Matheson GAS DATA BOOK

Seventh Edition

Carl L. Yaws

Chapter 59 DIMETHYL ETHER

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1	Name	DIMETHYL ETHER
2	Formula	C2H6O
3	CAS Number	115-10-6
4	Molecular Weight	46.069
5	Melting Point	131.66 K, -141.49 C, -222.68 F
6	Boiling Point @ 101.325 kPa (1 atm)	248.31 K, -24.84 C, -12.71 F
7	Critical Temperature	400.1 K, 126.95 C, 260.51 F
8	Critical Pressure	53.7 bar, 53 atm, 778.85 psia
9	Critical Volume	170 cm3/mol
10	Critical Density	0.271 g/cm3
11	Critical Compressibility Factor	0.274
12	Acentric Factor	0.204
13	Density of Liquid @ 25 C	0.655 g/cm3
14	Coefficient of Thermal Expansion of Liquid @ 25 C	0.0025 1/C
15	Surface Tension @ 25 C	11.36 dynes/cm
16	Density of Gas @ 1 atm and 70 F (21.1 C)	1.908 kg/m3, 0.1191 lb/ft3
17	Relative Density of Gas @ 1 atm and 70 F (Air = 1)	1.591
18	Enthalpy of Vaporization @ Boiling Point	467.99 kJ/kg, 201.24 BTU/lb
19	Enthalpy of Fusion @ Melting Point	107.17 kJ/kg, 46.08 BTU/lb
20	Heat Capacity of Gas @ 25 C, Constant Pressure (CP)	1.433 kJ/(kg K), 0.342 BTU/(lb R)
21	Heat Capacity of Gas @ 25 C, Constant Volume (CV)	1.253 kJ/(kg K), 0.299 BTU/(lb R)
22	Ratio of Heat Capacities for Gas, CP/CV	1.144
23	Heat Capacity of Liquid @ 25 C	2.634 kJ/(kg K), 0.63 BTU/(lb R)
24	Heat Capacity of Solid @ -183 C	1.169 kJ/(kg K), 0.279 BTU/(lb R)
25	Entropy of Gas @ 25 C	266.69 J/(mol K)
26	Entropy of Formation of Gas @ 25 C	-238.54 J/(mol K)
27	Enthalpy of Formation of Gas @ 25 C	-184.05 kJ/mol
28	Gibbs Energy of Formation of Gas @ 25 C	-112.93 kJ/mol
29	Solubility Parameter	17.572 (J/cm3)^0.5
30	Liquid Volume	63.147 cm3/mol
31	Solubility in Water @ 18 C	65180 parts per million (wt)
32	Octanol-Water Partition Coefficient, logKOW	0.1
33	Henry's Law Constant for Compound in Water @ 18 C	36.91 atm/mol fraction
34	Viscosity of Gas @ 25 C	91.6 micropoise
35	Viscosity of Liquid @ 25 C	0.149 centipoise
36	Thermal Conductivity of Gas @ 25 C	0.01344 watts/(m K)
37	Thermal Conductivity of Liquid @ 25 C	0.1453 watts/(m K)
38	Lower Explosion Limit in Air	3.4 vol %
39	Upper Explosion Limit in Air	18 vol %
40	Flash Point Temperature	-41.1 C, -42 F
41	Autoignition Temperature	350 C, 662 F
42	Enthalpy of Combustion @ 25 C (77 F), gas	28835 kJ/kg, 12399.1 BTU/lb
43	Threshold Limit Value (ACGIH)	--------
44	Permissible Exposure Limit (OSHA)	--------
45	Recommended Exposure Limit (NIOSH)	--------

MATHESON TRI·GAS

Description

Dimethyl ether is a flammable and colorless gas with a slight ethereal odor at room temperature and atmospheric pressure. Its boiling point is –24.84 ^{0}C.

Specifications and Equipment

Information on product specifications, gas handling equipment, and leak detection devices for this gas is available. Consult the website (www.mathesontrigas.com) for the most current and up-to-date information.

Uses

Dimethyl ether may be used as a refrigerant. Other uses include solvent, extraction agent, and propellant in aerosols. It is also useful as a fuel for welding, cutting, and brazing. It readily forms complexes with inorganic compounds. It is an excellent methylating agent.

Toxicity and First Aid

Information on toxicity and first aid is provided in the Material Safety Data Sheet (MSDS). Consult the internet (www.mathesontrigas.com) for current data.

Precautions in Handling and Storage

The general rules listed in Appendix 27 should be observed in handling and storage.

Disposal of Leaking Cylinders

The information provided in Appendix 28 should be consulted for disposal of leaking cylinders.

Analytical Detection

The concentration in air can be determined with the Matheson Kitagawa Toxic Gas Detector Model which gives accurate and reproducible results. A color stain is produced in the detector tube. The length of the color stain provides the concentration of the sample being measured. Consult the website (www.mathesontrigas.com) for the most current information.

Materials of Construction

Since dimethyl ether is not corrosive, any common or commercially available material may be used.

Cylinder and Valve Description

Cylinders of dimethyl ether are of the low-pressure type. The valve outlet is Compressed Gas Association (CGA) connection 510 (see Figure 59-1).

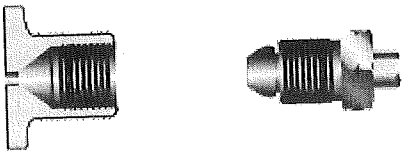

Figure 59-1 CONNECTION 510 0.885"-14 LH INT. accepting a Bullet Shaped Nipple

Pressure Relief Devices

The pressure relief device is a spring-loaded safety relief valve. If cylinder pressure becomes dangerously high, usually due to overheating, the safety relief device will open and release gas until the pressure returns to a safe level.

Shipping Regulations

Dimethyl ether is shipped under Department of Transportation (DOT) regulations as a flammable gas.

Commercial Preparation and Reactions

Information on commercial preparation and chemical reactions is available in ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY (17).

Chemical Properties

Dimethyl ether is not attacked by boiling alkalis. Halogenation gives a series of halogen substituted ethers. It is cleaved by hydriodic acid at 100 ^{0}C. At low temperatures, it forms a series of addition compounds with the halogens and halogen hydrides. It forms an addition compound with boron trifluoride. It reacts with oleum to give dimethyl sulfate. It can be oxidized catalytically to formaldehyde.

Dimethyl ether reacts with carbon monoxide to give acetic anhydride and methyl acetate. It reacts with acetic acid to give methyl acetate. It reacts with phthalic anhydride to give dimethyl phthalate. It methylates phenol to give anisole. It reacts with hydrogen cyanide to form acetonitrile.

Property Data

Physical, thermodynamic, safety, transport, environmental, and health related property data are presented in the tabulation at the beginning of the chapter. The results from data compilations by Yaws (1-7); DIPPR (Design Institute for Physical Property Research) project (8); and Braker and Mossman (9-10) were consulted extensively in

preparing the tabulation. Other data sources (14-31, 36-38, and 54-55) were also utilized as required.

The variation of selected properties with temperature is given in the graphs at the end of the chapter. The graphs cover important properties of vapor pressure, density of liquid, heat of vaporization, heat capacity, enthalpy, viscosity, thermal conductivity, enthalpy of formation, and Gibbs energy of formation. Both gas and liquid phases are covered in most cases. The temperature scale in all graphs is Fahrenheit. English units are primarily used for the property values. If metric units are desired, each graph contains an insert which provides the factor for converting between English and metric units. The properties presented in the graphs cover a wide temperature range to enable the engineer to quickly determine the values he needs at temperatures of interest.

References

References are given in the section near the end of the book.

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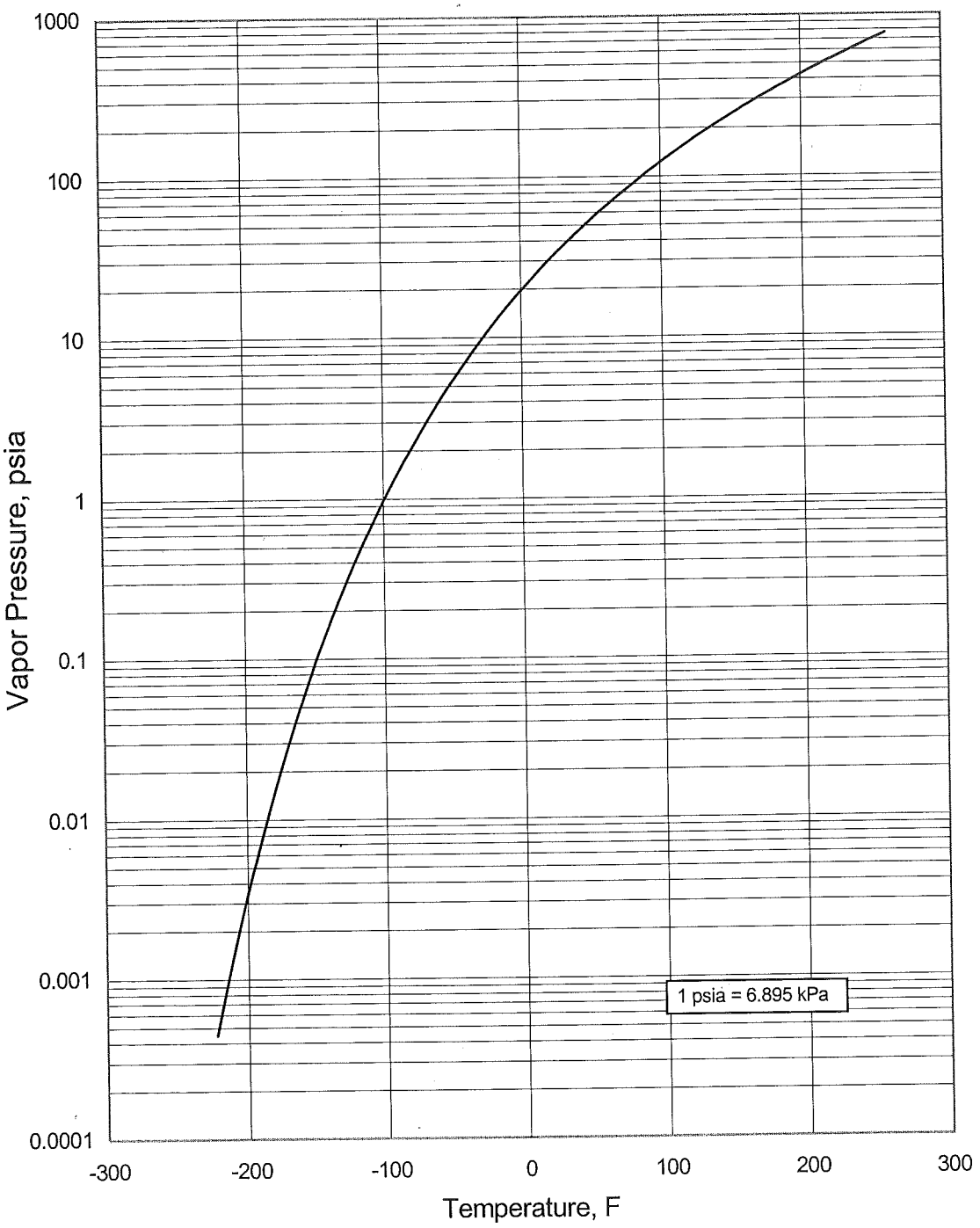
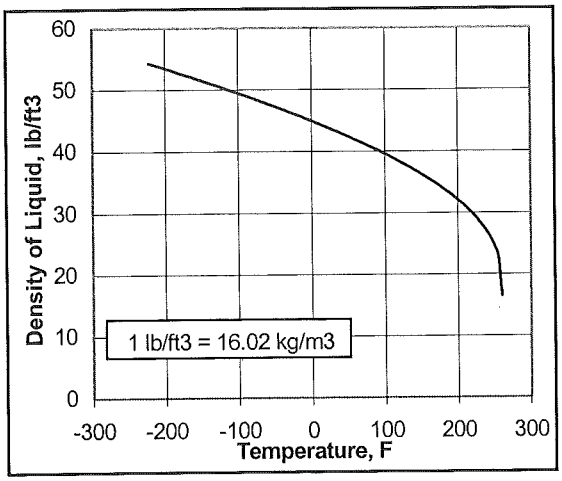
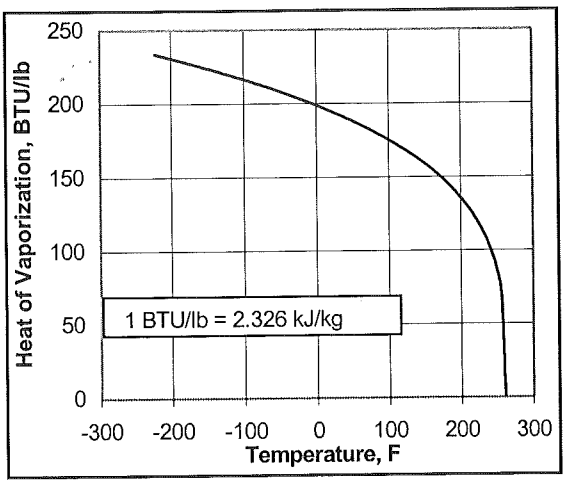
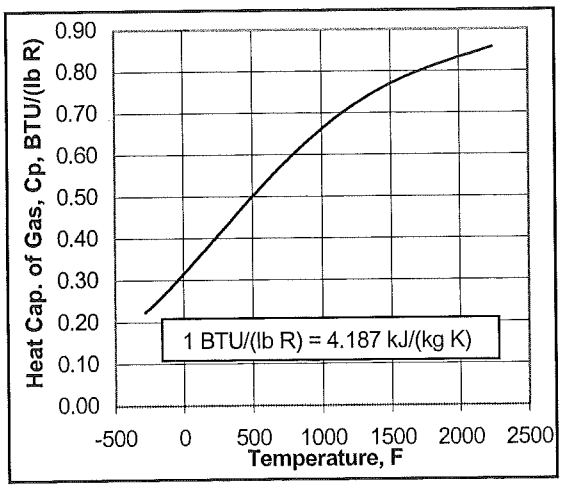
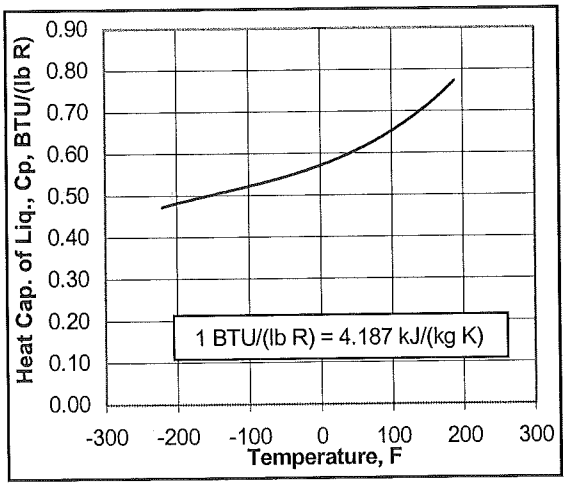
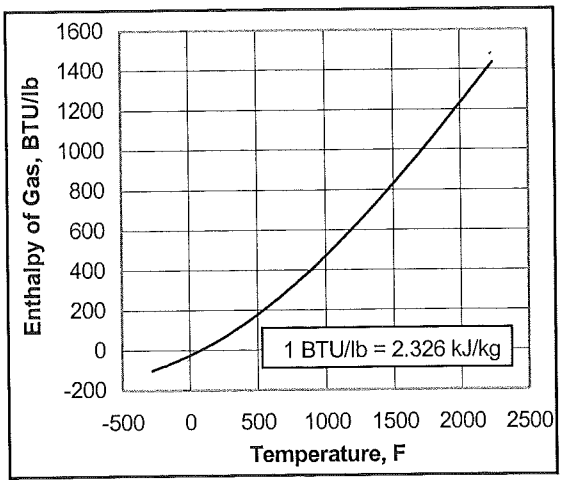

1000
100
10
1
0.1
0.01
0.001
0.0001
Vapor Pressure, psia
-300
-200
-100
0
100
200
300
Temperature, F
1 psia = 6.895 kPa

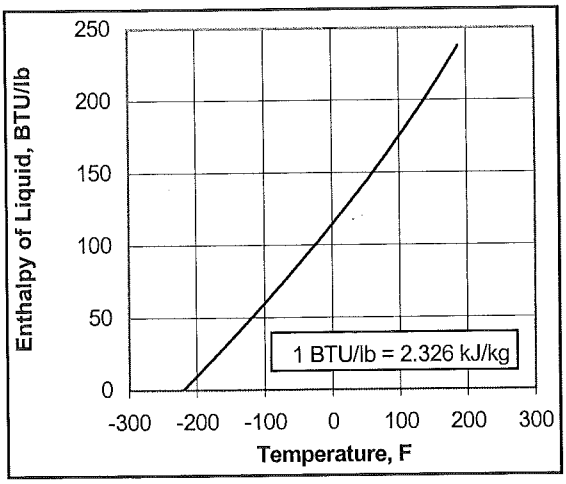












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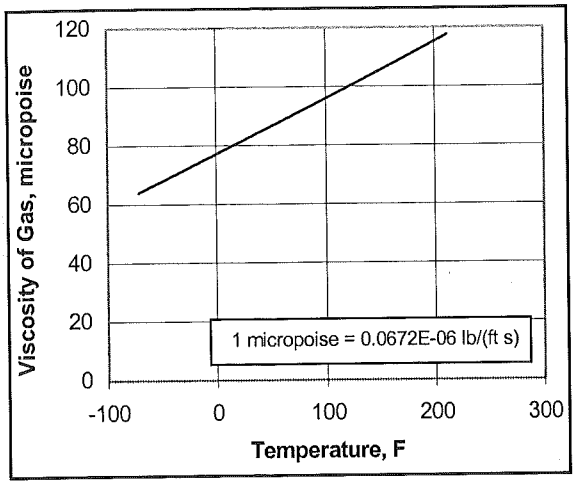
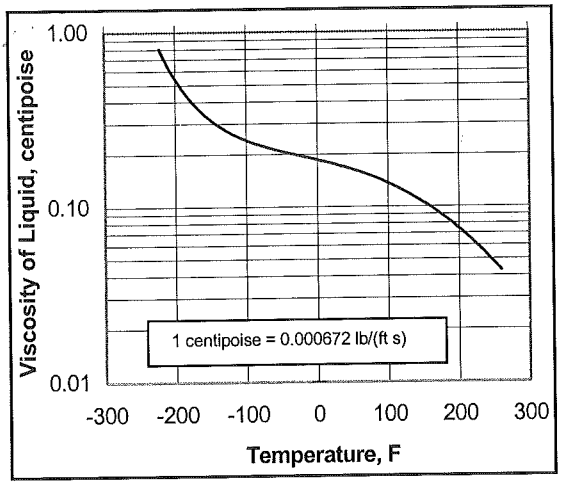
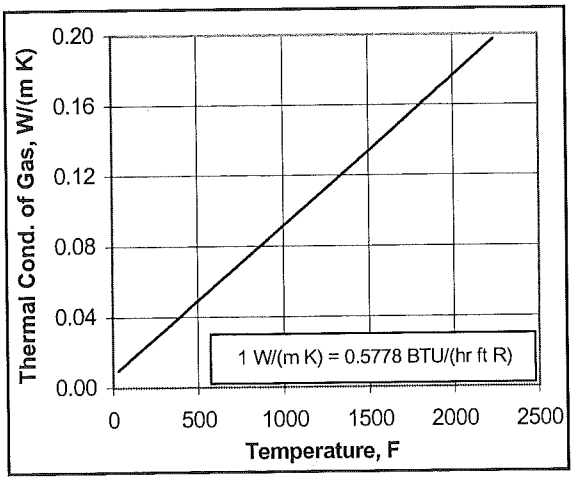
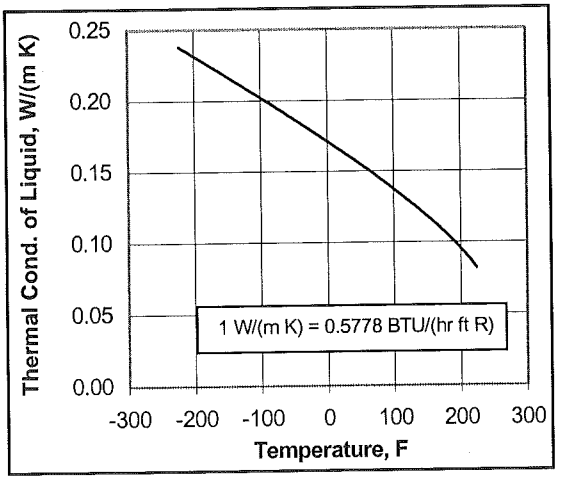
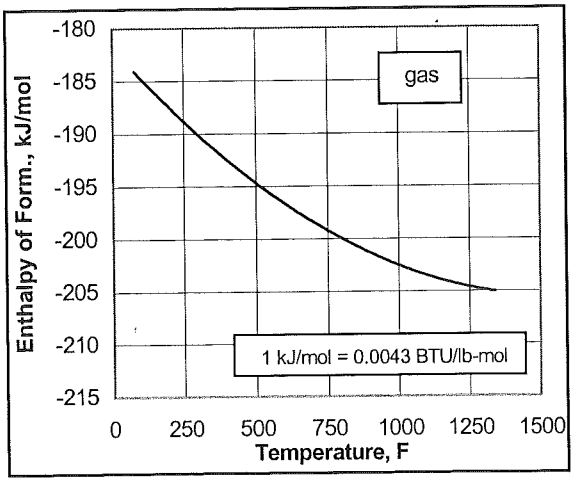
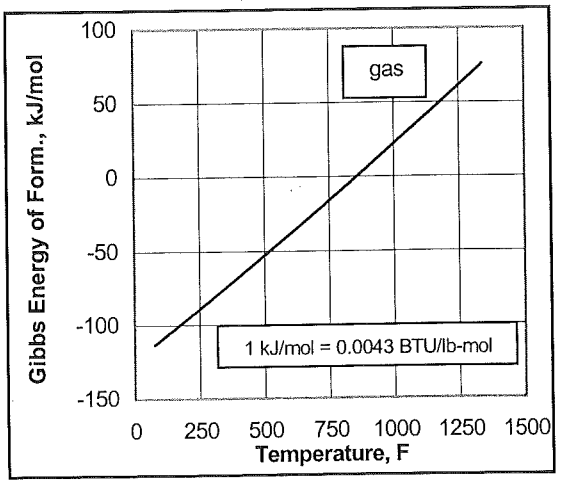

Viscosity of Gas, micropoise
120
100
80
60
40
20
0
-100
0
100
200
300
Temperature, F
1 micropoise = 0.0672E-06 lb/(ft s)


Viscosity of Liquid, centipoise
1.00
0.10
0.01
-300
-200
-100
0
100
200
300
Temperature, F
1 centipoise = 0.000672 lb/(ft s)


Thermal Cond. of Gas, W/(m K)
0.20
0.16
0.12
0.08
0.04
0.00
0
500
1000
1500
2000
2500
Temperature, F
1 W/(m K) = 0.5778 BTU/(hr ft R)


Thermal Cond. of Liquid, W/(m K)
0.25
0.20
0.15
0.10
0.05
0.00
-300
-200
-100
0
100
200
300
Temperature, F
1 W/(m K) = 0.5778 BTU/(hr ft R)


Enthalpy of Form., kJ/mol
-180
-185
-190
-195
-200
-205
-210
-215
0
250
500
750
1000
1250
1500
Temperature, F
gas
1 kJ/mol = 0.0043 BTU/lb-mol


Gibbs Energy of Form., kJ/mol
100
50
0
-50
-100
-150
0
250
500
750
1000
1250
1500
Temperature, F
gas
1 kJ/mol = 0.0043 BTU/lb-mol