE	-64.055	7.9174E-01	-6.6296E-04	2.4423E-07	-3.0828E-11	298	1500
293	C4H10O	n-BUTANOL	8.157	4.1032E-01	-2.2645E-04	6.0372E-08	-6.2802E-12	200	2980
294	C4H10O	sec-BUTANOL	22.465	3.5134E-01	-1.2858E-04	-1.1931E-08	1.2940E-11	200	1500
295	C4H10O	tert-BUTANOL	8.866	4.2394E-01	-2.4206E-04	6.1419E-08	-4.3829E-12	200	1500
296	C4H10O	DIETHYL ETHER	35.979	2.8444E-01	-1.2673E-06	-1.0128E-07	3.4529E-11	200	1500
297	C4H10O	METHYL ISOPROPYL ETHER	48.135	1.8178E-01	2.0299E-04	-2.6456E-07	7.9645E-11	200	1500
298	C4H10O	ISOBUTANOL	71.169	-3.9114E-01	3.1468E-03	-5.6342E-06	3.3290E-09	200	700
299	C4H10O2	1,3-BUTANEDIOL	1.100	5.2567E-01	-4.0675E-04	1.7268E-07	-3.0418E-11	298	1500
300	C4H10O2	1,4-BUTANEDIOL	-7.265	5.5344E-01	-4.5299E-04	2.0616E-07	-3.8161E-11	298	1500
301	C4H10O2	2,3-BUTANEDIOL	-1.698	5.3981E-01	-3.9103E-04	1.2195E-07	-3.1009E-12	298	1200
302	C4H10O2	t-BUTYL HYDROPEROXIDE	2.100	5.5655E-01	-4.5845E-04	2.1168E-07	-4.2051E-11	298	1500
303	C4H10O2	1,2-DIMETHOXYETHANE	6.542	4.6066E-01	-2.6242E-04	6.5670E-08	-5.4689E-12	298	1500
304	C4H10O2	2-ETHOXYETHANOL	-0.213	4.8872E-01	-3.0001E-04	8.1972E-08	-7.4878E-12	298	1500
305	C4H10O3	DIETHYLENE GLYCOL	13.906	4.8367E-01	-2.7706E-04	6.2086E-08	-1.5319E-12	200	1500
306	C4H10O4S	DIETHYL SULFATE	-16.764	6.7731E-01	-6.1231E-04	2.9140E-07	-5.6686E-11	298	1500
307	C4H10S	n-BUTYL MERCAPTAN	46.393	2.2674E-01	1.2687E-04	-1.9438E-07	5.8247E-11	200	1500
308	C4H10S	ISOBUTYL MERCAPTAN	37.177	2.8839E-01	1.8512E-05	-1.3850E-07	4.8919E-11	200	1500
309	C4H10S	sec-BUTYL MERCAPTAN	41.398	2.6634E-01	5.7961E-05	-1.6133E-07	5.3327E-11	200	1500
310	C4H10S	tert-BUTYL MERCAPTAN	30.326	3.3585E-01	-5.0433E-05	-9.9820E-08	4.0942E-11	200	1500
311	C4H10S	DIETHYL SULFIDE	49.361	2.0829E-01	1.5828E-04	-2.2475E-07	6.8109E-11	200	1500
312	C4H10S2	DIETHYL DISULFIDE	50.958	3.3793E-01	-6.5255E-05	-8.3102E-08	3.5651E-11	200	1500
313	C4H11N	n-BUTYLAMINE	45.381	2.2649E-01	1.5750E-04	-2.4190E-07	7.5475E-11	200	1500
314	C4H11N	ISOBUTYLAMINE	-1.698	4.7082E-01	-2.7368E-04	7.1498E-08	-5.8916E-12	298	1500
315	C4H11N	sec-BUTYLAMINE	18.784	3.5654E-01	-4.1983E-05	-1.1648E-07	4.5681E-11	200	1500
316	C4H11N	tert-BUTYLAMINE	28.406	3.3042E-01	4.8961E-06	-1.5250E-07	5.6636E-11	200	1500
317	C4H11N	DIETHYLAMINE	40.851	2.3495E-01	1.6164E-04	-2.5266E-07	7.9398E-11	200	1500
318	C4H11NO	DIMETHYLETHANOLAMINE	-18.435	6.0239E-01	-4.4463E-04	1.6514E-07	-2.2558E-11	298	1200
319	C4H11NO2	DIETHANOLAMINE	-5.264	6.1929E-01	-4.9545E-04	2.1789E-07	-3.8987E-11	298	1500
320	C4H11NO2	2-AMINOETHOXYETHANOL	-5.199	6.2316E-01	-5.2386E-04	2.6796E-07	-6.4932E-11	298	1200
321	C4H12N2O	N-AMINOETHYL ETHANOLAMINE	-13.558	6.7312E-01	-5.4235E-04	2.4320E-07	-4.6505E-11	298	1500
322	C4H12Si	TETRAMETHYLSILANE	61.616	2.9614E-01	-1.0454E-05	-9.9222E-08	3.5679E-11	200	1500
323	C4H13N3	DIETHYLENE TRIAMINE	-8.147	6.7234E-01	-5.1124E-04	2.1737E-07	-4.0511E-11	298	1500

Appendix F

COMPOUND LIST BY FORMULA

Appendix G

COMPOUND LIST BY NAME

Appendix H

Computer Program for Thermodynamic Properties

A computer program for calculation of thermodynamic properties using the Peng-Robinson equation of state is available for a nominal fee (Carl L. Yaws, Box 10053, Lamar University, Beaumont, TX 77710, phone/FAX 409-880-8787). The computer program is executable and complete with data files. The program calculates thermodynamic properties at pressures and temperatures that are input by the user. Representative results are shown below:

COMPOUND: 38 CH_4 METHANE

reference state: datum of ideal gas @ 77 F (25 C)

P psia	T F	Z	V ft^3/lb	H BTU/lb	S BTU/lb F
500.0	-100.00	0.711	0.342	-129.42	-0.715
500.0	0.00	0.878	0.540	-63.12	-0.552
500.0	100.00	0.938	0.703	-3.09	-0.434
500.0	200.00	0.967	0.854	57.52	-0.334
500.0	300.00	0.983	1.000	120.68	-0.245
500.0	400.00	0.993	1.142	187.39	-0.163
500.0	500.00	0.998	1.282	258.21	-0.085
500.0	1000.00	1.008	1.968	680.95	0.267
3000.0	-100.00	0.588	0.047	-247.28	-1.144
3000.0	0.00	0.699	0.072	-151.24	-0.909
3000.0	100.00	0.837	0.105	-63.59	-0.736
3000.0	200.00	0.925	0.136	13.76	-0.608
3000.0	300.00	0.976	0.165	87.76	-0.504
3000.0	400.00	1.007	0.193	162.12	-0.412
3000.0	500.00	1.026	0.220	238.68	-0.328
3000.0	1000.00	1.053	0.343	677.10	0.037
10000.0	-100.00	1.537	0.037	-233.64	-1.252
10000.0	0.00	1.385	0.043	-159.84	-1.071
10000.0	100.00	1.317	0.049	-84.87	-0.924
10000.0	200.00	1.287	0.057	-9.10	-0.799
10000.0	300.00	1.272	0.065	67.70	-0.691
10000.0	400.00	1.262	0.073	146.20	-0.594
10000.0	500.00	1.254	0.081	227.12	-0.505
10000.0	1000.00	1.215	0.119	683.01	-0.125