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Thermophysical Properties of the Natural Environment, Gases, Liquids, and Solids

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Thermophysical Properties of the
Natural Environment, Gases, Liquids, and Solids

PREFACE

This document is one of 14 Aerospace Information Reports (AIR) of the Third Edition of the SAE Aerospace Applied Thermodynamics Manual. The Manual provides a reference source for thermodynamics, aerodynamics, fluid dynamics, heat transfer, and properties of materials for the aerospace industry. Procedures and equations commonly used for aerospace applications of these technologies are included.

In the Third Edition, no attempt has been made to update material from the Second Edition nor were SI units added. However, all identified errata were corrected and incorporated and original figure numbering was retained, insofar as possible.

The SAE AC-9B Subcommittee originally created the SAE Aerospace Applied Thermodynamics Manual and, for the Third Edition, used a new format consisting of AIR1168/1 through AIR1168/10. AIR1168/11 through AIR1168/14 were created by the SAE SC-9 Committee.

The AIRs comprising the Third Edition are shown below. Applicable sections of the Second Edition are shown parenthetically in the third column.

AIR1168/1	Thermodynamics of Incompressible and Compressible Fluid Flow	(1A,1B)
AIR1168/2	Heat and Mass Transfer and Air-Water Mixtures	(lC,1D,1E)
AIR1168/3	Aerothermodynamic Systems Engineering and Design	(3A,3B,3C,3D)
AIR1168/4	Ice, Rain, Fog, and Frost Protection	(3F)

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AIR1168/5	Aerothermodynamic Test Instrumentation and Measurement	(3G)
AIR1168/6	Characteristics of Equipment Components, Equipment Cooling System Design, and Temperature Control System Design	(3H,3J,3K)
AIR1168/7	Aerospace Pressurization System Design	(3E)
AIR1168/8	Aircraft Fuel Weight Penalty Due to Air Conditioning	(3I)
AIR1168/9	Thermophysical Properties of the Natural Environment, Gases, Liquids, and Solids	(2A,2B,2C,2D)
AIR1168/10	Thermophysical Characteristics of Working Fluids and Heat Transfer Fluids	(2E,2F)
AIR1168/11	Spacecraft Boost and Entry Heat Transfer	(4A,4B)
AIR1168/12	Spacecraft Thermal Balance	(4C)
AIR1168/13	Spacecraft Equipment Environmental Control	(4D)
AIR1168/14	Spacecraft Life Support Systems	(4E)

F.R. Weiner, formerly of Rockwell International and past chairman of the SAE AC-9B Subcommittee, is commended for his dedication and effort in preparing the errata lists that were used in creating the Third Edition.

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1. INTRODUCTION

1.1 Scope

This AIR is arranged in the following four sections:

2A - Properties of the Natural Environment
2B - Properties of Gases
2C - Properties of Liquids
2D - Properties of Solids

A summary of each section is given below.

Section 2A - This section includes currently applicable earth atmosphere standards (Refs. 101 and 103) and data on the near-Earth environment. Limited data on Mars and Venus reflected solar and planetary-emitted radiation and on micrometeorite data are also included. For space vehicle applications, environmental models are of two general types: orbital and reentry. For orbital models, variable properties such as time and solar flux are usually averaged. Reentry atmospheres are chiefly a function of location and altitude, and selection may be based on reentry location. Variation with latitude is an important local effect (Ref. 106).

The electromagnetic solar radiation data in this section are for altitudes above the Earth's atmosphere. The amount of radiation energy below 0.22μ (Fig. 2A-10) is small and has little effect on vehicle thermal balance. It is primarily of interest because of degradation effects on thermal control coatings. Planetary albedo (fraction of solar radiation which is reflected) varies strongly with the local solar angle of incidence, surface characteristics, and existence of planetary atmosphere (particularly the extent of cloud cover; see Ref. 121). The following ranges may be used as a guide:

(1) Earth, 0.33-0.39 (frequently considered as uniform diffuse radiation, average value in low orbits is 0.36).
(2) Venus, 0.55-0.90 (0.76 at 5500Å).
(3) Mars, 0.3 at 7000Å; 0.04 below 4500Å.

Planetary thermal emission is predominantly infrared. Emission from the atmosphere occurs only at wavelengths at which the atmosphere absorbs; for wavelengths where the atmospheric gas is transparent, the emission comes from the planetary surface. An average value of 15% of solar flux is frequently used for low Earth orbits. The opaque atmosphere of Venus prevents long wave surface radiation from emerging. Thermal emission in the 8-13μ range comes from the upper atmosphere, which has an emitting temperature of 230K. The mean Mars surface temperature range is 200-300K, and these values bracket the seasonal, diurnal, and latitudinal variations (Ref. 118).

Considerable uncertainty still exists on meteorite data (Refs. 111-113). Ref. 114 is a more recent attempt to provide an interim standard. Data on space environments can be used only as a guide, since they are subject to rapid obsolescence as additional information from interplanetary probe experiments becomes available.

Sections 2B, 2C, and 2D - The data in these sections are presented primarily in graphical form. The data were compiled by Professor Harold Sogin, circa 1966, and represent a selection of the then best currently available sources. The following properties are listed as applicable to the materials listed alphabetically in the index, Par. 7. Consult specific material for desired properties. Materials are indexed by figure number and table number.

Section 2E - Thermodynamic Characteristics of Working Fluids and Section 2F - Properties of Heat Transfer Fluids are in AIR 1168/10.

Gases	Liquids (and Solutions)	Solids (and Alloys, Plastics, Insulation)
Critical pressure	Atomic/molecular weight	Absorptivity (solar)
Critical temperature	Boiling point	Atomic/molecular weight
Density (standard)	Chemical formula	Chemical formula
Gas constant	Critical pressure	Density
Prandtl number	Critical temperature	Distortion point (heat of)
Ratio of specific heats	Coefficient of cubical expansion	Emissivity
Specific heat	Density	Flow point
Thermal conductivity	Heat of fusion	Freezing point
Viscosity	Latent heat of vaporization	Heat of fusion
	Melting point	Linear expansion, coefficient of
	Specific heat	Melting point
	Thermal conductivity	Softening point
	Triple point	Sublimation point
	Vapor pressure	Specific heat
	Viscosity	Symbol
		Thermal Conductivity
		Viscosity

1.2 Nomenclature

Å = Wavelength, Angstroms ($1Å=10^{-4}\mu=10^{-10}m$)
a = Velocity of sound, ft/sec, mph, knots, m/sec
c_p or C_p = Specific heat capacity, constant pressure, Btu/lb -°F
F = Shower flux/sporadic flux, dimensionless
gρ or ρg = Specific weight (density), lb/ft^3, gm/cm^3
H = Enthalpy, Btu
H = Geopotential altitude, ft
H_p = Pressure scale height, km
H_x = Spectral irradiance, W/cm^2-Å
H_λ = Mean zero air mass spectral irradiance, W/cm^2-μ, W/m^2-Å
K = Factor N_{Re}/LV, 1/ft-fps, 1/ft-kn, 1/ft-Mach
k = Thermal conductivity, kcal/m-sec-°C, Btu/hr-ft-°F, cal/m-sec-K
L = Distance, ft
L = Mean free path, km
M = Molecular weight, kg/kg-mol
N_{Pr} = Prandtl number ($\mu g c_p/k$), dimensionless
n = Number density, m^3
P = Pressure, mm Hg, lb/ft^2, mb, psia
P_{cr} = Critical Pressure, psia
P_{std} = Standard Pressure, psia
P_λ = % solar constant associated with wavelength less than given value
q = Dynamic pressure ($\rho V^2/2$), lb/ft^2, in. Hg
q = Rate of heat transfer, Btu/min, Btu/hr
R = Universal gas constant, ft-lb/lb-°R
s = Specific entropy. Btu/lb-°F
t = Temperature, °F
t_{cr} = Critical temperature, °F

t_{std} = Standard Temperature, °F
T = Temperature, absolute, °R
v = Mol volume, m^3
V = Velocity, ft/sec, ft/min, km/sec
$\overline{V}$ = Mean particle speed, m/sec
Z = Geometric altitude, ft, km
β = Coefficient of linear or volumetric expansion, 1/°F
γ = Specific heat ratio (c_p/c_v), dimensionless
δ = Pressure ratio P/P_o, dimensionless
λ = Wavelength, Å, μ
λ = Latent heat of vaporization, Btu/lb
μ = Absolute viscosity, lb-sec/ft^2
μ = Coefficient of viscosity, kg/m-sec, slug/ft-sec (Table 2A-1)
η = Kinematic viscosity, m^2/sec, ft^2/sec, centistokes
θ = Temperature ratio, ratio of an absolute temperature to the standard absolute temperature for atmospheric air at sea level, T/518.67, dimensionless
σ = Relative density, ρ/ρ_o, dimensionless
ρ = Mass density, kg/m^3, gm/cm^3, slug/ft^3, lb-sec^2/ft^4 (see Note 1)
ρg = Specific weight (density), lb/ft^3, gm/cm^3
ν = Collision frequency, sec
ν = Kinematic viscosity, ft^2/sec
ω = Specific weight, kg/m^2-sec^2 (see Note 2)

Notes: (1) The units used in the 1962 Standard Atmosphere (Table 2A-1) differ from this AIR, which uses ρ in lb-sec^2/ft^4.
(2) This AIR also uses specific weight as $g\rho$ in lb/ft^3.
(3) Section 2A - Properties of the Natural Environment – Properties of the U.S. Standard Atmosphere, 1962 are given in Figs. 2A-1 to 2A-7. Particular reference is given to Fig. 2A-7(d), as follows: The meaning of geometric altitude Z and of geopotential altitude H can be seen by reference to Fig. 2A-7(d). If an elementary plumb line is used to explore gravity and if this plumb line is rotating with the Earth, then starting at point O and proceeding outward, the little plumb line will mark out line segments that progress along the curved path OP. Under the influence of gravitational and centrifugal forces, this line OP will bend poleward as it rises, except along the axis of rotation of the Earth and along an equatorial radius extended.

In Fig. 2A-7(d), the arc length, ds, measured along the line of gravity force from P to P' is identical with the increment, dZ, in geometric altitude. That is, the geometric altitude, Z, is the physical distance along the line OP.

Since $dH = (g/g_o)dZ$, the geopotential altitude is measured also along the line OP, but differs in numerical value because of the variation of the acceleration due to gravity. It is to be noted that the scale in Fig. 2A-7(d) is exaggerated in order to show the nature of the curvature of the middle latitude plumb line (line of force) and to show clearly the relationships among tangent line, radius line, and projections.

1.3 Common Abbreviations

Å	— Angstrom
abs. (ABS.)	— Absolute
AECO	— Atomic Energy Commission Report Series
AF	— Air Force
AFCRC	— Air Force Cambridge Research Center
AIR	— Aerospace Information Report (SAE)
Al	— Aluminum
Am.	— American
APEX	— Report series issued by the Atomic Energy Commission
Approx.	— Approximate
APR.	— April
ARDC	— Air Research and Development Command
ARP	— Aerospace Recommended Practice (SAE)
ARTC	— Aerospace Research & Testing Committee of the Aerospace Industries Association of America
ASM	— American Society for Metals
ASME	— American Society of Mechanical Engineers
ASTM	— American Society for Testing and Materials
ATM	— Atmosphere(s)
bp	— Boiling point
Btu (BTU)	— British Thermal Units
Bull.	— Bulletin
C	— Carbon
°C	— Degrees Centigrade
Ca	— Calcium
Calif.	— California
Chem.	— Chemical
cm (CM)	— Centimeters
Co.	— Company
Coef.	— Coefficient
Colo.	— Colorado
cp	— Critical point
Corp.	— Corporation
Cu	— Copper
D.C.	— District of Columbia (U.S.A.)
DEC.	— December
deg	— Degrees
Del.	— Delaware
Dept.	— Department
Div.	— Division
DOC.	— Document
ed.	— Edition
(ed.) (eds.)	— Editor(s)
Eq. (Eqs.)	— Equation(s)
et al.	— And others
°F	— Degrees Fahrenheit
Fe	— Iron

Fig. (Figs.)	— Figure(s)
ft (FT)	— Feet
gm (GM)	— grams
GMT	— Greenwich Mean Time
H	— Hydrogen
He	— Helium
Hg (HG)	— Mercury
hr (HR)	— Hour(s)
IES	— Institute of Environmental Sciences
in.	— Inch(es)
in. Hg	— Inches of Mercury
Inc.	— Incorporated
J	— Journal
Jan.	— January
JETP	— Journal of Experimental and Theoretical Physics
Jr.	— Junior
Jul.	— July
K	— Kelvins (formerly degrees Kelvin)
kcal (KCAL)	— Kilocalories
KFT	— Thousands of Feet
kg (KG)	— Kilograms
km (KM)	— Kilometers
kn	— Knots
lb (LB)	— Pounds
m (M)	— Meters
Mar. (MAR.)	— March
Mass.	— Massachusetts (U.S.A.)
max. (MAX.)	— Maximum
mb (MB)	— Millibars
MET.	— Meteorological
Mg	— Magnesium
MICH.	— Michigan (U.S.A.)
min. (MIN.)	— Minimum
min	— Minutes
MIT	— Massachusetts Institute of Technology
mm	— Millimeters
mm Hg (MM HG)	— Millimeters of Mercury
Mn	— Manganese
mol (MOL)	— Mole
mp	— Melting point
MSC	— Marshall Spacecraft Center
N	— North
NACA	— National Advisory Committee for Aeronautics
NASA	— National Aeronautics and Space Administration
NATO	— North Atlantic Treaty Organization
NBS	— National Bureau of Standards
nbp	— Normal boiling point
Ne	— Neon

Ni	— Nickel
nmp	— Normal melting point
No.	— Number
NRL	— Naval Research Laboratory
N.Y.	— New York (U.S.A.)
O	— Oxygen
p. (pp.)	— Page(s)
Pa.	— Pennsylvania (U.S.A.)
Par. (Pars.)	— Paragraph(s)
Pb	— Lead
Phys.	— Physical
Press.	— Pressure
Proc.	— Proceedings
psi (PSI)	— Pounds per square inch
psia (PSIA)	— Pounds per square inch absolute
psig (PSIG)	— Pounds per square inch gage
Ref. (Refs.)	— Reference(s)
°R	— Degrees Rankine
SAE	— Society of Automotive Engineers, Inc.
SCEL	— Signal Corps Engineering Laboratory
sec (SEC)	— Seconds
Sept.	— September
SI	— International System of Units (Modern Metric System)
Si	— Silicon
Soc.	— Society
STD.	— Standard
TB	— Technical Bulletin
Tech.	— Technical
Temp.	— Temperature
Torr	— A unit of pressure defined approximately as 1 Torr = 1 mm Hg abs.
UCLA	— University of California at Los Angeles (U.S.A.)
U.S.	— United States
U.S.A.	— United States of America
USAF	— United States Air Force
USSR	— Union of Soviet Socialist Republics
Vol.	— Volume
W	— Watts
WADC	— Wright Air Development Center
WSPG	— White Sands Proving Ground
wt.	— Weight
Zn	— Zinc
μ	— Microns ($1\mu = 10^{-6}$m)
&	— And
%	— Percent
2nd	— Second

SECTION 2A - PROPERTIES OF THE NATURAL ENVIRONMENT

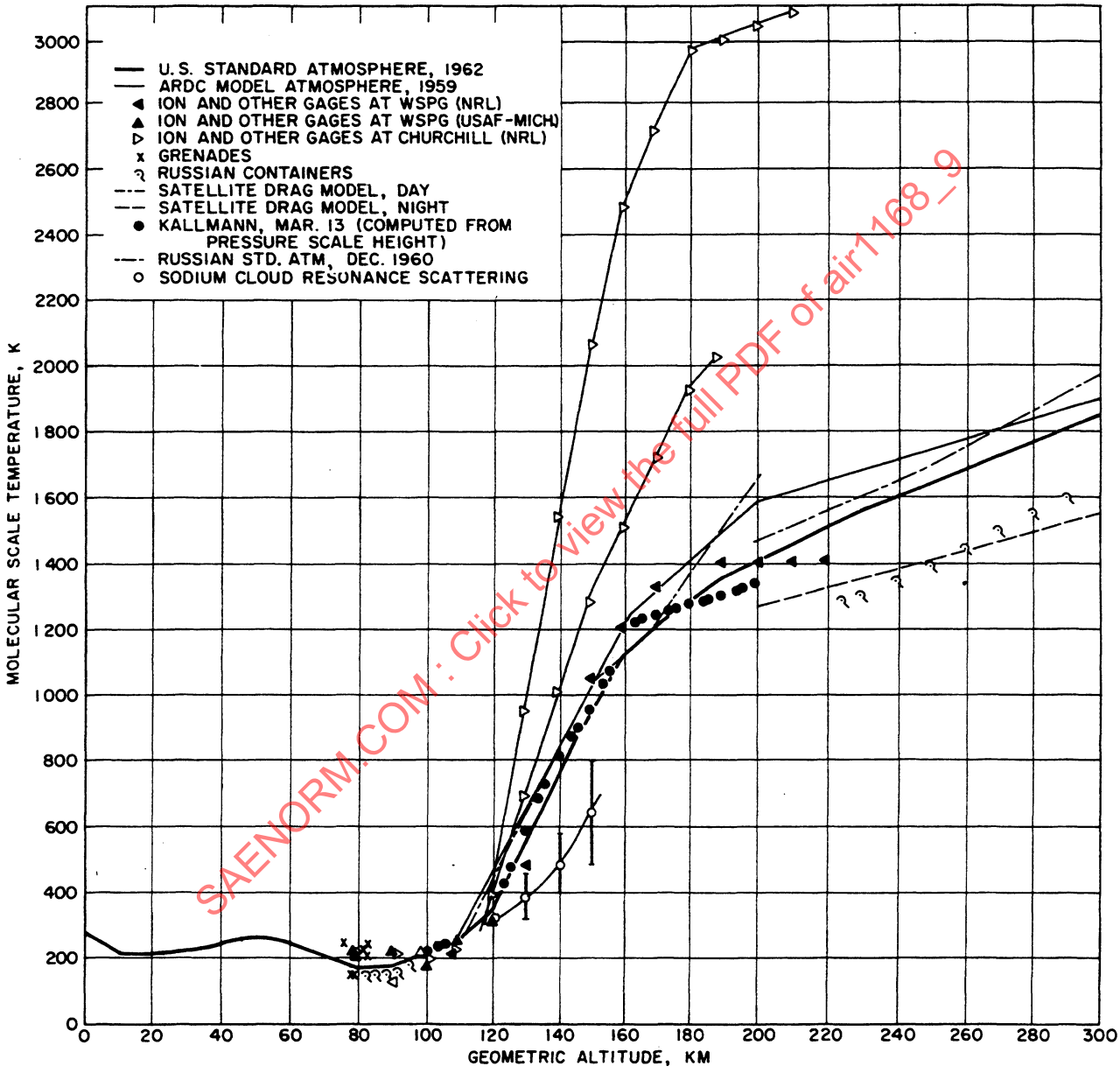


Figure 2A-1 - Molecular Scale Temperatures of U.S. Standard Atmosphere, 1962, Compared with ARDC Model Atmosphere, 1959, and with Available Data. (Ref. 101)

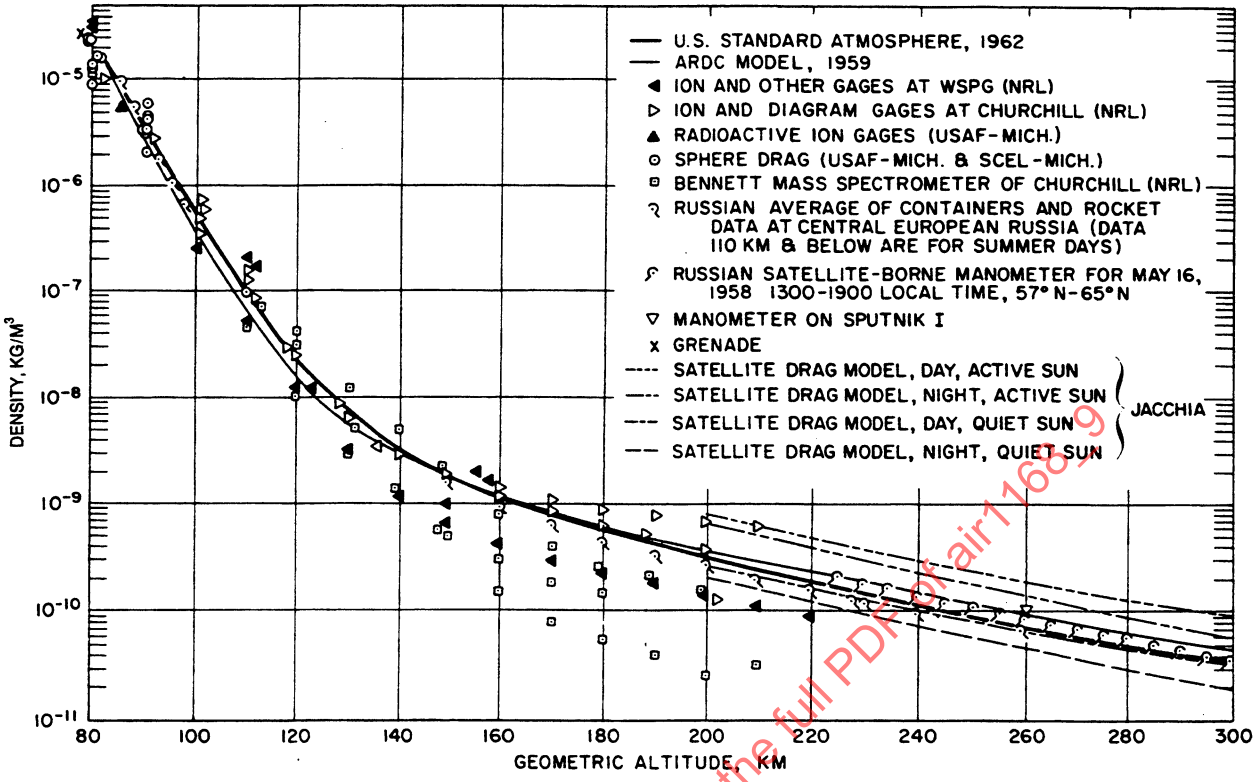


Figure 2A-2(a) - Density of U.S. Standard Atmosphere, 1962, Compared with ARDC Model Atmosphere, 1959, and with Available Data. (Ref. 101)

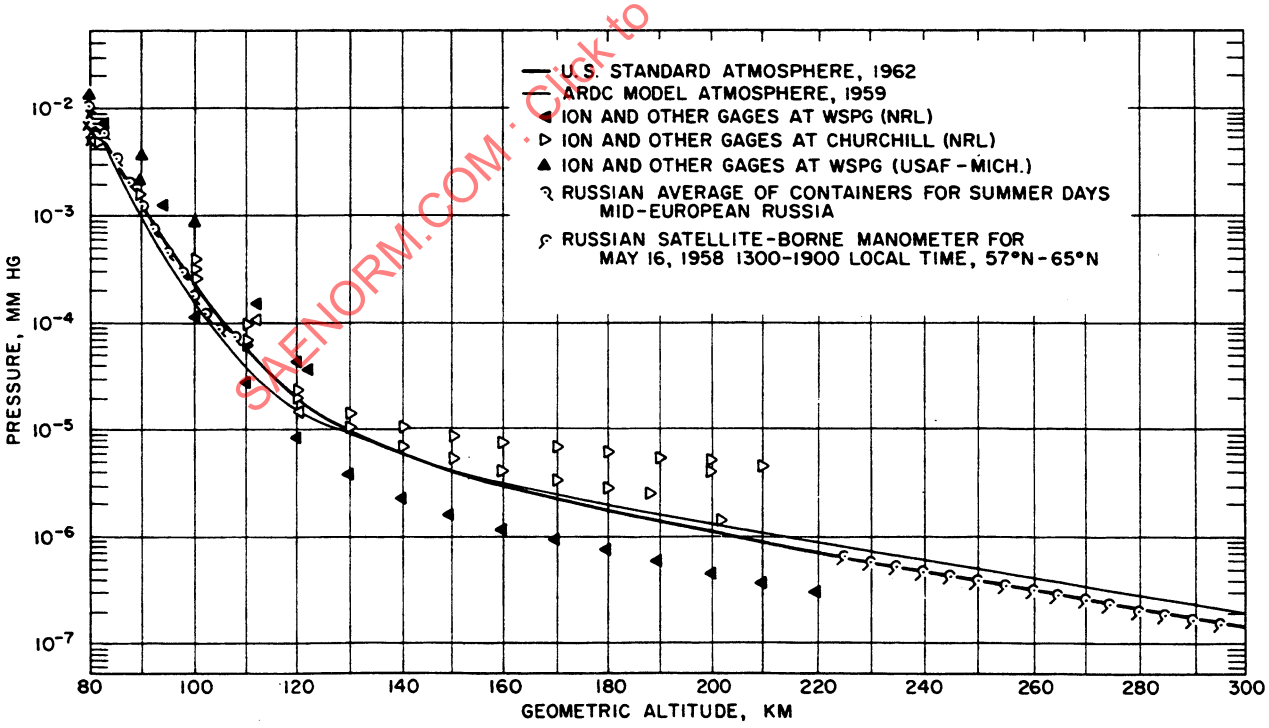


Figure 2A-2(b) - Pressures of U.S. Standard Atmosphere, 1962, Compared with ARDC Model Atmosphere, 1959, and with Available Data. (Ref. 101)

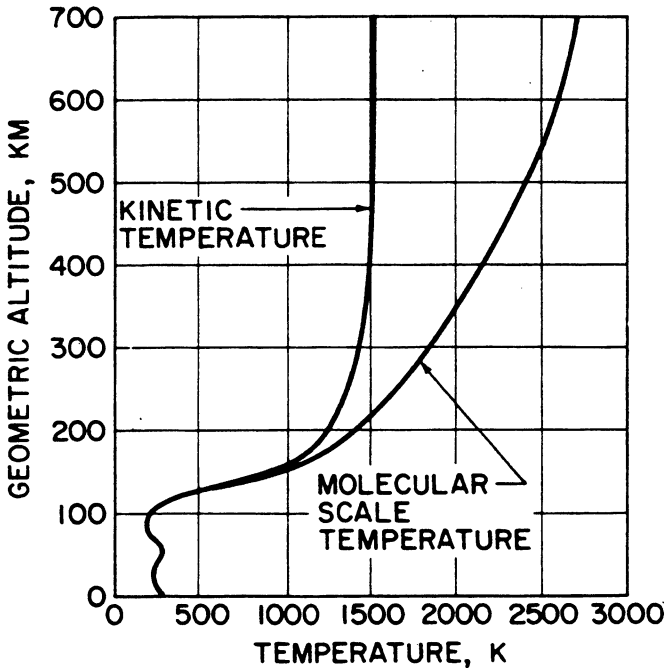


Figure 2A-3(a) - Molecular Scale Temperature and Kinetic Temperature as Functions of Geometric Altitude. (Ref. 101)

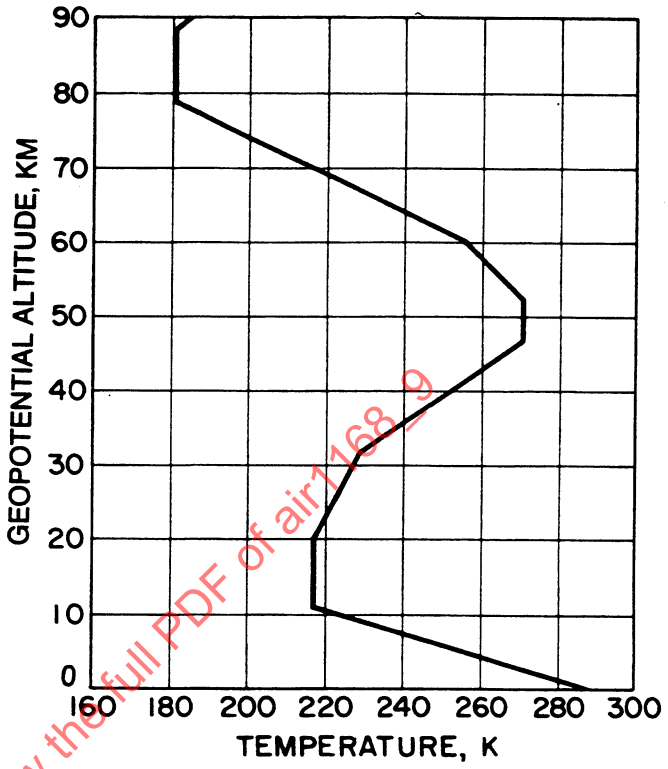


Figure 2A-3(b) - Temperature as a Function of Geopotential Altitude. (Ref. 101)

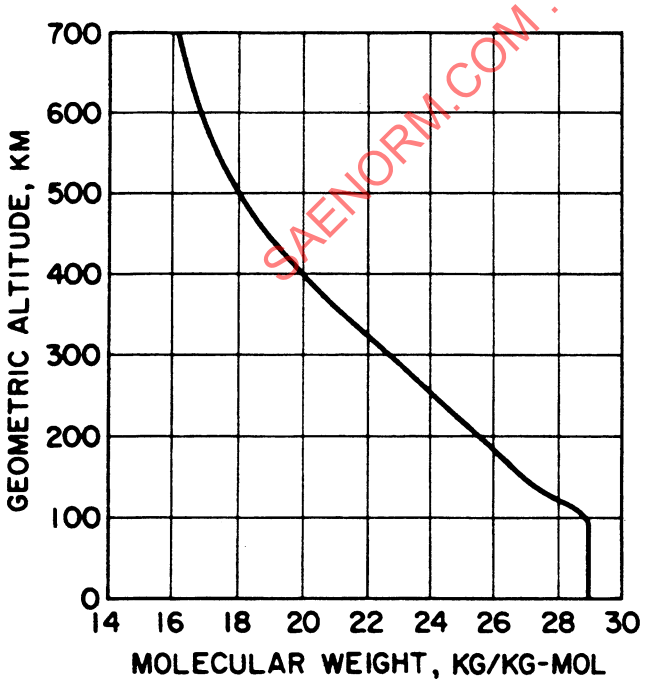


Figure 2A-3(c) - Molecular Weight as a Function of Geometric Altitude. (Ref. 101)

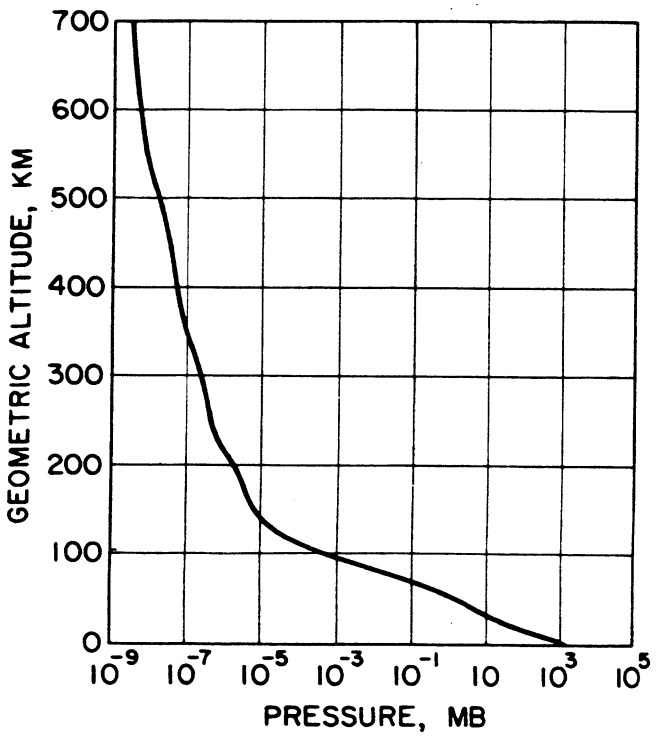


Figure 2A-3(d) - Pressure as a Function of Geometric Altitude. (Ref. 101)

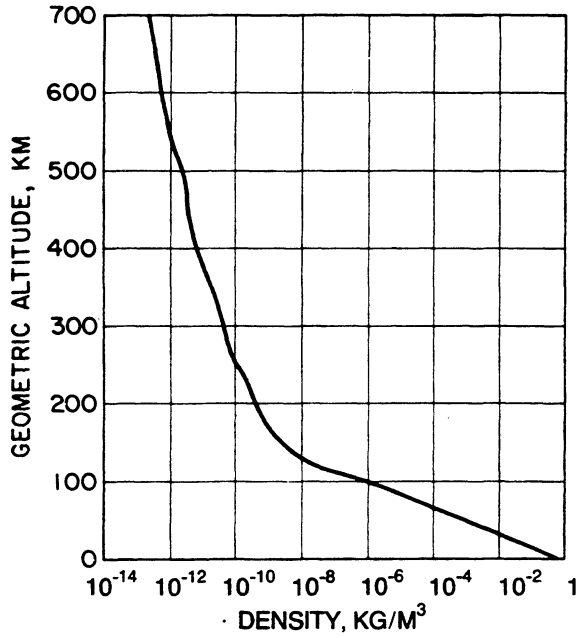


Figure 2A-4(a) - Density as a Function of Geometric Altitude. (Note: As used in the 1962 Standard Atmosphere these units differ from this AIR, which uses ρ in lb-sec^2/ft^4); (Ref. 101)

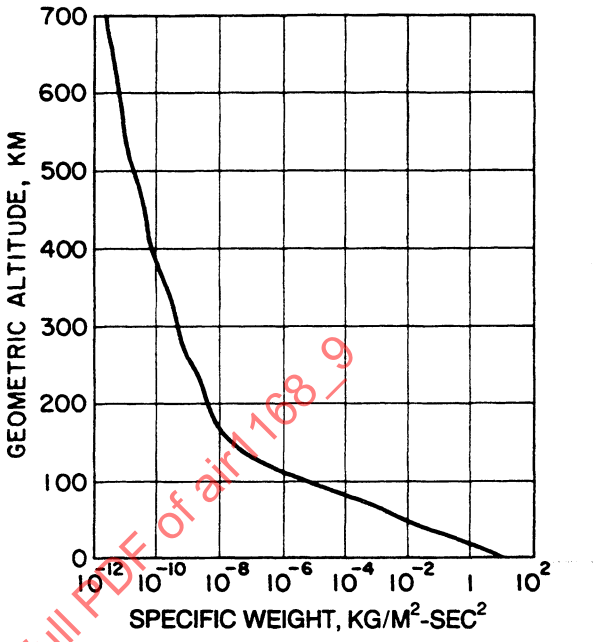


Figure 2A-4(b) - Specific Weight as a Function of Geometric Altitude. (Note: As used in the 1962 Standard Atmosphere these units differ from this AIR, which uses $g\rho$ in lb/ft^3); (Ref. 101)

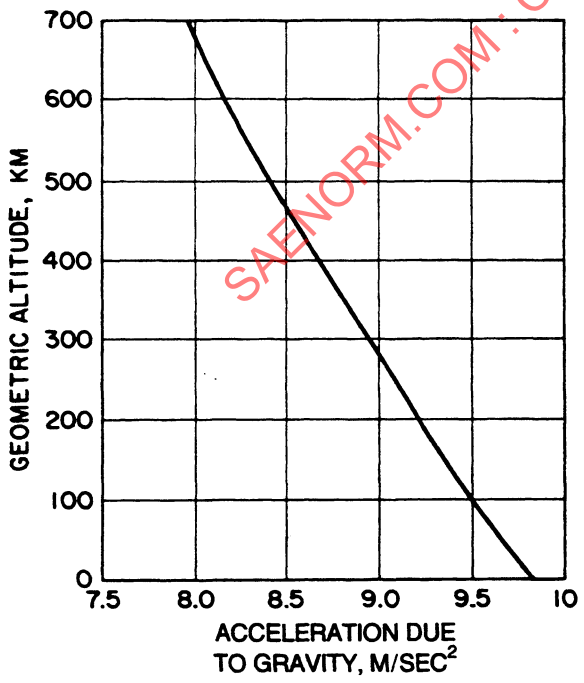


Figure 2A-4(c) - Acceleration Due to Gravity as a Function of Geometric Altitude. (Ref. 101)

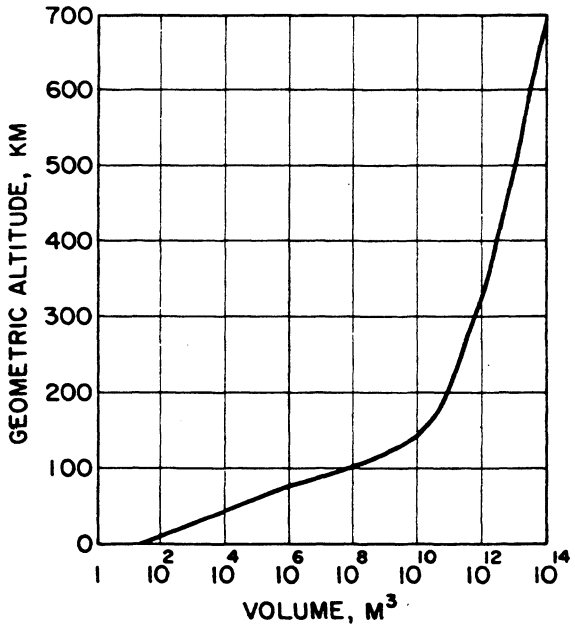


Figure 2A-4(d) - Mol Volume as a Function of Geometric Altitude. (Ref. 101)

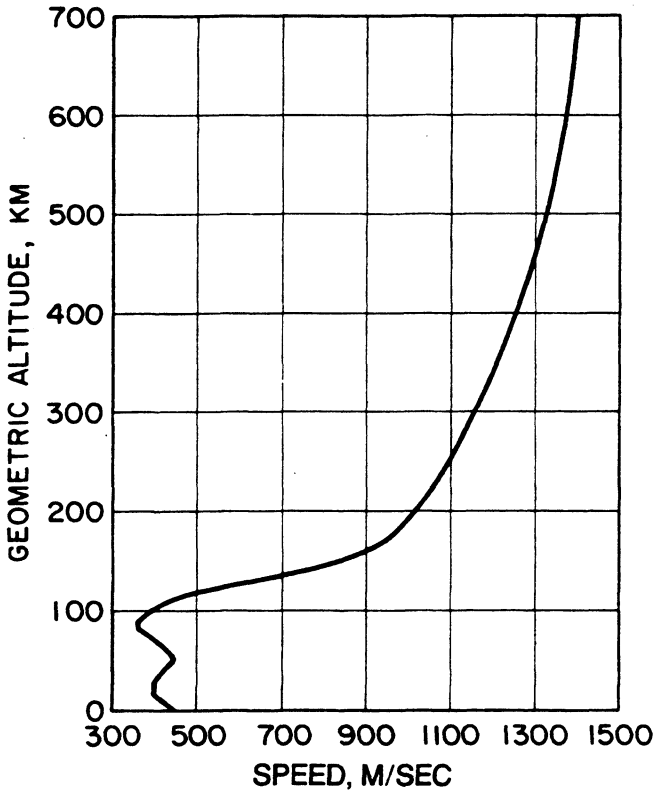


Figure 2A-5(a) - Mean Particle Speed as a Function of Geometric Altitude. (Ref. 101)

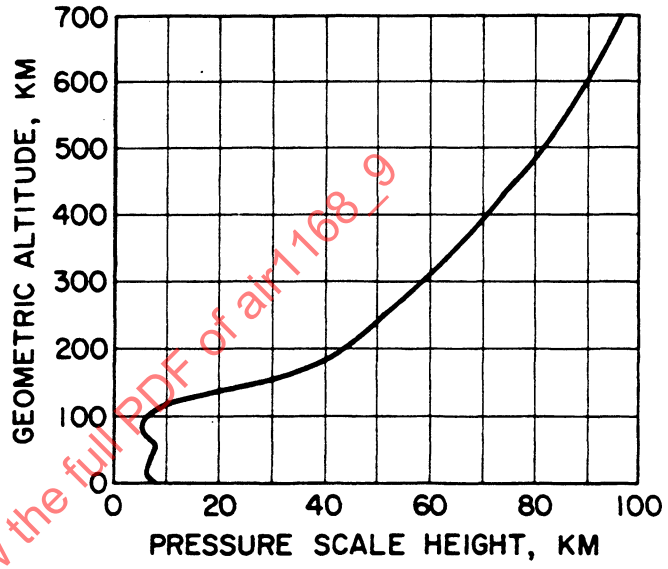


Figure 2A-5(b) - Pressure Scale Height as a Function of Geometric Altitude. (Ref. 101)

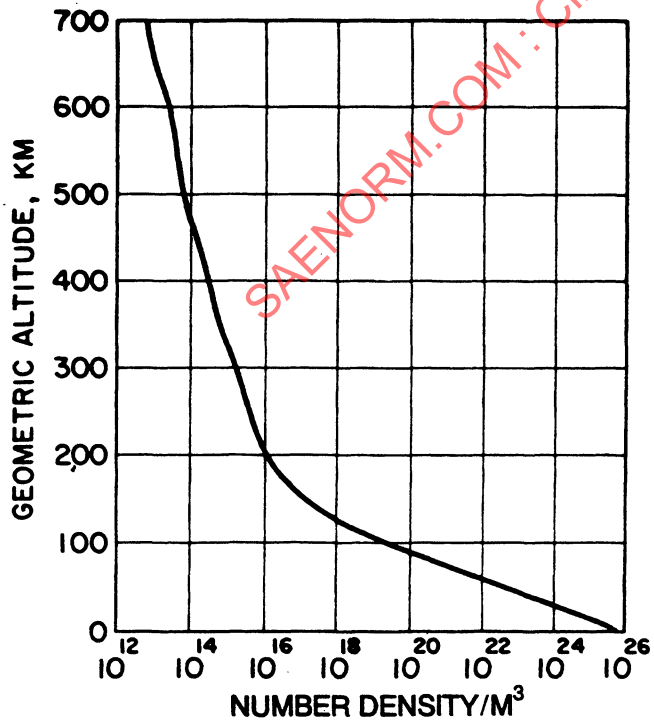


Figure 2A-5(c) - Number Density as a Function of Geometric Altitude. (Ref. 101)

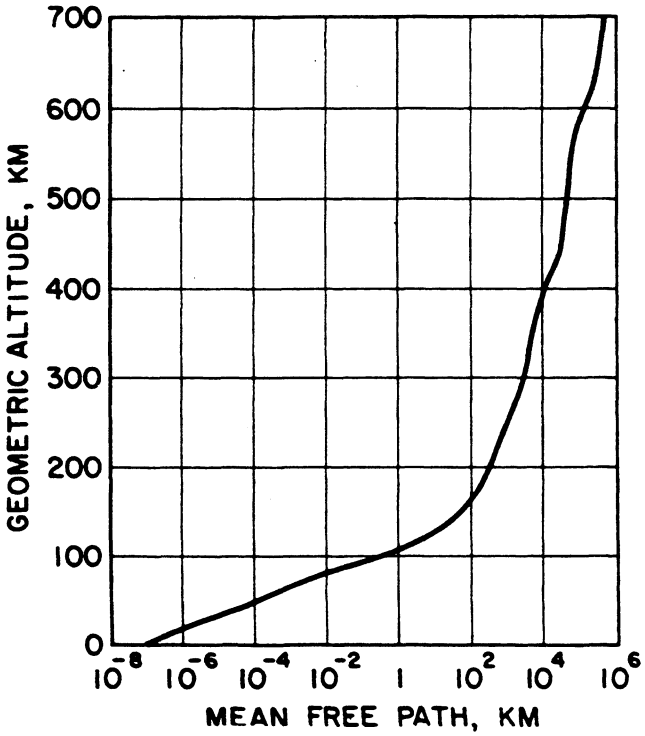


Figure 2A-5(d) - Mean Free Path as a Function of Geometric Altitude. (Ref. 101)

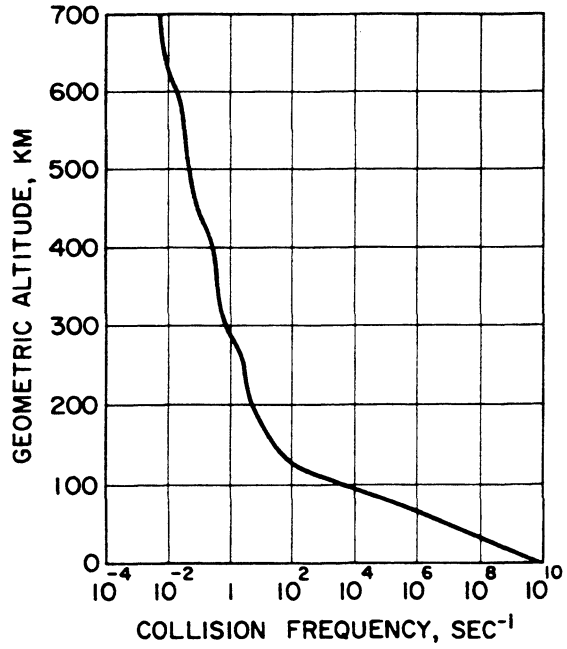


Figure 2A-6(a) - Collision Frequency as a Function of Geometric Altitude. (Ref. 101)

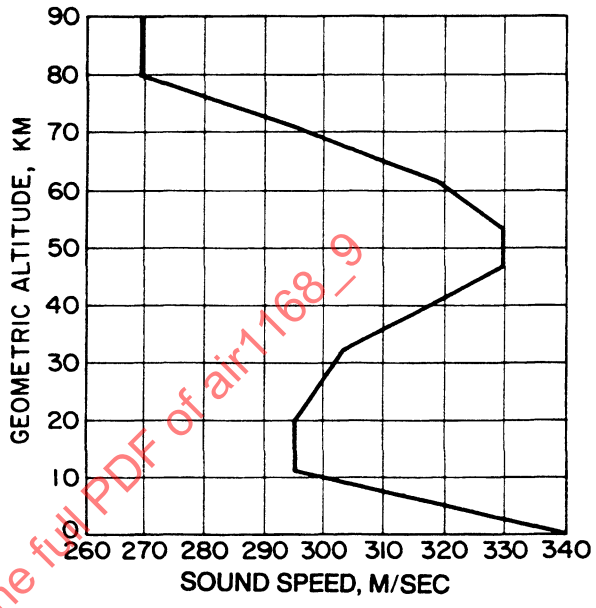


Figure 2A-6(b) - Sound Speed as a Function of Geometric Altitude. (Ref. 101)

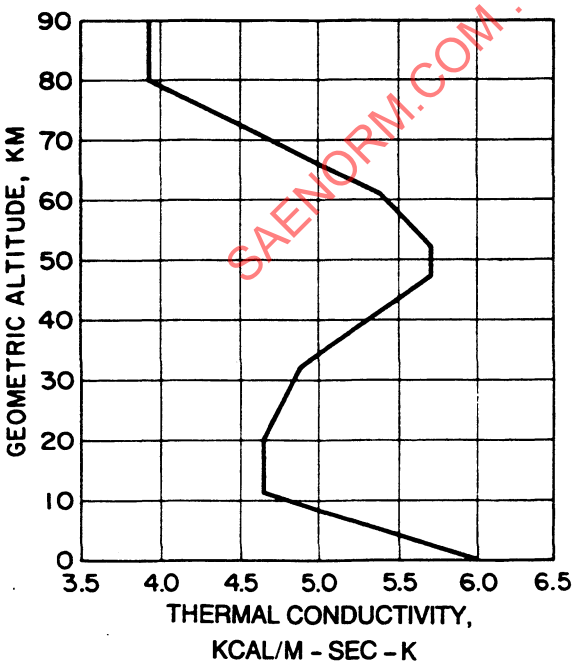


Figure 2A-6(c) - Coefficient of Thermal Conductivity as a Function of Geometric Altitude. (Ref. 101)

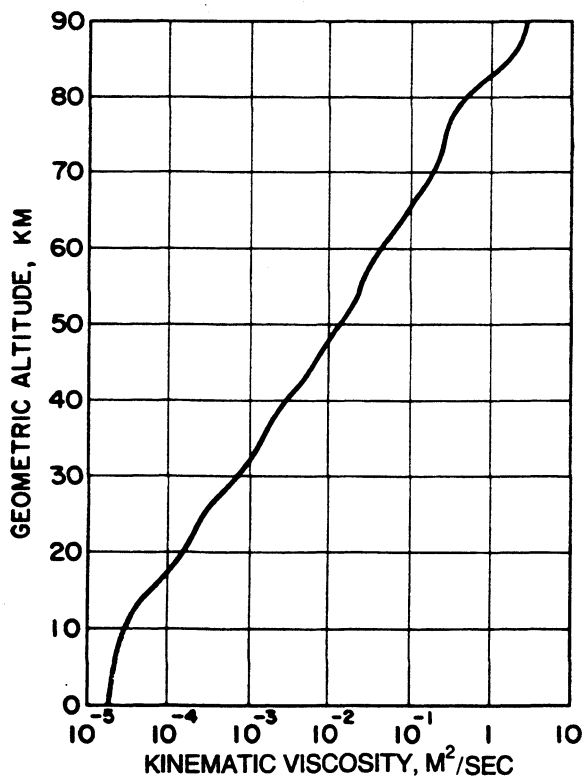


Figure 2A-6(d) - Kinematic Viscosity as a Function of Geometric Altitude. (Ref. 101)

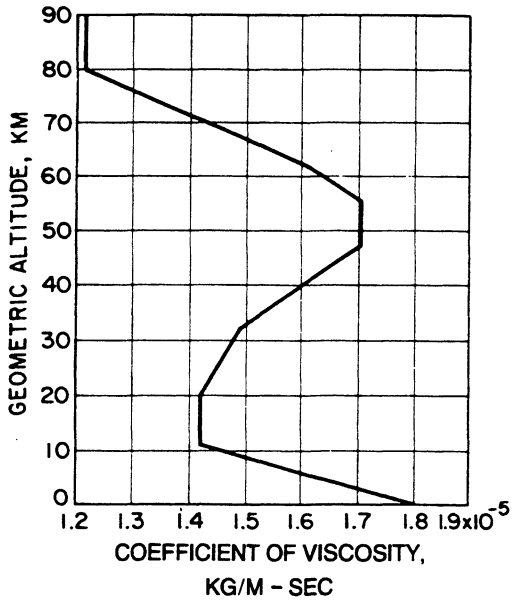


Figure 2A-7(a) - Coefficient of Viscosity as a Function of Geometric Altitude. (Ref. 101)

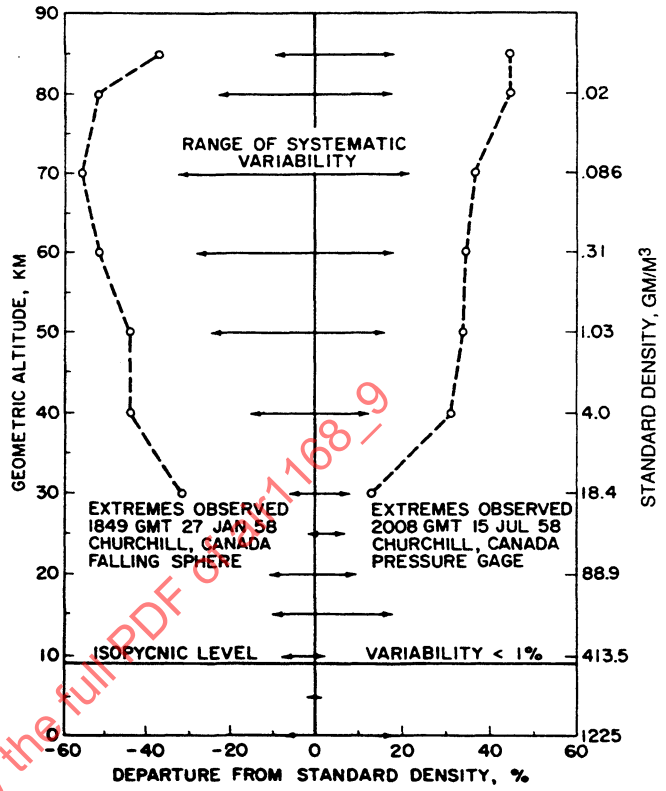


Figure 2A-7(b) - Range of Systematic Variability of Density About the U.S. Standard Atmosphere, 1962. (Ref. 101)

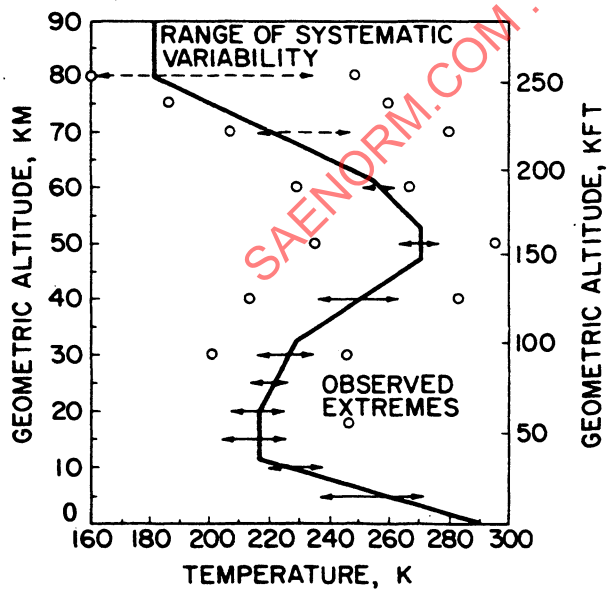


Figure 2A-7(c) - Range of Systematic Variability of Temperature About the U.S. Standard Atmosphere, 1962. (Ref. 101)

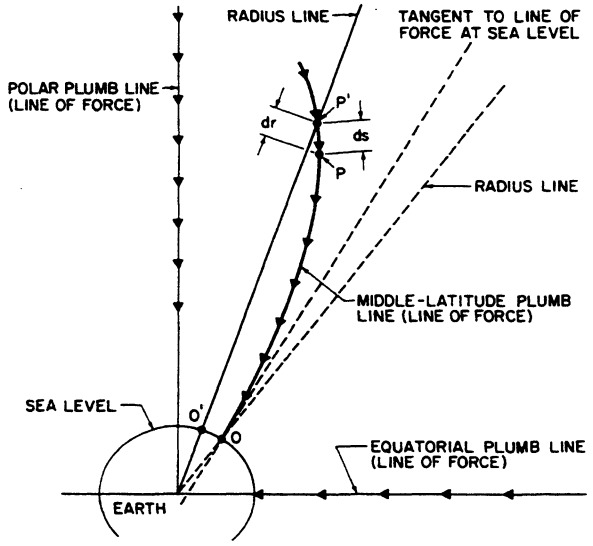


Figure 2A-7(d) - Relationships Between Various Heights.

Table 2A-1 U.S. Standard Atmosphere, 1962

Altitude Z ft	Altitude H ft	Pressure P lb/ft²	Pressure q/M² (= 0.7P) lb/ft²	Density ρ slug/ft³	Density σ	Density √σ	Temperature T °R	Temperature t °F	Temperature θ = T/518.67	Temperature t °C	Viscosity μ slug/ft-sec	Viscosity ν ft²/sec	N_{Re} "K" Factor K_{fps} 1/ft-fps	N_{Re} "K" Factor K_{kn} 1/ft-kn	N_{Re} "K" Factor K_M 1/ft-Mach	Speed of Sound a fps	Speed of Sound a√σ fps	Speed of Sound a mph	Speed of Sound a√σ mph	Speed of Sound a kn	Speed of Sound a√σ kn	Altitude Z ft
0	0	2116.22 +0	1.00000 +0	1461.35 +0	.237689 -2	1.00000 +0	1.0000 +0	518.670	59.000	1.00000	15.000	.37372 -6	.15723 -3	6.360 +3	1.073 +4	7.101 +6	1116.45	1116.45 +0	761.22	761.22 +0	661.48	661.48 +0	0
1000	999	2040.86	9.63869 -1	1426.69	.230812	9.7107 -1	9.8543 -1	515.154	55.834	0.99312	13.819	.37172	.16105	6.209	1.048	6.908	1112.61	1096.39	758.59	747.54	659.20	649.60	1000
2000	1999	1967.69	9.29816	1377.38	.224088	9.4278	9.7097	511.638	51.868	0.98625	11.038	.36971	.16499	6.061	1.023	6.720	1108.75	1076.56	755.96	734.02	656.92	637.84	2000
3000	2999	1896.67	8.96256	1327.67	.217516	9.1513	9.5662	508.123	48.303	0.97938	9.057	.36770	.16905	5.916	9.98e +3	6.536	1104.88	1056.95	753.33	720.65	654.62	626.23	3000
4000	3999	1827.75	8.63887	1279.42	.211093	8.8811	9.4239	504.608	44.738	0.97250	7.077	.36568	.17323	5.773	9.783	6.356	1100.99	1037.57	750.68	707.43	652.32	614.74	4000
5000	4998	1760.87	8.32065	1232.61	.204817	8.6170	9.2828	501.092	41.173	0.96563	5.096	.36366	.17755	5.632	9.566	6.179	1097.10	1018.61	748.02	694.37	650.01	603.35	5000
6000	5998	1696.00	8.01683	1187.20	.198685	8.3590	9.1428	497.579	37.609	0.95876	3.116	.36162	.18201	5.494	9.273	6.006	1093.19	9994.76 -1	745.35	681.46	647.70	592.17	6000
7000	6997	1633.08	7.71698	1143.14	.192695	8.1070	9.0039	494.065	34.045	0.95189	1.136	.35958	.18661	5.359	9.045	5.837	1089.26	9867.61	742.68	672.70	645.37	581.69	7000
8000	7996	1572.07	7.42869	1100.45	.186885	7.8609	8.8662	490.552	30.482	0.94502	-0.884	.35754	.19136	5.226	8.820	5.672	1085.32	9622.67	739.99	656.09	643.04	570.13	8000
9000	8996	1512.93	7.14921	1059.65	.181133	7.6266	8.7296	486.588	26.918	0.93815	-2.823	.35549	.19626	5.095	8.600	5.510	1081.37	9439.92	737.30	643.63	640.76	559.30	9000
10000	9995	1455.60 +0	6.87832 -1	1018.92 +0	.175555 -2	7.3859 -1	8.5941 -1	482.025	23.355	0.93126	-4.803	.35343 -6	.20132 -3	4.967 +3	8.384 +3	5.352 +6	1077.40	9259.36 -1	734.59	631.32 +0	638.35	548.66 +0	10000
11000	10994	1400.85	6.61584	9800.38 -1	.170110	7.1566	8.4596	479.463	19.793	0.92441	-6.782	.35136	.20655	4.841	8.172	5.197	1073.42	9080.96	731.88	619.16	635.99	538.62	11000
12000	11993	1348.24	6.36155	9423.69	.164796	6.9333	8.3266	475.901	16.231	0.91754	-8.761	.34928	.21195	4.718	7.965	5.046	1069.43	8896.75	729.16	607.14	633.62	527.59	12000
13000	12991	1298.12	6.11525	9058.84	.159610	6.7151	8.1946	472.339	12.669	0.91067	-10.76C	.34720	.21753	4.597	7.759	4.898	1065.42	8730.65	726.42	595.27	631.25	517.28	13000
14000	13990	1249.65	5.87676	8705.55	.154551	6.5022	8.0626	468.777	9.107	0.90381	-12.718	.34512	.22320	4.478	7.558	4.753	1061.40	8558.71	723.68	583.55	628.86	507.09	14000
15000	14989	1194.79	5.64587	8361.52	.149616	6.2966	7.9328	465.216	5.546	0.89696	-14.697	.34302	.22927	4.362	7.362	4.612	1057.36	8385.90	720.92	571.97	626.47	497.02	15000
16000	15987	1147.50	5.42281	8032.50	.144802	6.0921	7.8052	461.655	1.985	0.89007	-16.675	.34092	.23544	4.247	7.169	4.474	1053.30	8221.21	718.16	560.54	624.07	487.05	16000
17000	16986	1101.74	5.20619	7712.19	.140109	5.8966	7.6776	458.095	-1.575	0.88321	-18.653	.33881	.24182	4.135	6.98C	4.339	1049.23	8055.63	715.39	549.25	621.65	477.28	17000
18000	17984	1057.46	4.99762	7402.34	.135533	5.7021	7.5512	454.535	-5.135	0.87635	-20.631	.33669	.24842	4.025	6.794	4.207	1045.15	7892.14	712.60	538.10	619.23	467.60	18000
19000	18982	1014.67	4.79472	7102.67	.131072	5.5145	7.4259	450.975	-8.695	0.86948	-22.609	.33457	.25525	3.918	6.612	4.078	1041.05	7736.74	709.80	527.10	616.80	458.02	19000
20000	19980	9732.75 -1	4.59913 -1	6812.93 -1	.126726 -2	5.3316 -1	7.3018 -1	447.415	-12.255	0.86262	-24.586	.33244 -6	.26223 -3	3.812 +3	6.434 +3	3.953 +6	1036.93	7571.42 -1	707.00	516.23 +0	614.37	446.66 +0	20000
21000	20978	9332.66	4.41067	6532.86	.122691	5.1534	7.1787	443.856	-15.814	0.85576	-26.563	.33030	.26965	3.709	6.259	3.820	1032.80	7414.16	704.18	505.51	611.92	439.26	21000
22000	21976	8946.62	4.22736	6262.21	.118365	4.9758	7.0568	440.297	-19.373	0.84890	-28.540	.32815	.27723	3.607	6.088	3.710	1028.65	7258.96	701.35	494.93	609.46	430.65	22000
23000	22974	8572.49	4.05066	6000.74	.114247	4.8158	6.9360	436.739	-22.931	0.84204	-30.517	.32599	.28505	3.508	5.922	3.594	1024.48	7105.80	698.51	484.49	606.99	421.61	23000
24000	23972	8211.72	3.88038	5746.21	.110435	4.6662	6.8163	433.181	-26.489	0.83518	-32.494	.32383	.29323	3.410	5.756	3.479	1020.30	6954.67	695.66	474.18	604.51	412.65	24000
25000	24970	7864.38	3.71577	5504.37	.106826	4.5259	6.6977	429.623	-30.047	0.82832	-34.471	.32167	.30167	3.315	5.595	3.368	1016.10	6805.56	692.80	464.02	602.02	403.22	25000
26000	25967	7527.14	3.55688	5269.00	.103219	4.3906	6.5802	426.065	-33.605	0.82146	-36.447	.31960	.31062	3.221	5.447	3.260	1011.89	6658.47	689.92	453.99	599.53	394.5C	26000
27000	26965	7202.46	3.40356	5041.86	.099712	4.2599	6.4629	422.508	-37.162	0.81460	-38.423	.31750	.31950	3.130	5.303	3.154	1007.65	6513.37	687.04	444.09	597.02	385.61	27000
28000	27962	6889.64	3.25564	4822.75	.958016	4.0305	6.3457	418.951	-40.719	0.80774	-40.399	.31510	.32691	3.040	5.161	3.051	1003.40	6370.27	684.14	434.34	594.50	377.42	28000
29000	28959	6587.75	3.11298	4611.42	.923880	3.8869	6.2345	415.365	-44.275	0.80089	-42.375	.31290	.33868	2.953	4.963	2.950	999.14	6229.14	681.23	424.71	591.97	369.07	29000
30000	29956	6296.69 -1	2.97545 -1	4407.68 -1	.890686 -3	3.7472 -1	6.1215 -1	411.839	-47.831	0.79403	-44.351	.31069 -6	.34862 -3	2.867 +3	4.835 +3	2.852 +6	994.85	6089.97 -1	678.31	415.23 +0	589.43	360.82 +0	30000
31000	30953	6016.15	2.84288	4211.31	.858616	3.6115	6.0096	408.263	-51.387	0.78717	-46.326	.30847	.35935	2.783	4.667	2.756	990.55	5952.77	675.37	405.67	586.86	352.49	31000
32000	31950	5745.65	2.71515	4022.10	.827050	3.4795	5.8988	404.728	-54.942	0.78034	-48.301	.30625	.37039	2.701	4.552	2.663	986.22	5817.50	672.42	396.65	584.32	344.68	32000
33000	32947	5485.50	2.59213	3839.85	.796572	3.3513	5.7891	401.173	-58.497	0.77346	-50.276	.30401	.38165	2.620	4.422	2.573	981.88	5684.17	669.47	387.56	581.75	336.76	33000
34000	33944	5234.80	2.47366	3664.36	.766963	3.2267	5.6804	397.618	-62.052	0.76661	-52.251	.30177	.39346	2.542	4.296	2.484	977.52	5552.77	666.49	378.66	579.17	328.95	34000
35000	34941	4993.49	2.35963	3495.44	.738206	3.1058	5.5729	394.064	-65.606	0.75976	-54.226	.29951	.40573	2.465	4.160	2.398	973.14	5423.27	663.51	369.77	576.57	321.32	35000
36000	35937	4761.28	2.24990	3332.90	.710284	2.9882	5.4665	390.510	-69.160	0.75291	-56.200	.29725	.41850	2.389	4.033	2.315	968.75	5295.67	660.51	361.07	573.97	312.76	36000
36151	36069	4726.80 -1	2.23361 -1	3308.76 -1	.706117 -3	2.9768 -1	5.4585 -1	389.970	-69.700	0.75187	-56.500	.29691 -6	.42048 -3	2.378 +3	4.014 +3	2.302 +6	968.08	5276.87 -1	660.05	359.76 +0	573.57	312.62 +0	36151
37000	36934	4536.63	2.14469	3177.04	.678007	2.8525	5.3469	385.970	-69.700	0.75187	-56.500	.29691	.43792	2.284	3.856	2.211	968.08	5170.37	660.05	352.53	573.57	306.34	37000
38000	37930	4326.40	2.04440	3028.48	.646302	2.7191	5.2165	389.970	-69.700	0.75187	-56.500	.29691	.45940	2.177	3.674	2.107	968.08	5048.04	660.05	344.18	573.57	299.09	38000
39000	38927	4124.10	1.94881	2886.87	.616082	2.5920	5.0911	389.970	-69.700	0.75187	-56.500	.29691	.48194	2.075	3.502	2.009	968.08	4926.61	660.05	336.04	573.57	292.01	39000
40000	39923	3931.29 -1	1.85770 -1	2751.90 -1	.587278 -3	2.4726 -1	4.9657 -1	389.970	-69.700	0.75187	-56.500	.29691 -6	.50557 -3	1.978 +3	3.338 +3	1.915 +6	968.08	4812.01 -1	660.05	328.09 +0	573.57	285.1C +0	40000
41000	40919	3747.50	1.77085	2623.25	.559823	2.3553	4.8531	389.970	-69.700	0.75187	-56.500	.29691	.53026	1.885	3.182	1.825	968.08	4698.19	660.05	320.33	573.57	278.3E	41000
42000	41915	3572.33	1.68867	2500.63	.533455	2.2452	4.7383	389.970	-69.700	0.75187	-56.500	.29691	.55637	1.797	3.034	1.740	968.08	4587.07	660.05	312.75	573.57	271.7E	42000
43000	42911	3405.36	1.60917	2383.75	.508711	2.1402	4.6263	389.970	-69.700	0.75187	-56.500	.29691	.58365	1.713	2.892	1.659	968.08	4478.58	660.05	305.36	573.57	265.35	43000
44000	43907	3246.20	1.53397	2272.34	.484936	2.0402	4.5169	389.970	-69.700	0.75187	-56.500	.29691	.61227	1.633	2.757	1.581	968.08	4372.67	660.05	298.14	573.57	259.07	44000
45000	44903	3094.50	1.46228	2166.15	.462274	1.9449	4.4101	389.970	-69.700	0.75187	-56.500	.29691	.64228	1.557	2.628	1.507	968.08	4269.26	660.05	291.09	573.57	252.95	45000
46000	45898	2949.90	1.39395	2064.93	.440673	1.8546	4.3058	389.970	-69.700	0.75187	-56.500	.29691	.67376	1.484	2.505	1.437	968.08	4168.36	660.05	284.21	573.57	246.97	46000
47000	46894	2812.68	1.32862	1968.45	.420084	1.7674	4.2040	389.970	-69.700	0.75187	-56.500	.29691	.70679	1.415	2.388	1.370	968.08	4069.80	660.05	277.49	573.57	241.12	47000
48000	47889	2682.70	1.26674	1876.49	.400458	1.6848	4.1046	389.970	-69.700	0.75187	-56.500	.29691	.74143	1.349	2.276	1.306	968.08	3973.59	660.05	270.93	573.57	235.43	48000
49000	48885	2555.47	1.20757	1788.83	.381751	1.6061	4.0087	389.970	-69.700	0.75187	-56.500	.29691	.77773	1.285	2.170	1.245	968.08	3879.67	660.05	264.52	573.57	229.88	49000
50000	49880	2436.11 -1	1.15116 -1	1705.27 -1	.363919 -3	1.5311 -1	3.9129 -1	389.970	-69.700	0.75187	-56.500	.29691 -6	.81587 -3	1.226 +3	2.069 +3	1.187 +6	968.08	3787.98 -1	660.05	258.27 +0	573.57	224.43 +0	50000
51000	50875	2322.33	1.09749	1625.63	.346922	1.4596	3.8206	389.970	-69.700	0.75187	-56.500	.29691	.85566	1.168	1.972	1.131	968.08	3698.46	660.05	252.17	573.57	219.13	51000
52000	51870	2213.87	1.04615	1549.71	.330721	1.3914	3.7301	389.970	-69.700	0.75187	-56.500	.29691	.89777	1.114	1.886	1.078	968.08	3611.67	660.05	246.21	573.57	213.95	52000
53000	52865	2110.49	9.97295 -2	1477.34	.315277	1.3266	3.6426	389.970	-69.700	0.75187	-56.500	.29691	.94174	1.062	1.792	1.026	968.08	3525.75	660.05	240.39	573.57	208.9C	53000
54000	53860	2011.95	9.50729	1408.36	.300556	1.2645	3.5586	389.970	-69.700	0.75187	-56.500	.29691	.98787	1.012	1.709	9.800 +5	968.08	3442.45	660.05	234.71	573.57	202.96	54000
55000	54855	1918.01	9.06341	1342.61	.286524	1.2055	3.4782	389.970	-69.700	0.75187	-56.500	.29691	.10362 -2	9.650 +2	1.629	9.342	968.08	3361.13	660.05	229.17	573.57	198.14	55000
56000	55849	1828.47	8.64030	1279.93	.273148	1.1492	3.3977	389.970	-69.700	0.75187	-56.500	.29691	.10870	9.200	1.553	8.906	968.08	3281.74	660.05	223.75	573.57	193.44	56000
57000	56844	1743.12	8.23697	1220.19	.260397	1.0955	3.3099	389.970	-69.700	0.75187	-56.500	.29691	.11402	8.770	1.480	8.490	968.08	3204.23	660.05	218.47	573.57	189.05	57000
58000	57839	1661.76	7.85251	1163.23	.248243	1.0444	3.2317	389.970	-69.700	0.75187	-56.500	.29691	.11960	8.361	1.411	8.094	968.08	3128.55	660.05	213.31	573.57	185.36	58000
59000	58833	1584.21	7.48803	1108.94	.236658	9.9566 -2	3.1554	389.970	-69.700	0.75187	-56.500	.29691	.12546	7.971	1.345	7.716	968.08	3054.66	660.05	208.27	573.57	180.96	59000
60000	59827	1510.28 -1	7.13669 -2	1057.19 -1	.225814 -3	9.4920 -2	3.0809 -1	386.970	-69.700	0.75187	-56.500	.29691 -6	.13160 -2	7.599 +2	1.283 +3	7.356 +5	968.08	2982.55 -1	660.05	203.36 +0	573.57	176.71 +0	60000
61000	60822	1439.61	6.80368	1007.86	.215086	9.0491	3.0082	386.970	-69.700	0.75187	-56.500	.29691	.13804	7.244	1.223	7.013	968.08	2912.12	660.05	198.55	573.57	172.54	61000
62000	61816	1372.63	6.48623	960E.39 -2	.205051	8.6269	2.9372	386.970	-69.700	0.75187	-56.500	.29691	.14460	6.906	1.166	6.686	968.08	2843.39	660.05	193.87	573.57	168.47	62000
63000	62810	1308.59	6.18363	9166.13	.195485	8.2244	2.8676	386.970	-69.700	0.75187	-56.500	.29691	.15188	6.584	1.111	6.374	968.08	2776.27	660.05	189.29	573.57	164.49	63000
64000	63804	1247.55	5.89517	8732.62	.186365	7.8407	2.8001	389.970	-69.700	0.75187	-56.500	.29691	.15932	6.277	1.059	6.076	968.08	2710.74	660.05	184.82	573.57	160.61	64000
65000	64797	1189.35	5.62019	8325.48	.177673	7.4756	2.7340	389.970	-69.700	0.75187	-56.500	.29691	.16711	5.984	1.01C	5.793	968.08	2646.76	660.05	180.46	573.57	156.82	65000
65824	65616	1143.45 -1	5.40330 -2	8004.18 -2	.170816 -3	7.1865 -2	2.6808 -1	389.970	-69.700	0.75187	-56.500	.29691 -6	.17382 -2	5.753 +2	9.71C +2	5.569 +5	968.08	2595.19 -1	660.05	176.94 +0	573.57	153.78 +0	65824
66000	65791	1133.88	5.35807	7937.19	.169344	7.1246	2.6692	390.066	-69.604	0.75245	-56.447	.29697	.17537	5.702	9.625	5.521	968.20	2584.30	660.13	176.20	573.64	153.12	66000
67000	66785	1081.05	5.10842	7567.37	.161229	6.7832	2.6045	396.611	-69.059	0.75531C	-56.194	.29732	.18041	5.423	9.153	5.254	968.87	2523.38	660.59	172.05	574.04	149.51	67000
68000	67778	1030.76	4.87076	7215.30	.153513	6.4566	2.5416	391.156	-68.514	0.75815	-55.681	.29767	.19390	5.157	8.706	5.000	969.55	2463.98	661.05	168.00	574.44	145.99	68000
69000	68772	9828.71 -2	4.64447	6885.10	.146178	6.1566	2.4799	391.701	-67.969	0.75528	-55.538	.29801	.20367	4.905	8.279	4.759	970.22	2404.07	661.52	164.05	574.84	142.56	69000

Table 2A-1 U.S. Standard Atmosphere, 1962 (continued)

Altitude Z ft	H ft	Pressure P lb/ft²	δ	q/M² (= 0.7P) lb/ft²	Density ρ slug/ft³	σ	√σ	Temperature T °R	t °F	θ (T/518.67)	t °C	Viscosity μ slug/ft-sec	ν ft²/sec	N_{Re} "K" Factor K_{fps} 1/ft-fps	K_{kn} 1/ft-kn	K_M 1/ft-Mach	Speed of Sound a fps	a√σ fps	a mph	a√σ mph	a kn	a√σ kn	Altitude Z ft
70000	69765	9372.76 -2	4.42902 -2	6560.93 -2	.139203 -3	5.8565 -2	2.4200 -1	392.246	-67.424	0.75625	-55.235	.29836 -6	.21433 -2	4.666 +2	7.875 +2	4.530 +5	970.90	2349.40 -1	661.98	160.20 +0	575.24	139.21 +0	70000
71000	70758	8938.59	4.22385	6257.01	.132571	5.5775	2.3617	392.791	-66.879	0.75730	-54.933	.29871	.22532	4.436	7.491	4.312	971.57	2294.53	662.44	156.45	575.64	135.95	71000
72000	71752	8525.13	4.02847	5967.59	.126263	5.3121	2.3048	393.336	-66.334	0.75836	-54.630	.29905	.23665	4.222	7.126	4.105	972.25	2240.83	662.89	152.78	576.04	132.77	72000
73000	72745	8131.36	3.84240	5691.95	.120265	5.0598	2.2494	393.881	-65.789	0.75941	-54.327	.29940	.24895	4.017	6.780	3.908	972.92	2188.47	663.35	149.21	576.44	129.66	73000
74000	73736	7756.32	3.66518	5429.43	.114559	4.8197	2.1954	394.426	-65.244	0.76046	-54.025	.29974	.26165	3.822	6.451	3.721	973.59	2137.41	663.81	145.73	576.84	126.64	74000
75000	74731	7399.10	3.49638	5179.37	.109133	4.5914	2.1428	394.970	-64.700	0.76151	-53.722	.30009	.27498	3.637	6.138	3.543	974.26	2087.61	664.27	142.34	577.24	123.65	75000
76000	75723	7058.82	3.33558	4941.17	.103970	4.3742	2.0915	395.515	-64.155	0.76256	-53.419	.30044	.28896	3.461	5.841	3.374	974.93	2039.04	664.73	139.03	577.63	120.81	76000
77000	76716	6734.63	3.18240	4714.26	.990592 -4	4.1676	2.0415	396.060	-63.610	0.76361	-53.117	.30078	.30364	3.293	5.559	3.213	975.61	1991.67	665.19	135.80	578.03	118.00	77000
78000	77709	6425.82	3.03647	4498.07	.943868	3.9710	1.9927	396.604	-63.066	0.76466	-52.814	.30113	.31903	3.134	5.290	3.060	976.28	1945.47	665.64	132.65	578.43	115.23	78000
79000	78701	6131.57	2.89742	4292.10	.899412	3.7840	1.9452	397.149	-62.521	0.76571	-52.512	.30147	.33519	2.983	5.035	2.915	976.95	1900.40	666.10	129.57	578.83	112.60	79000
80000	79694	5851.20 -2	2.76493 -2	4095.84 -2	.857110 -4	3.6060 -2	1.8990 -1	397.693	-61.977	0.76676	-52.209	.30181 -6	.35213 -2	2.840 +2	4.792 +2	2.776 +5	977.62	1856.44 -1	666.56	126.58 +0	579.22	109.99 +0	80000
81000	80686	5584.03	2.63868	3908.82	.816855	3.4367	1.8538	398.238	-61.432	0.76781	-51.907	.30216	.36990	2.703	4.563	2.645	978.28	1813.57	667.01	123.65	579.62	107.45	81000
82000	81678	5329.42	2.51837	3730.59	.778546	3.2755	1.8098	398.782	-60.888	0.76886	-51.604	.30250	.38855	2.574	4.344	2.520	978.95	1771.74	667.47	120.80	580.01	104.97	82000
83000	82670	5086.77	2.40371	3560.74	.742086	3.1221	1.7669	399.327	-60.343	0.76990	-51.302	.30285	.40810	2.450	4.136	2.400	979.62	1730.93	667.92	118.02	580.41	102.56	83000
84000	83662	4855.49	2.29442	3398.85	.707382	2.9761	1.7251	399.871	-59.799	0.77095	-51.000	.30319	.42861	2.333	3.938	2.287	980.29	1691.13	668.38	115.30	580.81	100.20	84000
85000	84654	4635.05	2.19025	3244.54	.674348	2.8371	1.6844	400.415	-59.255	0.77200	-50.697	.30353	.45011	2.222	3.750	2.179	980.95	1652.29	668.83	112.66	581.20	978.94 -1	85000
86000	85646	4424.91	2.09095	3097.44	.642902	2.7048	1.6446	400.959	-58.711	0.77305	-50.395	.30388	.47266	2.116	3.571	2.077	981.62	1614.40	669.29	110.07	581.60	956.51	86000
87000	86638	4224.59	1.99629	2957.21	.612964	2.5788	1.6059	401.503	-58.167	0.77410	-50.093	.30422	.49631	2.015	3.401	1.979	982.29	1577.43	669.74	107.55	581.99	934.61	87000
88000	87630	4033.60	1.90604	2823.52	.584461	2.4589	1.5681	402.047	-57.623	0.77515	-49.790	.30456	.52110	1.919	3.239	1.886	982.95	1541.37	670.19	105.09	582.38	913.28	88000
89000	88621	3851.51	1.82000	2696.05	.557322	2.3448	1.5313	402.591	-57.079	0.77620	-49.488	.30490	.54709	1.828	3.085	1.796	983.62	1500.17	670.65	102.69	582.78	892.38	89000
90000	89613	3677.84 -2	1.73795 -2	2574.51 -2	.531480 -4	2.2360 -2	1.4953 -1	403.135	-56.535	0.77725	-49.186	.30525 -6	.57433 -2	1.741 +2	2.939 +2	1.714 +5	984.28	1471.83 -1	671.10	100.35 +0	583.17	872.04 -1	90000
91000	90604	3512.31	1.65971	2458.62	.506870	2.1325	1.4603	403.679	-55.991	0.77830	-48.884	.30559	.60269	1.659	2.800	1.634	984.95	1438.22	671.55	980.67 -1	583.57	852.18	91000
92000	91595	3354.42	1.58510	2348.09	.483433	2.0339	1.4261	404.223	-55.447	0.77935	-48.582	.30593	.63282	1.580	2.667	1.557	985.61	1405.62	672.01	958.38	583.96	832.81	92000
93000	92586	3203.84	1.51395	2242.69	.461112	1.9400	1.3928	404.767	-54.903	0.78039	-48.280	.30627	.66420	1.506	2.541	1.485	986.27	1373.71	672.46	936.62	584.35	813.90	93000
94000	93578	3060.22	1.44608	2142.16	.439851	1.8505	1.3603	405.311	-54.359	0.78144	-47.977	.30661	.69708	1.435	2.421	1.416	986.93	1342.57	672.91	915.39	584.74	795.45	94000
95000	94569	2923.23	1.38135	2046.26	.419598	1.7653	1.3287	405.854	-53.816	0.78249	-47.675	.30695	.73154	1.367	2.307	1.350	987.60	1312.17	673.36	894.66	585.14	777.44	95000
96000	95559	2792.56	1.31960	1954.79	.400305	1.6842	1.2977	406.398	-53.272	0.78354	-47.373	.30729	.76765	1.303	2.199	1.287	988.26	1282.51	673.81	874.44	585.53	759.87	96000
97000	96550	2667.90	1.26069	1867.53	.381925	1.6068	1.2676	406.942	-52.728	0.78459	-47.071	.30763	.80548	1.241	2.095	1.228	988.92	1253.56	674.26	854.70	585.92	742.71	97000
98000	97541	2548.98	1.20450	1784.28	.364413	1.5332	1.2382	407.485	-52.185	0.78563	-46.769	.30797	.84512	1.183	1.997	1.171	989.58	1225.30	674.71	835.43	586.31	725.47	98000
99000	98532	2435.51	1.15088	1704.86	.347728	1.4630	1.2095	408.029	-51.641	0.78668	-46.467	.30831	.88665	1.128	1.904	1.117	990.24	1197.72	675.16	816.63	586.70	709.63	99000
100000	99522	2327.25 -2	1.09972 -2	1629.07 -2	.331829 -4	1.3961 -2	1.1816 -1	408.572	-51.098	0.78773	-46.165	.30865 -6	.93016 -2	1.075 +2	1.815 +2	1.065 +5	990.90	1170.79 -1	675.61	798.27 -1	587.09	693.68 -1	100000
101000	100512	2223.94	1.05090	1556.76	.316678	1.3323	1.1543	409.115	-50.555	0.78878	-45.864	.30899	.97573	1.025	1.730	1.016	991.56	1144.51	676.06	780.35	587.48	678.11	101000
102000	101503	2125.36	1.00432	1487.75	.302238	1.2716	1.1276	409.659	-50.011	0.78983	-45.562	.30933	.10235 -1	9.771 +1	1.649	9.695 +4	992.21	1118.86	676.51	762.86	587.87	662.51	102000
103000	102493	2031.27	9.59860 -3	1421.89	.288477	1.2137	1.1017	410.202	-49.468	0.79087	-45.260	.30967	.10735	9.316	1.572	9.249	992.87	1093.81	676.96	745.76	588.26	648.07	103000
104000	103483	1941.46	9.17429	1359.04	.275360	1.1585	1.0763	410.745	-48.925	0.79192	-44.958	.31001	.11258	8.882	1.499	8.825	993.53	1069.36	677.41	729.11	588.65	633.58	104000
105000	104473	1855.77	8.76930	1299.04	.262856	1.1059	1.0516	411.288	-48.382	0.79297	-44.656	.31035	.11807	8.470	1.430	8.420	994.18	1045.49	677.85	712.84	589.04	619.44	105000
105518	104986	1812.09 -2	8.56068 -3	1269.03 -2	.256607 -4	1.0796 -2	1.0390 -1	411.570	-48.100	0.79351	-44.500	.31052 -6	.12101 -1	8.264 +1	1.395 +2	8.218 +4	994.53	1033.35 -1	678.09	704.55 -1	589.24	612.24 -1	105518
106000	105463	1773.99	8.38282	1241.79	.250654	1.0545	1.0269	412.302	-47.368	0.79492	-44.093	.31096	.12407	8.060	1.360	8.023	995.41	1022.20	678.69	696.95	589.77	605.64	106000
107000	106453	1696.07	8.01463	1187.25	.238764	1.0045	1.0022	413.823	-45.847	0.79785	-43.248	.31192	.13064	7.655	1.292	7.633	997.24	9994.96 -2	679.94	681.47	590.85	592.19	107000
108000	107443	1621.65	7.66390	1135.29	.227480	9.5705 -3	9.7829 -2	415.344	-44.326	0.80079	-42.404	.31287	.13754	7.271	1.227	7.264	999.07	9773.62	681.19	666.40	591.94	579.08	108000
109000	108432	1551.13	7.32975	1085.79	.216768	9.1198	9.5498	416.864	-42.806	0.80372	-41.559	.31381	.14477	6.908	1.166	6.914	1000.90	9558.37	682.43	651.71	593.02	566.33	109000
110000	109422	1483.75 -2	7.01134 -3	1038.63 -2	.206598 -4	8.6919 -3	9.3231 -2	418.384	-41.286	0.80665	-40.714	.31475 -6	.15235 -1	6.564 +1	1.108 +2	6.582 +4	1002.72	9348.46 -2	683.68	637.39 -1	594.10	553.88 -1	110000
111000	110412	1419.53	6.70787	9936.71 -3	.196940	8.2856	9.1025	419.904	-39.766	0.80958	-39.870	.31569	.16030	6.238	1.053	6.267	1004.54	9143.90	684.92	623.45	595.18	541.76	111000
112000	111401	1358.31	6.41858	9508.18	.187767	7.8997	8.8880	421.424	-38.246	0.81251	-39.026	.31663	.16863	5.930	1.001	5.968	1006.36	8944.58	686.15	609.86	596.25	529.95	112000
113000	112390	1299.94	6.14277	9099.61	.179053	7.5331	8.6793	422.944	-36.726	0.81544	-38.181	.31757	.17736	5.638	9.516 +1	5.684	1008.17	8750.27	687.39	596.61	597.33	518.44	113000
114000	113379	1244.29	5.87977	8710.00	.170773	7.1847	8.4763	424.463	-35.207	0.81837	-37.337	.31850	.18650	5.362	9.050	5.415	1009.98	8560.90	688.62	583.70	598.40	507.22	114000
115000	114369	1191.20	5.62893	8338.42	.162905	6.8537	8.2787	425.983	-33.687	0.82130	-36.493	.31943	.19609	5.100	8.608	5.160	1011.79	8376.20	689.86	571.11	599.47	496.28	115000
116000	115358	1140.57	5.38965	7983.96	.155426	6.5390	8.0864	427.502	-32.168	0.82423	-35.649	.32036	.20612	4.852	8.188	4.917	1013.59	8196.33	691.09	558.84	600.54	485.62	116000
117000	116346	1092.25	5.16135	7645.78	.148315	6.2399	7.8993	429.021	-30.649	0.82716	-34.805	.32129	.21663	4.616	7.791	4.687	1015.39	8020.87	692.31	546.88	601.60	475.22	117000
118000	117335	1046.15	4.94351	7323.07	.141554	5.9554	7.7171	430.540	-29.130	0.83009	-33.961	.32222	.22763	4.393	7.415	4.469	1017.19	7849.77	693.54	535.21	602.67	465.09	118000
119000	118324	1002.15	4.73559	7015.08	.135124	5.6849	7.5398	432.059	-27.611	0.83301	-33.117	.32315	.23915	4.181	7.058	4.261	1018.98	7682.93	694.76	523.84	603.73	455.20	119000
120000	119313	9601.55 -3	4.53713 -3	6721.08 -3	.129007 -4	5.4276 -3	7.3672 -2	433.578	-26.092	0.83594	-32.273	.32407 -6	.25121 -1	3.981 +1	6.719 +1	4.063 +4	1020.77	7520.21 -2	695.98	512.74 -1	604.75	445.56 -1	120000
121000	120301	9200.57	4.34765	6440.40	.123188	5.1827	7.1991	435.096	-24.574	0.83887	-31.430	.32500	.26382	3.790	6.398	3.876	1022.55	7361.51	697.20	501.92	605.85	436.16	121000
122000	121290	8817.68	4.16672	6172.37	.117651	4.9498	7.0355	436.615	-23.055	0.84180	-30.586	.32592	.27702	3.610	6.093	3.698	1024.34	7206.70	698.41	491.37	606.90	426.95	122000
123000	122278	8452.00	3.99392	5916.40	.112381	4.7261	6.8741	438.133	-21.537	0.84472	-29.743	.32684	.29083	3.438	5.803	3.528	1026.12	7055.69	699.63	481.07	607.96	418.04	123000
124000	123266	8102.71	3.82887	5671.90	.107365	4.5170	6.7209	439.651	-20.019	0.84765	-28.899	.32776	.30528	3.276	5.529	3.367	1027.89	6908.36	700.84	471.02	609.01	409.31	124000
125000	124254	7769.02	3.67118	5438.31	.102589	4.3161	6.5697	441.169	-18.501	0.85058	-28.056	.32868	.32038	3.121	5.268	3.214	1029.67	6764.61	702.05	461.22	610.06	400.79	125000
126000	125242	7450.18	3.52052	5215.12	.980415 -5	4.1248	6.4224	442.687	-16.983	0.85350	-27.213	.32959	.33618	2.975	5.021	3.066	1031.44	6624.34	703.25	451.66	611.11	392.48	126000
127000	126230	7145.47	3.37653	5001.83	.937104	3.9426	6.2790	444.205	-15.465	0.85643	-26.369	.33051	.35269	2.835	4.786	2.930	1033.20	6487.46	704.46	442.33	612.16	384.37	127000
128000	127218	6854.23	3.23891	4797.96	.895848	3.7690	6.1392	445.722	-13.948	0.85936	-25.526	.33142	.36995	2.703	4.562	2.798	1034.97	6353.88	705.66	433.22	613.20	376.46	128000
129000	128206	6575.82	3.10735	4603.07	.856543	3.6036	6.0030	447.240	-12.430	0.86228	-24.683	.33233	.38799	2.577	4.350	2.672	1036.73	6223.49	706.86	424.33	614.24	368.73	129000
130000	129194	6309.62 -3	2.98156 -3	4416.74 -3	.819091 -5	3.4461 -3	5.8703 -2	448.757	-10.913	0.86521	-23.840	.33324 -6	.40684 -1	2.458 +1	4.149 +1	2.553 +4	1038.48	6096.23 -2	708.06	415.65 -1	615.29	361.19 -1	130000
131000	130181	6055.07	2.86127	4238.55	.783398	3.2959	5.7410	450.274	-9.396	0.86813	-22.998	.33415	.42654	2.344	3.957	2.439	1040.24	5971.59	709.25	407.18	616.32	352.83	131000
132000	131169	5811.62	2.74623	4068.13	.749376	3.1528	5.6149	451.791	-7.879	0.87106	-22.155	.33506	.44711	2.237	3.775	2.330	1041.99	5850.70	710.45	398.91	617.36	344.65	132000
133000	132156	5578.75	2.63619	3905.12	.716941	3.0163	5.4921	453.308	-6.362	0.87398	-21.312	.33596	.46860	2.134	3.602	2.227	1043.74	5732.28	711.64	390.84	618.40	339.63	133000
134000	133144	5355.95	2.53091	3749.17	.686014	2.8862	5.3723	454.825	-4.845	0.87691	-20.470	.33686	.49105	2.036	3.437	2.129	1045.48	5616.66	712.83	382.95	619.43	332.76	134000
135000	134131	5142.78	2.43018	3599.94	.656520	2.7621	5.2556	456.341	-3.329	0.87983	-19.627	.33777	.51448	1.944	3.281	2.035	1047.22	5503.74	714.02	375.28	620.46	326.09	135000
136000	135118	4938.77	2.33377	3457.14	.628389	2.6437	5.1417	457.858	-1.812	0.88275	-18.785	.33867	.53895	1.855	3.132	1.946	1048.96	5393.48	715.20	367.74	621.49	319.56	136000
137000	136105	4743.51	2.24150	3320.46	.601552	2.5308	5.0307	459.374	-0.296	0.88568	-17.942	.33957	.56449	1.772	2.990	1.861	1050.70	5285.78	716.38	360.39	622.52	313.17	137000
138000	137092	4556.59	2.15318	3189.61	.575947	2.4231	4.9225	460.890	1.220	0.88860	-17.100	.34047	.59114	1.692	2.855	1.780	1052.43	5180.59	717.56	353.22	623.55	306.94	138000
139000	138079	4377.65	2.06861	3064.36	.551513	2.3203	4.8170	462.406	2.736	0.89152	-16.258	.34136	.61896	1.616	2.727	1.703	1054.16	5077.84	718.74	346.22	624.57	300.85	139000
140000	139065	4206.27 -3	1.98764 -3	2944.39 -3	.528193 -5	2.2222 -3	4.7140 -2	463.922	4.252	0.89445	-15.416	.34226 -6	.64798 -1	1.543 +1	2.605 +1	1.630 +4	1055.88	4977.46 -2	719.92	339.37 -1	625.60	294.91 -1	140000
141000	140052	4042.16	1.91009	2829.51	.505932	2.1285	4.6136	465.438	5.768	0.89737	-14.573	.34315	.67826	1.474	2.488	1.559	1057.61	4879.40	721.10	332.69	626.62	289.10	141000
142000	141039	3884.97	1.83581	2719.48	.484679	2.0391	4.5157	466.953	7.283	0.90029	-13.732	.34404	.70984	1.409	2.378	1.492	1059.33	4783.58	722.27	326.15	627.64	283.42	142000
143000	142025	3734.38	1.76465	2614.07	.464385	1.9538	4.4201	468.469	8.799	0.90321	-12.890	.34493	.74278	1.346	2.272	1.428	1061.05	4689.90	723.44	319.77	628.65	277.87	143000
144000	143012	3590.10	1.69647	2513.07	.445004	1.8722	4.3269	469.984	10.314	0.90613	-12.048	.34582	.77713	1.287	2.172	1.368	1062.76	4598.47	724.61	313.52	629.67	272.45	144000
145000	143998	3451.85	1.63114	2416.30	.426493	1.7943	4.2360	471.499	11.829	0.90905	-11.206	.34671	.81294	1.230	2.076	1.309	1064.47	4509.05	725.78	307.44	630.68	267.15	145000
146000	144984	3319.36	1.56853	2323.55	.408808	1.7199	4.1472	473.014	13.344	0.91197	-10.364	.34760	.85027	1.176	1.985	1.254	1066.18	4421.67	726.94	301.48	631.70	261.98	146000
147000	145970	3192.35	1.50852	2234.65	.391912	1.6488	4.0606	474.529	14.859	0.91490	-9.523	.34848	.88919	1.125	1.898	1.201	1067.89	4336.26	728.10	295.65	632.71	256.92	147000
148000	146956	3070.61	1.45099	2149.42	.375766	1.5809	3.9761	476.044	16.374	0.91782	-8.681	.34937	.92975	1.076	1.815	1.150	1069.59	4252.77	729.27	289.96	633.72	251.97	148000
149000	147942	2953.88	1.39583	2067.71	.360335	1.5160	3.8936	477.558	17.888	0.92074	-7.840	.35025	.97201	1.029	1.736	1.102	1071.29	4171.15	730.42	284.40	634.72	247.13	149000

Table 2A-1 U.S. Standard Atmosphere, 1962 (continued)

Altitude		Pressure			Density			Temperature				Viscosity		N_{Re} "K" Factor			Speed of Sound						Altitude
Z ft	H ft	P lb/ft²	δ	q/M² (= 0.7P) lb/ft²	ρ slug/ft³	σ	√σ	T °R	t °F	θ $\left(\frac{T}{518.67}\right)$	t °C	μ slug/ft-sec	ν ft²/sec	K_{fps} 1/ft-fps	K_{kn} 1/ft-kn	K_M 1/ft-Mach	a fps	a√σ fps	a mph	a√σ mph	a kn	a√σ kn	Z ft
150000	148928	2841.95 -3	1.34294 -3	1989.36 -3	.345585 -5	1.4539 -3	3.8131 -2	479.072	19.402	0.92366	-6.999	.35113 -6	.10160 +0	9.842 +0	1.661 +1	1.056 +4	1072.99	4091.36 -2	731.58	278.96 -1	635.73	242.41 -1	150000
151000	149914	2734.60	1.29221	1914.22	.331483	1.3946	3.7344	480.587	20.917	0.92658	-6.157	.35201	.10619	9.417	1.589	1.012	1074.68	4013.34	732.74	273.64	636.73	237.78	151000
152000	150899	2631.63	1.24356	1842.14	.318000	1.3379	3.6577	482.101	22.431	0.92949	-5.316	.35289	.11097	9.011	1.521	9.700 +3	1076.37	3937.06	733.89	268.44	637.73	233.26	152000
153000	151885	2532.86	1.19688	1773.00	.305107	1.2836	3.5826	483.615	23.945	0.93241	-4.475	.35377	.11595	8.625	1.456	9.298	1078.06	3862.47	735.04	263.35	638.74	228.85	153000
154000	152870	2434.09	1.15210	1706.67	.292775	1.2318	3.5096	485.129	25.459	0.93533	-3.634	.35464	.12113	8.256	1.393	8.914	1079.75	3789.52	736.19	258.38	639.73	224.52	154000
155000	153855	2347.16	1.10913	1643.01	.280979	1.1821	3.4382	486.642	26.972	0.93825	-2.793	.35552	.12653	7.903	1.334	8.547	1081.43	3718.18	737.34	253.51	640.73	220.30	155000
155348	154199	2316.33 -3	1.09456 -3	1621.43 -3	.276987 -5	1.1653 -3	3.4137 -2	487.170	27.500	0.93927	-2.500	.35582 -6	.12846 +0	7.784 +0	1.314 +1	8.423 +3	1082.02	3693.68 -2	737.74	251.84 -1	641.08	218.84 -1	155348
156000	154841	2259.84	1.06787	1581.89	.270232	1.1369	3.3718	487.170	27.500	0.93927	-2.500	.35582	.13167	7.595	1.282	8.218	1082.02	3648.36	737.74	248.75	641.08	216.18	156000
157000	155826	2175.79	1.02815	1523.05	.260181	1.0946	3.3085	487.170	27.500	0.93927	-2.500	.35582	.13676	7.312	1.234	7.912	1082.02	3579.87	737.74	244.08	641.08	212.10	157000
158000	156811	2094.87	9.89913 -4	1466.41	.250505	1.0539	3.2464	487.170	27.500	0.93927	-2.500	.35582	.14204	7.040	1.188	7.618	1082.02	3512.66	737.74	239.50	641.08	208.12	158000
159000	157796	2016.97	9.53102	1411.88	.241190	1.0147	3.1855	487.170	27.500	0.93927	-2.500	.35582	.14753	6.778	1.144	7.334	1082.02	3446.74	737.74	235.01	641.08	204.21	159000
160000	158781	1941.97 -3	9.17663 -4	1359.38 -3	.232222 -5	9.7700 -4	3.1257 -2	487.170	27.500	0.93927	-2.500	.35582 -6	.15322 +0	6.526 +0	1.102 +1	7.062 +3	1082.02	3382.06 -2	737.74	230.59 -1	641.08	200.38 -1	160000
161000	159766	1869.77	8.83545	1308.84	.223588	9.4067	3.0670	487.170	27.500	0.93927	-2.500	.35582	.15914	6.284	1.061	6.799	1082.02	3318.59	737.74	226.27	641.08	196.62	161000
162000	160750	1800.26	8.50698	1260.18	.215276	9.0570	3.0095	487.170	27.500	0.93927	-2.500	.35582	.16529	6.050	1.021	6.546	1082.02	3256.32	737.74	222.02	641.08	192.93	162000
163000	161735	1733.34	8.19076	1213.34	.207273	8.7204	2.9530	487.170	27.500	0.93927	-2.500	.35582	.17167	5.825	9.832 +0	6.303	1082.02	3195.23	737.74	217.86	641.08	189.31	163000
164000	162719	1668.92	7.88631	1168.24	.199569	8.3962	2.8976	487.170	27.500	0.93927	-2.500	.35582	.17829	5.609	9.466	6.069	1082.02	3135.28	737.74	213.77	641.08	185.76	164000
165000	163704	1606.89	7.59322	1124.82	.192152	8.0842	2.8433	487.170	27.500	0.93927	-2.500	.35582	.18516	5.400	9.115	5.843	1082.02	3076.47	737.74	209.76	641.08	182.28	165000
166000	164688	1547.17	7.31104	1083.02	.185011	7.7836	2.7899	487.170	27.500	0.93927	-2.500	.35582	.19232	5.200	8.776	5.626	1082.02	3018.76	737.74	205.82	641.08	178.86	166000
167000	165672	1489.68	7.03937	1042.78	.178137	7.4945	2.7376	487.170	27.500	0.93927	-2.500	.35582	.19975	5.006	8.450	5.417	1082.02	2962.15	737.74	201.96	641.08	175.50	167000
168000	166656	1434.33	6.77782	1004.03	.171518	7.2161	2.6863	487.170	27.500	0.93927	-2.500	.35582	.20745	4.820	8.136	5.216	1082.02	2906.59	737.74	198.18	641.08	172.21	168000
169000	167640	1381.03	6.52601	9667.32 -4	.165146	6.9480	2.6359	487.170	27.500	0.93927	-2.500	.35582	.21546	4.641	7.834	5.022	1082.02	2852.09	737.74	194.46	641.08	168.98	169000
170000	168624	1329.74 -3	6.28359 -4	9308.20 -4	.159011 -5	6.6899 -4	2.5865 -2	487.170	27.500	0.93927	-2.500	.35582 -6	.22377 +0	4.469 +0	7.543 +0	4.835 +3	1082.02	2798.62 -2	737.74	190.81 -1	641.08	165.81 -1	170000
171000	169606	1280.35	6.05019	8962.45	.153105	6.4414	2.5380	487.170	27.500	0.93927	-2.500	.35582	.23240	4.303	7.262	4.656	1082.02	2746.15	737.74	187.24	641.08	162.71	171000
172000	170592	1232.80	5.82547	8629.57	.147418	6.2021	2.4904	487.170	27.500	0.93927	-2.500	.35582	.24137	4.143	6.993	4.483	1082.02	2694.67	737.74	183.73	641.08	159.65	172000
172011	170603	1232.26 -3	5.82294 -4	8625.82 -4	.147354 -5	6.1994 -4	2.4899 -2	487.170	27.500	0.93927	-2.500	.35582 -6	.24147 +0	4.141 +0	6.990 +0	4.481 +3	1082.02	2694.08 -2	737.74	183.69 -1	641.08	159.62 -1	172011
173000	171576	1186.96	5.60890	8308.75	.142249	5.9847	2.4464	486.103	26.433	0.93721	-3.093	.35520	.24971	4.005	6.759	4.328	1080.83	2644.10	736.93	180.28	640.38	156.66	173000
174000	172559	1142.74	5.39994	7999.21	.137254	5.7745	2.4030	485.024	25.354	0.93513	-3.692	.35458	.25834	3.871	6.533	4.179	1079.63	2594.38	736.11	176.89	639.67	153.71	174000
175000	173543	1100.08	5.19835	7700.58	.132425	5.5714	2.3604	483.945	24.275	0.93305	-4.292	.35396	.26729	3.741	6.315	4.035	1078.43	2545.49	735.29	173.56	638.95	150.82	175000
176000	174526	1058.93	5.00387	7412.49	.127756	5.3749	2.3184	482.866	23.196	0.93097	-4.891	.35333	.27657	3.616	6.103	3.895	1077.23	2497.43	734.47	170.28	638.24	147.97	176000
177000	175509	1019.23	4.81628	7134.60	.123242	5.1850	2.2771	481.787	22.117	0.92889	-5.491	.35271	.28619	3.494	5.897	3.760	1076.02	2450.16	733.65	167.06	637.53	145.17	177000
178000	176492	9809.38 -4	4.63534	6866.56	.118878	5.0014	2.2364	480.708	21.038	0.92681	-6.090	.35208	.29617	3.376	5.695	3.629	1074.82	2403.70	732.83	163.89	636.81	142.42	178000
179000	177475	9440.08	4.46083	6608.05	.114659	4.8239	2.1963	479.629	19.959	0.92473	-6.689	.35146	.30652	3.262	5.506	3.503	1073.61	2358.02	732.01	160.77	636.10	139.71	179000
180000	178458	9083.95 -4	4.29253 -4	6358.75 -4	.110582 -5	4.6524 -4	2.1569 -2	478.551	18.881	0.92265	-7.289	.35083 -6	.31725 +0	3.152 +0	5.320 +0	3.380 +3	1072.40	2313.11 -2	731.18	157.71 -1	635.38	137.05 -1	180000
181000	179441	8740.49	4.13024	6118.34	.106642	4.4866	2.1182	477.472	17.802	0.92057	-7.888	.35020	.32839	3.045	5.140	3.262	1071.19	2268.96	730.36	154.70	634.67	134.43	181000
182000	180424	8409.33	3.97376	5886.53	.102834	4.3264	2.0800	476.394	16.724	0.91849	-8.487	.34957	.33994	2.942	4.965	3.148	1069.98	2225.56	729.53	151.74	633.95	131.86	182000
183000	181407	8090.04	3.82288	5663.03	.991537 -6	4.1716	2.0424	475.315	15.645	0.91641	-9.086	.34894	.35192	2.842	4.796	3.037	1068.77	2182.90	728.71	148.83	633.23	129.32	183000
184000	182390	7782.22	3.67742	5447.55	.955979	4.0220	2.0055	474.237	14.567	0.91433	-9.685	.34831	.36435	2.745	4.632	2.930	1067.56	2140.97	727.88	145.98	632.51	126.85	184000
185000	183372	7485.48	3.53720	5239.63	.921621	3.8774	1.9691	473.159	13.489	0.91225	-10.284	.34768	.37725	2.651	4.474	2.827	1066.34	2099.76	727.05	143.17	631.79	124.41	185000
186000	184354	7199.44	3.40203	5039.61	.888428	3.7378	1.9333	472.081	12.411	0.91018	-10.883	.34705	.39064	2.560	4.321	2.727	1065.13	2059.25	726.22	140.40	631.07	122.01	186000
187000	185337	6923.74	3.27175	4846.62	.856361	3.6029	1.8981	471.003	11.333	0.90810	-11.482	.34642	.40453	2.472	4.172	2.630	1063.91	2019.43	725.39	137.69	630.35	119.65	187000
188000	186319	6658.03	3.14619	4660.62	.825385	3.4725	1.8635	469.925	10.255	0.90602	-12.080	.34579	.41894	2.387	4.029	2.537	1062.69	1980.31	724.56	135.02	629.63	117.33	188000
189000	187301	6401.96	3.02519	4481.37	.795465	3.3467	1.8294	468.848	9.178	0.90394	-12.679	.34516	.43391	2.305	3.890	2.446	1061.47	1941.85	723.73	132.40	628.91	115.05	189000
190000	188283	6155.21 -4	2.90859 -4	4308.65 -4	.766568 -6	3.2251 -4	1.7959 -2	467.770	8.100	0.90186	-13.278	.34452 -6	.44944 +0	2.225 +0	3.755 +0	2.359 +3	1060.25	1904.06 -2	722.90	129.82 -1	628.18	112.81 -1	190000
191000	189265	5917.45	2.79624	4142.22	.738659	3.1077	1.7629	466.692	7.022	0.89979	-13.876	.34389	.46556	2.146	3.623	2.275	1059.03	1866.92	722.07	127.29	627.46	110.61	191000
192000	190247	5688.39	2.68800	3981.87	.711709	2.9943	1.7304	465.615	5.945	0.89771	-14.475	.34326	.48230	2.073	3.500	2.193	1057.81	1830.43	721.23	124.80	626.74	108.45	192000
193000	191229	5467.71	2.58372	3827.39	.685684	2.8848	1.6985	464.538	4.868	0.89563	-15.073	.34262	.49968	2.001	3.378	2.115	1056.58	1794.58	720.40	122.36	626.01	106.33	193000
194000	192211	5255.12	2.48326	3678.59	.660557	2.7791	1.6671	463.461	3.791	0.89356	-15.672	.34199	.51772	1.932	3.260	2.038	1055.36	1759.34	719.56	119.96	625.28	104.24	194000
195000	193192	5050.36	2.38650	3535.25	.636298	2.6770	1.6362	462.383	2.714	0.89148	-16.270	.34135	.53646	1.864	3.146	1.965	1054.13	1724.73	718.73	117.60	624.56	102.19	195000
196000	194174	4853.14	2.29331	3397.20	.612878	2.5785	1.6058	461.307	1.637	0.88940	-16.869	.34071	.55592	1.799	3.036	1.894	1052.90	1690.72	717.89	115.28	623.83	100.17	196000
197000	195155	4663.21	2.20356	3264.25	.590270	2.4834	1.5759	460.230	0.560	0.88733	-17.467	.34007	.57613	1.736	2.930	1.825	1051.67	1657.30	717.05	113.00	623.10	981.93 -2	197000
198000	196136	4480.31	2.11713	3136.22	.568448	2.3916	1.5465	459.153	-0.517	0.88525	-18.065	.33944	.59713	1.675	2.827	1.759	1050.44	1624.48	716.21	110.76	622.37	962.48	198000
199000	197118	4304.20	2.03391	3012.94	.547387	2.3030	1.5175	458.076	-1.594	0.88317	-18.663	.33880	.61894	1.616	2.727	1.695	1049.21	1592.23	715.37	108.56	621.64	943.37	199000
200000	198099	4134.63 -4	1.95378 -4	2894.24 -4	.527061 -6	2.2174 -4	1.4891 -2	457.000	-2.670	0.88110	-19.261	.33816 -6	.64159 +0	1.559 +0	2.631 +0	1.633 +3	1047.98	1560.55 -2	714.53	106.40 -1	620.91	924.60 -2	200000
201000	199080	3971.38	1.87664	2779.97	.507447	2.1349	1.4611	455.923	-3.747	0.87902	-19.859	.33752	.66513	1.503	2.536	1.574	1046.74	1529.43	713.69	104.28	620.18	906.17	201000
202000	200061	3814.23	1.80238	2669.96	.488520	2.0553	1.4336	454.847	-4.823	0.87695	-20.457	.33688	.68959	1.450	2.448	1.516	1045.51	1498.87	712.84	102.20	619.45	888.06	202000
202071	200131	3803.25 -4	1.79719 -4	2662.28 -4	.487196 -6	2.0497 -4	1.4317 -2	454.770	-4.900	0.87680	-20.500	.33683 -6	.69137 +0	1.446 +0	2.441 +0	1.512 +3	1045.42	1496.71 -2	712.78	102.05 -1	619.39	886.78 -2	202071
203000	201042	3662.81	1.73083	2563.97	.471277	1.9827	1.4081	452.771	-6.899	0.87295	-21.611	.33564	.71219	1.404	2.370	1.465	1043.12	1468.81	711.22	100.15	618.03	870.25	203000
204000	202022	3516.74	1.66181	2461.72	.454644	1.9128	1.3830	450.619	-9.051	0.86880	-22.806	.33435	.73542	1.360	2.295	1.415	1040.64	1439.23	709.52	981.29 -2	616.56	852.72	204000
205000	203003	3375.85	1.59523	2363.09	.438524	1.8449	1.3583	448.467	-11.203	0.86465	-24.002	.33307	.75952	1.317	2.222	1.367	1038.15	1410.10	707.83	961.43	615.09	835.46	205000
206000	203984	3239.98	1.53102	2267.98	.422903	1.7792	1.3339	446.315	-13.355	0.86050	-25.197	.33177	.78452	1.275	2.151	1.320	1035.65	1381.43	706.13	941.69	613.61	818.48	206000
207000	204964	3108.97	1.46912	2176.28	.407769	1.7156	1.3098	444.163	-15.507	0.85635	-26.393	.33048	.81046	1.234	2.083	1.275	1033.15	1353.22	704.42	922.65	612.13	801.78	207000
208000	205944	2982.67	1.40943	2087.87	.393108	1.6539	1.2860	442.011	-17.659	0.85220	-27.588	.32918	.83739	1.194	2.016	1.231	1030.65	1325.45	702.71	903.71	610.64	785.31	208000
209000	206925	2860.93	1.35191	2002.65	.378908	1.5941	1.2626	439.860	-19.810	0.84805	-28.783	.32788	.86534	1.156	1.950	1.188	1028.14	1298.12	701.00	885.08	609.16	769.11	209000
210000	207905	2743.62 -4	1.29647 -4	1920.53 -4	.365156 -6	1.5363 -4	1.2395 -2	437.709	-21.961	0.84391	-29.978	.32658 -6	.89436 +0	1.118 +0	1.887 +0	1.147 +3	1025.62	1271.22 -2	699.29	866.74 -2	607.66	753.18 -2	210000
211000	208885	2630.58	1.24306	1841.41	.351840	1.4803	1.2167	435.558	-24.112	0.83976	-31.173	.32528	.92450	1.082	1.826	1.107	1023.10	1244.76	697.57	848.70	606.17	737.50	211000
212000	209865	2521.69	1.19160	1765.18	.338949	1.4260	1.1942	433.407	-26.263	0.83561	-32.368	.32397	.95581	1.046	1.766	1.068	1020.57	1218.72	695.84	830.95	604.67	722.07	212000
213000	210845	2416.80	1.14204	1691.76	.326471	1.3735	1.1720	431.257	-28.413	0.83147	-33.563	.32266	.98832	1.012	1.708	1.030	1018.03	1193.11	694.11	813.48	603.17	706.90	213000
214000	211825	2315.79	1.09431	1621.06	.314394	1.3227	1.1501	429.107	-30.563	0.82732	-34.757	.32135	.10221 +1	9.784 -1	1.651	9.935 +2	1015.49	1167.91	692.38	796.30	601.66	691.97	214000
215000	212805	2218.54	1.04835	1552.98	.302708	1.2735	1.1285	426.957	-32.713	0.82318	-35.952	.32003	.10572	9.459	1.596	9.581	1012.94	1143.12	690.64	779.40	600.15	677.28	215000
216000	213784	2124.92	1.00411	1487.45	.291402	1.2260	1.1072	424.807	-34.863	0.81903	-37.146	.31871	.10937	9.143	1.543	9.238	1010.39	1118.74	688.90	762.78	598.64	662.84	216000
217000	214764	2034.82	9.61536 -5	1424.37	.280464	1.1800	1.0863	422.657	-37.013	0.81489	-38.341	.31739	.11317	8.837	1.491	8.906	1007.83	1094.77	687.16	746.43	597.12	648.63	217000
218000	215743	1948.11	9.20563	1363.68	.269886	1.1355	1.0656	420.508	-39.162	0.81074	-39.535	.31606	.11711	8.539	1.441	8.584	1005.27	1071.19	685.41	730.36	595.60	634.66	218000
219000	216723	1864.69	8.81144	1305.28	.259656	1.0924	1.0452	418.358	-41.312	0.80660	-40.729	.31474	.12121	8.250	1.392	8.272	1002.69	1048.00	683.65	714.55	594.08	620.93	219000

Table 2A-1 U.S. Standard Atmosphere, 1962 (continued)

Altitude Z ft	Altitude H ft	Pressure P lb/ft²	Pressure δ	Pressure q/M² (= 0.7P) lb/ft²	Density ρ slug/ft³	Density σ	Density √σ	Temperature T °R	Temperature t °F	Temperature θ (T/518.67)	Temperature t °C	Viscosity μ slug/ft-sec	Viscosity ν ft²/sec	N_{Re} "K" Factor K_{fps} 1/ft-fps	N_{Re} "K" Factor K_{kn} 1/ft-kn	N_{Re} "K" Factor K_M 1/ft-Mach	Speed of Sound a fps	Speed of Sound a√σ fps	Speed of Sound a mph	Speed of Sound a√σ mph	Speed of Sound a kn	Speed of Sound a√σ kn	Altitude Z ft
220000	217702	1784.45 -4	8.43226 -5	1249.11 -4	.249765 -6	1.0508 -4	1.0251 -2	416.209	-43.461	0.80245	-41.923	.31341 -6	.12548 +1	7.969 -1	1.365 +0	7.970 +2	1000.11	1025.21 -2	681.90	699.00 -2	592.55	607.42 -2	220000
221000	218681	1707.28	8.06759	1195.09	.240204	1.0106	1.0053	414.060	-45.610	0.79831	-43.116	.31207	.12992	7.697	1.299	7.678	997.53	1002.79	680.13	683.72	591.02	594.14	221000
222000	219660	1633.07	7.71695	1143.15	.230963	9.7170 -5	9.8575 -3	411.912	-47.758	0.79417	-44.310	.31074	.13454	7.433	1.255	7.395	994.94	9807.59 -3	678.37	668.70	589.49	581.08	222000
223000	220639	1561.74	7.37987	1093.22	.222032	9.3413	9.6650	409.763	-49.907	0.79003	-45.504	.30940	.13935	7.176	1.211	7.121	992.34	9591.00	676.60	653.93	587.95	568.25	223000
224000	221618	1493.18	7.05580	1045.22	.213403	8.9783	9.4754	407.615	-52.055	0.78588	-46.697	.30805	.14435	6.927	1.169	6.856	989.74	9378.10	674.82	639.42	586.40	555.64	224000
225000	222597	1427.29	6.74456	9991.04 -5	.205068	8.6276	9.2885	405.467	-54.203	0.78174	-47.891	.30671	.14956	6.686	1.128	6.600	987.12	9168.87	673.04	625.15	584.86	543.24	225000
226000	223575	1363.99	6.44543	9547.95	.197017	8.2889	9.1043	403.319	-56.351	0.77760	-49.084	.30536	.15499	6.452	1.089	6.352	984.51	8963.25	671.25	611.13	583.30	531.04	226000
227000	224554	1303.19	6.15812	9122.34	.189242	7.9618	8.9229	401.171	-58.499	0.77346	-50.277	.30401	.16065	6.225	1.051	6.112	981.88	8761.20	669.46	597.35	581.75	519.05	227000
228000	225533	1244.80	5.88220	8713.60	.181736	7.6460	8.7441	399.024	-60.646	0.76932	-51.470	.30266	.16654	6.005	1.015	5.880	979.25	8562.67	667.67	583.82	580.19	507.33	228000
229000	226511	1188.74	5.61727	8321.16	.174490	7.3411	8.5680	396.877	-62.793	0.76518	-52.663	.30130	.17267	5.791	9.775 -1	5.656	976.61	8367.63	665.87	570.52	578.63	495.77	229000
230000	227489	1134.92 -4	5.36296 -5	7944.44 -5	.167496 -6	7.0469 -5	8.3946 -3	394.730	-64.940	0.76104	-53.856	.29994 -6	.17907 +1	5.584 -1	9.425 -1	5.439 +2	973.97	8176.02 -3	664.07	557.46 -2	577.06	484.42 -2	230000
231000	228468	1083.27	5.11890	7582.89	.160748	6.7630	8.2237	392.583	-67.087	0.75690	-55.048	.29857	.18574	5.384	9.087	5.229	971.31	7987.81	662.26	544.62	575.49	473.27	231000
232000	229446	1033.71	4.88471	7235.98	.154237	6.4890	8.0555	390.436	-69.234	0.75276	-56.241	.29721	.19269	5.190	8.759	5.027	968.65	7802.95	660.45	532.02	573.91	462.31	232000
233000	230424	9861.70 -5	4.66006	6903.19	.147957	6.2248	7.8898	388.290	-71.380	0.74863	-57.433	.29584	.19995	5.001	8.441	4.831	965.99	7621.41	658.63	519.64	572.33	451.56	233000
234000	231402	9405.74	4.44460	6584.01	.141900	5.9700	7.7266	386.144	-73.526	0.74449	-58.626	.29446	.20752	4.819	8.133	4.642	963.32	7443.13	656.81	507.49	570.75	440.95	234000
235000	232380	8968.53	4.23800	6277.97	.136061	5.7243	7.5659	383.998	-75.672	0.74035	-59.818	.29309	.21541	4.642	7.835	4.460	960.63	7268.09	654.98	495.55	569.16	430.62	235000
236000	233357	8549.40	4.03995	5984.58	.130431	5.4875	7.4077	381.852	-77.818	0.73621	-61.010	.29171	.22365	4.471	7.547	4.283	957.95	7096.22	653.15	483.83	567.57	420.44	236000
237000	234335	8147.70	3.85013	5703.39	.125005	5.2592	7.2520	379.706	-79.964	0.73208	-62.202	.29033	.23225	4.306	7.267	4.113	955.25	6927.51	651.31	472.33	565.97	410.44	237000
238000	235313	7762.79	3.66824	5433.96	.119776	5.0392	7.0987	377.561	-82.109	0.72794	-63.394	.28894	.24123	4.145	6.997	3.949	952.55	6761.89	649.47	461.04	564.37	400.62	238000
239000	236290	7394.06	3.49400	5175.85	.114739	4.8273	6.9479	375.416	-84.254	0.72380	-64.586	.28755	.25062	3.990	6.735	3.790	949.84	6599.35	647.62	449.96	562.77	391.00	239000
240000	237268	7040.92 -5	3.32713 -5	4928.64 -5	.109887 -6	4.6231 -5	6.7994 -3	373.271	-86.399	0.71967	-65.777	.28616 -6	.26042 +1	3.840 -1	6.481 -1	3.637 +2	947.12	6439.83 -3	645.76	439.08 -2	561.16	381.55 -2	240000
241000	238245	6702.78	3.16734	4691.95	.105214	4.4265	6.6532	371.126	-88.544	0.71553	-66.969	.28477	.27065	3.695	6.236	3.489	944.40	6283.29	643.91	428.41	559.54	372.28	241000
242000	239222	6379.09	3.01438	4465.36	.100715	4.2373	6.5094	368.981	-90.689	0.71140	-68.160	.28337	.28136	3.554	5.999	3.347	941.66	6129.69	642.04	417.93	557.92	363.18	242000
243000	240199	6069.31	2.86800	4248.52	.963843 -7	4.0551	6.3679	366.837	-92.833	0.70726	-69.352	.28197	.29254	3.418	5.769	3.210	938.92	5979.01	640.18	407.66	556.30	354.25	243000
244000	241176	5772.92	2.72794	4041.04	.922164	3.8797	6.2287	364.693	-94.977	0.70313	-70.543	.28056	.30424	3.287	5.548	3.077	936.18	5831.19	638.30	397.58	554.67	345.49	244000
245000	242153	5489.40	2.59397	3842.58	.882061	3.7110	6.0918	362.549	-97.121	0.69900	-71.734	.27915	.31648	3.160	5.333	2.949	933.42	5686.20	636.42	387.70	553.04	336.90	245000
246000	243130	5218.28	2.46585	3652.79	.843483	3.5487	5.9571	360.405	-99.265	0.69486	-72.925	.27774	.32928	3.037	5.126	2.826	930.66	5544.00	634.54	378.00	551.40	328.47	246000
247000	244107	4959.07	2.34337	3471.35	.806381	3.3926	5.8246	358.262	-101.408	0.69073	-74.116	.27633	.34268	2.918	4.925	2.708	927.88	5404.55	632.65	368.49	549.76	320.21	247000
248000	245084	4711.32	2.22629	3297.92	.770705	3.2425	5.6943	356.118	-103.552	0.68660	-75.307	.27491	.35670	2.803	4.732	2.594	925.10	5267.82	630.75	359.17	548.11	312.11	248000
249000	246060	4474.58	2.11443	3132.21	.736411	3.0982	5.5662	353.975	-105.695	0.68247	-76.497	.27349	.37138	2.693	4.545	2.483	922.32	5133.76	628.85	350.03	546.46	304.17	249000
250000	247037	4248.43 -5	2.00756 -5	2973.90 -5	.703450 -7	2.9595 -5	5.4402 -3	351.832	-107.838	0.67834	-77.688	.27206 -6	.38676 +1	2.586 -1	4.364 -1	2.378 +2	919.52	5002.35 -3	626.95	341.07 -2	544.80	296.38 -2	250000
251000	248013	4032.45	1.90550	2822.72	.671780	2.8263	5.3163	349.689	-109.981	0.67420	-78.878	.27063	.40286	2.482	4.190	2.276	916.72	4873.54	625.03	332.29	543.14	288.75	251000
252000	248989	3826.25	1.80806	2678.37	.641357	2.6983	5.1945	347.547	-112.123	0.67007	-80.068	.26920	.41974	2.382	4.021	2.177	913.90	4747.29	623.12	323.68	541.47	281.27	252000
253000	249966	3629.43	1.71505	2540.60	.612139	2.5754	5.0748	345.404	-114.266	0.66594	-81.259	.26777	.43743	2.286	3.858	2.083	911.08	4623.58	621.19	315.24	539.80	273.94	253000
254000	250942	3441.62	1.62631	2409.13	.584084	2.4574	4.9572	343.262	-116.408	0.66181	-82.449	.26633	.45598	2.193	3.702	1.992	908.25	4502.36	619.26	306.98	538.13	266.76	254000
255000	251918	3262.46	1.54165	2283.72	.557156	2.3441	4.8415	341.120	-118.550	0.65768	-83.639	.26489	.47543	2.103	3.550	1.904	905.42	4383.61	617.33	298.88	536.44	259.72	255000
256000	252894	3091.60	1.46091	2164.12	.531313	2.2353	4.7279	338.979	-120.691	0.65355	-84.829	.26344	.49583	2.017	3.404	1.820	902.57	4267.28	615.39	290.95	534.76	252.83	256000
257000	253869	2928.70	1.38393	2050.09	.506519	2.1310	4.6163	336.837	-122.833	0.64942	-86.018	.26199	.51724	1.933	3.263	1.739	899.71	4153.33	613.44	283.18	533.07	246.08	257000
258000	254845	2773.45	1.31057	1941.41	.482736	2.0310	4.5066	334.696	-124.974	0.64530	-87.208	.26054	.53972	1.853	3.127	1.662	896.85	4041.75	611.49	275.57	531.37	239.47	258000
259000	255821	2625.52	1.24067	1837.86	.459930	1.9350	4.3989	332.555	-127.115	0.64117	-88.397	.25908	.56331	1.775	2.996	1.587	893.98	3932.48	609.53	268.12	529.67	232.99	259000
260000	256796	2484.61 -5	1.17408 -5	1739.23 -5	.438067 -7	1.8430 -5	4.2930 -3	330.414	-129.256	0.63704	-89.587	.25762 -6	.58809 +1	1.700 -1	2.870 -1	1.515 +2	891.09	3825.50 -3	607.56	260.83 -2	527.96	226.66 -2	260000
261000	257772	2350.44	1.11068	1645.31	.417113	1.7549	4.1891	328.273	-131.397	0.63291	-90.776	.25616	.61413	1.628	2.748	1.446	888.20	3720.78	605.59	253.69	526.25	220.45	261000
262000	258747	2222.71	1.05032	1555.90	.397035	1.6704	4.0871	326.132	-133.538	0.62879	-91.965	.25469	.64149	1.559	2.631	1.380	885.30	3618.27	603.61	246.70	524.53	214.38	262000
262449	259186	2167.31 -5	1.02414 -5	1517.11 -5	.388284 -7	1.6336 -5	4.0418 -3	325.170	-134.500	0.62693	-92.500	.25403 -6	.65424 +1	1.528 -1	2.580 -1	1.351 +2	883.99	3572.89 -3	602.72	243.61 -2	523.75	211.65 -2	262449
263000	259723	2101.28	9.92943 -6	1470.90	.376456	1.5838	3.9797	325.170	-134.500	0.62693	-92.500	.25403	.67480	1.482	2.501	1.310	883.99	3518.05	602.72	239.87	523.75	208.44	263000
264000	260698	1986.43	9.38648	1390.50	.355879	1.4972	3.8694	325.170	-134.500	0.62693	-92.500	.25403	.71382	1.401	2.364	1.236	883.99	3420.55	602.72	233.22	523.75	202.66	264000
265000	261673	1877.86	8.87365	1314.50	.336428	1.4154	3.7622	325.170	-134.500	0.62693	-92.500	.25403	.75509	1.324	2.235	1.171	883.99	3325.76	602.72	226.76	523.75	197.05	265000
266000	262648	1775.23	8.38870	1242.66	.318042	1.3381	3.6579	325.170	-134.500	0.62693	-92.500	.25403	.79874	1.252	2.113	1.107	883.99	3233.60	602.72	220.47	523.75	191.59	266000
267000	263623	1678.22	7.93029	1174.76	.300662	1.2649	3.5566	325.170	-134.500	0.62693	-92.500	.25403	.84491	1.184	1.998	1.046	883.99	3144.01	602.72	214.36	523.75	186.28	267000
268000	264598	1586.52	7.49698	1110.57	.284234	1.1958	3.4581	325.170	-134.500	0.62693	-92.500	.25403	.89375	1.119	1.888	9.891 +1	883.99	3056.91	602.72	208.43	523.75	181.12	268000
269000	265572	1499.84	7.08737	1049.89	.268705	1.1305	3.3623	325.170	-134.500	0.62693	-92.500	.25403	.94540	1.058	1.765	9.350	883.99	2972.23	602.72	202.65	523.75	176.10	269000
270000	266547	1417.90 -5	6.70019 -6	9925.33 -6	.254025 -7	1.0687 -5	3.2691 -3	325.170	-134.500	0.62693	-92.500	.25403 -6	.10000 +2	10.000 -2	1.688 -1	8.840 +1	883.99	2889.90 -3	602.72	197.04 -2	523.75	171.22 -2	270000
271000	267521	1340.45	6.33419	9383.16	.240149	1.0103	3.1786	325.170	-134.500	0.62693	-92.500	.25403	.10578	9.453	1.596	8.357	883.99	2809.86	602.72	191.58	523.75	166.48	271000
272000	268496	1267.23	5.98821	8870.64	.227032	9.5516 -6	3.0906	325.170	-134.500	0.62693	-92.500	.25403	.11189	8.937	1.508	7.900	883.99	2732.05	602.72	186.28	523.75	161.87	272000
273000	269470	1198.02	5.66116	8386.17	.214632	9.0300	3.0050	325.170	-134.500	0.62693	-92.500	.25403	.11836	8.449	1.426	7.469	883.99	2656.39	602.72	181.12	523.75	157.39	273000
274000	270445	1132.60	5.35200	7928.20	.202911	8.5368	2.9218	325.170	-134.500	0.62693	-92.500	.25403	.12519	7.988	1.348	7.061	883.99	2582.84	602.72	176.10	523.75	153.03	274000
275000	271419	1070.75	5.05975	7495.27	.191831	8.0707	2.8409	325.170	-134.500	0.62693	-92.500	.25403	.13243	7.551	1.275	6.675	883.99	2511.33	602.72	171.23	523.75	148.79	275000
276000	272393	1012.29	4.78349	7086.03	.181357	7.6300	2.7622	325.170	-134.500	0.62693	-92.500	.25403	.14007	7.139	1.205	6.311	883.99	2441.81	602.72	166.49	523.75	144.67	276000
277000	273367	9570.24 -6	4.52233	6699.17	.171456	7.2135	2.6858	325.170	-134.500	0.62693	-92.500	.25403	.14816	6.749	1.139	5.966	883.99	2374.22	602.72	161.88	523.75	140.67	277000
278000	274341	9047.79	4.27546	6333.46	.162096	6.8197	2.6114	325.170	-134.500	0.62693	-92.500	.25403	.15672	6.381	1.077	5.641	883.99	2308.50	602.72	157.40	523.75	136.78	278000
279000	275315	8553.92	4.04208	5987.74	.153248	6.4474	2.5392	325.170	-134.500	0.62693	-92.500	.25403	.16577	6.033	1.018	5.333	883.99	2244.62	602.72	153.04	523.75	132.99	279000
280000	276288	8087.04 -6	3.82146 -6	5660.93 -6	.144884 -7	6.0955 -6	2.4689 -3	325.170	-134.500	0.62693	-92.500	.25403 -6	.17534 +2	5.703 -2	9.626 -2	5.042 +1	883.99	2182.50 -3	602.72	148.81 -2	523.75	129.31 -2	280000
281000	277262	7645.69	3.61291	5351.98	.136977	5.7628	2.4006	325.170	-134.500	0.62693	-92.500	.25403	.18546	5.392	9.101	4.767	883.99	2122.11	602.72	144.69	523.75	125.73	281000
282000	278235	7228.46	3.41575	5059.92	.129502	5.4484	2.3342	325.170	-134.500	0.62693	-92.500	.25403	.19616	5.098	8.604	4.506	883.99	2063.40	602.72	140.69	523.75	122.25	282000
283000	279209	6834.04	3.22937	4783.83	.122436	5.1511	2.2696	325.170	-134.500	0.62693	-92.500	.25403	.20748	4.820	8.135	4.261	883.99	2006.31	602.72	136.79	523.75	118.87	283000
284000	280182	6461.18	3.05317	4522.82	.115755	4.8700	2.2068	325.170	-134.500	0.62693	-92.500	.25403	.21946	4.557	7.691	4.028	883.99	1950.81	602.72	133.01	523.75	115.58	284000
285000	281155	6108.69	2.88661	4276.08	.109440	4.6043	2.1458	325.170	-134.500	0.62693	-92.500	.25403	.23212	4.308	7.271	3.808	883.99	1896.85	602.72	129.33	523.75	112.38	285000
286000	282129	5775.46	2.72914	4042.82	.103470	4.3532	2.0864	325.170	-134.500	0.62693	-92.500	.25403	.24551	4.073	6.875	3.601	883.99	1844.39	602.72	125.75	523.75	109.26	286000
287000	283102	5460.43	2.58028	3822.30	.978266 -8	4.1157	2.0287	325.170	-134.500	0.62693	-92.500	.25403	.25968	3.851	6.500	3.404	883.99	1793.38	602.72	122.28	523.75	106.26	287000
288000	284075	5162.62	2.43955	3613.83	.924911	3.8913	1.9726	325.170	-134.500	0.62693	-92.500	.25403	.27466	3.641	6.145	3.219	883.99	1743.79	602.72	118.89	523.75	103.32	288000
289000	285047	4881.08	2.30651	3416.75	.874471	3.6791	1.9181	325.170	-134.500	0.62693	-92.500	.25403	.29050	3.442	5.810	3.043	883.99	1695.58	602.72	115.61	523.75	100.46	289000
290000	286020	4614.91 -6	2.18074 -6	3230.44 -6	.826784 -8	3.4784 -6	1.8651 -3	325.170	-134.500	0.62693	-92.500	.25403 -6	.30725 +2	3.255 -2	5.493 -2	2.877 +1	883.99	1648.70 -3	602.72	112.41 -2	523.75	976.83 -3	290000
291000	286993	4363.28	2.06183	3054.30	.781705	3.2888	1.8135	325.170	-134.500	0.62693	-92.500	.25403	.32497	3.077	5.194	2.720	883.99	1603.12	602.72	109.30	523.75	949.82	291000
292000	287966	4125.40	1.94942	2887.78	.739087	3.1095	1.7634	325.170	-134.500	0.62693	-92.500	.25403	.34371	2.909	4.911	2.572	883.99	1558.81	602.72	106.28	523.75	923.57	292000
293000	288938	3900.50	1.84315	2730.35	.698795	2.9400	1.7146	325.170	-134.500	0.62693	-92.500	.25403	.36353	2.751	4.643	2.432	883.99	1515.72	602.72	103.34	523.75	898.04	293000
294000	289911	3687.88	1.74268	2581.52	.660704	2.7797	1.6672	325.170	-134.500	0.62693	-92.500	.25403	.38449	2.601	4.390	2.299	883.99	1473.83	602.72	100.49	523.75	873.22	294000
295000	290883	3486.88	1.64769	2440.81	.624692	2.6282	1.6212	325.170	-134.500	0.62693	-92.500	.25403	.40665	2.459	4.150	2.174	883.99	1433.10	602.72	977.12 -3	523.75	849.09	295000
295275	291151	3433.38 -6	1.62242 -6	2403.37 -6	.615109 -8	2.5879 -6	1.6087 -3	325.170	-134.500	0.62693	-92.500	.25403 -6	.41299 +2	2.421 -2	4.087 -2	2.140 +1	883.99	1422.07 -3	602.72	969.59 -3	523.75	842.55 -3	295275

Table 2A-2 - Hot Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A

H ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ slugs/ft³	ρg lb/ft³	σ ρ/ρ_0	$\sigma^{1/2}$	q/M^2 lb/ft²	p lb/ft²	p lb/in.²	p in. Hg	p mb	δ p/p_0	μ lb-sec/ft²	ν ft²/sec
0	-.0	562.7	103.00	39.44	312.6	1162.8	689.0	661.5	.002191	.07050	.9218	.960	1481.4	2116.2	14.70	29.92	1,013.2	1.00000	.0000003993	.0001822
500	485.7	560.8	101.15	38.42	311.6	1160.9	687.8	655.7	.002160	.06950	.9087	.953	1455.5	2079.3	14.44	29.40	995.6	.98257	.0000003982	.0001844
1000	969.8	559.0	99.30	37.39	310.5	1159.0	686.7	649.9	.002129	.06851	.8958	.946	1430.2	2043.1	14.19	28.89	978.2	.96545	.0000003972	.0001865
1500	1452.4	557.1	97.45	36.36	309.5	1157.1	685.6	644.3	.002099	.06754	.8832	.940	1405.2	2007.5	13.94	28.38	961.2	.94862	.0000003962	.0001887
2000	1933.4	555.3	95.60	35.33	308.5	1155.2	684.4	638.4	.002069	.06658	.8706	.933	1380.7	1972.5	13.70	27.89	944.4	.93208	.0000003952	.0001910
2500	2412.8	553.4	93.75	34.31	307.5	1153.2	683.3	633.0	.002040	.06564	.8583	.926	1356.7	1938.1	13.46	27.40	928.0	.91583	.0000003941	.0001932
3000	2890.8	551.6	91.90	33.28	306.4	1151.3	682.1	627.5	.002011	.06471	.8462	.920	1333.0	1904.3	13.22	26.92	911.8	.89986	.0000003931	.0001954
3500	3367.2	549.7	90.05	32.25	305.4	1149.4	681.0	622.0	.001983	.06380	.8342	.913	1309.8	1871.1	12.99	26.46	895.9	.88417	.0000003921	.0001977
4000	3842.0	547.9	88.20	31.22	304.4	1147.4	679.8	616.5	.001955	.06290	.8224	.907	1286.9	1838.4	12.77	25.99	880.3	.86874	.0000003910	.0002000
4500	4315.4	546.0	86.35	30.19	303.4	1145.5	678.7	611.1	.001927	.06201	.8108	.900	1264.5	1806.4	12.54	25.54	864.9	.85359	.0000003900	.0002024
5000	4787.3	544.2	84.50	29.17	302.3	1143.6	677.5	605.8	.001900	.06113	.7994	.894	1242.4	1774.9	12.33	25.09	849.8	.83869	.0000003890	.0002047
5500	5257.6	542.3	82.65	28.14	301.3	1141.6	676.4	600.5	.001873	.06027	.7881	.888	1220.7	1743.9	12.11	24.66	835.0	.82406	.0000003879	.0002071
6000	5726.5	540.5	80.80	27.11	300.3	1139.7	675.2	595.2	.001847	.05942	.7770	.881	1199.4	1713.4	11.90	24.23	820.4	.80967	.0000003869	.0002095
6500	6193.9	538.6	78.95	26.08	299.2	1137.7	674.1	590.0	.001821	.05859	.7661	.875	1178.5	1683.5	11.69	23.80	806.1	.79554	.0000003859	.0002119
7000	6659.8	536.8	77.10	25.06	298.2	1135.8	672.9	584.8	.001795	.05776	.7553	.869	1157.9	1654.1	11.49	23.39	792.0	.78165	.0000003848	.0002143
7500	7124.3	534.9	75.25	24.03	297.2	1133.8	671.8	579.7	.001770	.05695	.7447	.863	1137.7	1625.2	11.29	22.98	778.2	.76799	.0000003838	.0002168
8000	7587.3	533.1	73.40	23.00	296.2	1131.8	670.6	574.6	.001745	.05615	.7342	.857	1117.8	1596.9	11.09	22.58	764.6	.75458	.0000003827	.0002193
8500	8048.8	531.2	71.55	21.97	295.1	1129.9	669.4	569.6	.001721	.05536	.7239	.851	1098.3	1569.0	10.90	22.18	751.2	.74139	.0000003817	.0002218
9000	8508.9	529.4	69.70	20.94	294.1	1127.9	668.3	564.6	.001696	.05458	.7137	.845	1079.1	1541.5	10.71	21.80	738.1	.72844	.0000003806	.0002244
9500	8967.6	527.5	67.85	19.92	293.1	1125.9	667.1	559.6	.001673	.05382	.7037	.839	1060.2	1514.6	10.52	21.41	725.2	.71570	.0000003796	.0002269
10000	9424.8	525.7	66.00	18.89	292.0	1124.0	665.9	554.7	.001649	.05306	.6938	.833	1041.7	1488.1	10.33	21.04	712.5	.70319	.0000003785	.0002295
10500	9924.0	523.8	64.15	17.86	291.0	1122.0	664.8	549.4	.001623	.05223	.6830	.826	1021.7	1459.6	10.14	20.64	698.9	.68973	.0000003775	.0002325
11000	10421.0	522.0	62.30	16.83	290.0	1120.0	663.6	544.1	.001598	.05141	.6723	.820	1002.2	1431.7	9.94	20.24	685.5	.67654	.0000003764	.0002356
11500	10915.9	520.1	60.45	15.81	289.0	1118.0	662.4	538.9	.001573	.05061	.6618	.813	983.0	1404.3	9.75	19.86	672.4	.66361	.0000003754	.0002386
12000	11408.6	518.3	58.60	14.78	287.9	1116.0	661.2	533.7	.001548	.04982	.6514	.807	964.3	1377.5	9.57	19.48	659.6	.65093	.0000003743	.0002417
12500	11899.2	516.4	56.75	13.75	286.9	1114.0	660.0	528.6	.001524	.04904	.6413	.801	945.9	1351.2	9.38	19.10	647.0	.63851	.0000003732	.0002449
13000	12387.7	514.6	54.90	12.72	285.9	1112.0	658.9	523.5	.001501	.04828	.6313	.795	927.8	1325.4	9.20	18.74	634.6	.62633	.0000003722	.0002480
13500	12874.0	512.7	53.05	11.69	284.9	1110.0	657.7	518.5	.001477	.04753	.6215	.788	910.1	1300.2	9.03	18.38	622.5	.61439	.0000003711	.0002512
14000	13358.3	510.9	51.20	10.67	283.8	1108.0	656.5	513.5	.001454	.04679	.6119	.782	892.8	1275.4	8.86	18.03	610.7	.60268	.0000003700	.0002544
14500	13840.5	509.0	49.35	9.64	282.8	1106.0	655.3	508.6	.001432	.04607	.6024	.776	875.8	1251.1	8.69	17.69	599.0	.59121	.0000003690	.0002577
15000	14320.7	507.2	47.50	8.61	281.8	1104.0	654.1	503.7	.001410	.04536	.5931	.770	859.1	1227.3	8.52	17.35	587.6	.57996	.0000003679	.0002610
15500	14798.7	505.3	45.65	7.58	280.7	1102.0	652.9	498.9	.001388	.04466	.5840	.764	842.8	1204.0	8.36	17.02	576.5	.56893	.0000003668	.0002643
16000	15274.8	503.5	43.80	6.56	279.7	1100.0	651.7	494.2	.001367	.04397	.5750	.758	826.8	1181.1	8.20	16.70	565.5	.55812	.0000003657	.0002676
16500	15748.8	501.6	41.95	5.53	278.7	1097.9	650.5	489.5	.001346	.04329	.5661	.752	811.1	1158.7	8.05	16.38	554.8	.54752	.0000003647	.0002710
17000	16220.7	499.8	40.10	4.50	277.7	1095.9	649.3	484.8	.001325	.04263	.5574	.747	795.7	1136.7	7.89	16.07	544.2	.53713	.0000003636	.0002744
17500	16690.7	497.9	38.25	3.47	276.6	1093.9	648.1	480.2	.001305	.04198	.5489	.741	780.6	1115.1	7.74	15.77	533.9	.52694	.0000003625	.0002779
18000	17158.6	496.1	36.40	2.44	275.6	1091.9	646.9	475.6	.001285	.04133	.5405	.735	765.8	1094.0	7.60	15.47	523.8	.51695	.0000003614	.0002813
18500	17624.6	494.2	34.55	1.42	274.6	1089.8	645.7	471.1	.001265	.04070	.5322	.730	751.3	1073.3	7.45	15.17	513.9	.50716	.0000003603	.0002848
19000	18088.6	492.4	32.70	.39	273.5	1087.8	644.5	466.6	.001246	.04008	.5241	.724	737.1	1052.9	7.31	14.89	504.1	.49756	.0000003593	.0002884
19500	18550.6	490.5	30.85	-.64	272.5	1085.7	643.3	462.2	.001227	.03947	.5162	.718	723.1	1033.0	7.17	14.61	494.6	.48814	.0000003582	.0002919
20000	19010.7	488.7	29.00	-1.67	271.5	1083.7	642.1	457.8	.001208	.03887	.5083	.713	709.4	1013.5	7.04	14.33	485.3	.47891	.0000003571	.0002955
20500	19520.3	486.8	27.15	-2.69	270.5	1081.6	640.8	452.9	.001187	.03820	.4995	.707	694.5	992.2	6.89	14.03	475.1	.46885	.0000003560	.0002998
21000	20027.6	485.0	25.30	-3.72	269.4	1079.6	639.6	448.2	.001167	.03754	.4909	.701	680.0	971.4	6.75	13.73	465.1	.45901	.0000003549	.0003042
21500	20532.6	483.1	23.45	-4.75	268.4	1077.5	638.4	443.4	.001147	.03689	.4824	.695	665.7	951.0	6.60	13.45	455.3	.44938	.0000003538	.0003085
22000	21035.4	481.3	21.60	-5.78	267.4	1075.4	637.2	438.7	.001127	.03626	.4741	.689	651.7	931.0	6.47	13.16	445.8	.43995	.0000003527	.0003130
22500	21535.9	479.4	19.75	-6.81	266.4	1073.4	636.0	434.1	.001108	.03564	.4660	.683	638.1	911.5	6.33	12.89	436.4	.43073	.0000003516	.0003174
23000	22034.1	477.6	17.90	-7.83	265.3	1071.3	634.7	429.6	.001089	.03503	.4580	.677	624.7	892.4	6.20	12.62	427.3	.42170	.0000003505	.0003220
23500	22530.2	475.7	16.05	-8.86	264.3	1069.2	633.5	425.0	.001070	.03442	.4501	.671	611.6	873.7	6.07	12.35	418.3	.41287	.0000003494	.0003266
24000	23024.0	473.9	14.20	-9.89	263.3	1067.1	632.3	420.6	.001052	.03384	.4424	.665	598.8	855.4	5.94	12.09	409.6	.40423	.0000003483	.0003312
24500	23515.5	472.0	12.35	-10.92	262.2	1065.1	631.0	416.1	.001034	.03326	.4349	.659	586.3	837.5	5.82	11.84	401.0	.39577	.0000003472	.0003359

Table 2A-2 - Hot Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A (continued)

H ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ slugs/ ft³	ρg lb/ ft³	σ, ρ/ρ_o	$\sigma^{1/2}$	q/M^2 lb/ ft²	p lb/ ft²	p lb/ in.²	p in. Hg	p mb	δ p/p_o	μ lb-sec/ ft²	ν ft²/ sec
25000	24004.9	470.2	10.50	−11.94	261.2	1063.0	629.8	411.8	.001016	.03269	.4275	.654	574.0	820.0	5.69	11.59	392.6	.38749	.0000003461	.0003406
25500	24492.1	468.3	8.65	−12.97	260.2	1060.9	628.6	407.4	.000999	.03213	.4202	.648	562.0	802.9	5.58	11.35	384.4	.37939	.0000003450	.0003454
26000	24977.2	466.5	6.80	−14.00	259.2	1058.8	627.3	403.2	.000982	.03159	.4130	.643	550.3	786.1	5.46	11.11	376.4	.37146	.0000003439	.0003503
26500	25460.1	464.6	4.95	−15.03	258.1	1056.7	626.1	398.9	.000965	.03105	.4060	.637	538.8	769.7	5.34	10.88	368.5	.36370	.0000003427	.0003552
27000	25940.8	462.8	3.10	−16.06	257.1	1054.6	624.8	394.7	.000949	.03052	.3991	.632	527.5	753.6	5.23	10.66	360.8	.35611	.0000003416	.0003601
27500	26419.4	460.9	1.25	−17.08	256.1	1052.5	623.6	390.6	.000933	.03001	.3924	.626	516.5	737.9	5.12	10.43	353.3	.34867	.0000003405	.0003651
28000	26895.9	459.1	−.60	−18.11	255.0	1050.3	622.3	386.5	.000917	.02950	.3857	.621	505.7	722.5	5.02	10.22	345.9	.34140	.0000003394	.0003702
28500	27370.3	457.2	−2.45	−19.14	254.0	1048.2	621.1	382.4	.000901	.02900	.3792	.616	495.2	707.4	4.91	10.00	338.7	.33428	.0000003383	.0003753
29000	27842.6	455.4	−4.30	−20.17	253.0	1046.1	619.8	378.4	.000886	.02851	.3728	.611	484.9	692.7	4.81	9.79	331.6	.32731	.0000003371	.0003805
29500	28312.8	453.5	−6.15	−21.19	252.0	1044.0	618.5	374.5	.000871	.02803	.3665	.605	474.8	678.2	4.71	9.59	324.7	.32049	.0000003360	.0003857
30000	28781.0	451.7	−8.00	−22.22	250.9	1041.8	617.3	370.6	.000857	.02756	.3604	.600	464.9	664.1	4.61	9.39	318.0	.31381	.0000003349	.0003910
30500	29306.9	449.8	−9.85	−23.25	249.9	1039.7	616.0	366.2	.000840	.02702	.3534	.594	454.0	648.5	4.50	9.17	310.5	.30645	.0000003338	.0003974
31000	29830.4	448.0	−11.70	−24.28	248.9	1037.6	614.7	361.9	.000824	.02650	.3465	.589	443.3	633.3	4.40	8.95	303.2	.29926	.0000003326	.0004039
31500	30351.4	446.1	−13.55	−25.31	247.9	1035.4	613.5	357.6	.000808	.02598	.3398	.583	432.9	618.4	4.29	8.74	296.1	.29224	.0000003315	.0004105
32000	30869.9	444.3	−15.40	−26.33	246.8	1033.3	612.2	353.4	.000792	.02548	.3332	.577	422.8	603.9	4.19	8.54	289.2	.28538	.0000003304	.0004172
32500	31386.0	442.4	−17.25	−27.36	245.8	1031.1	610.9	349.2	.000777	.02499	.3267	.572	412.8	589.8	4.10	8.34	282.4	.27869	.0000003292	.0004239
33000	31899.8	440.6	−19.10	−28.39	244.8	1029.0	609.6	345.1	.000762	.02450	.3204	.566	403.2	575.9	4.00	8.14	275.8	.27216	.0000003281	.0004308
33500	32411.1	438.7	−20.95	−29.42	243.7	1026.8	608.4	341.0	.000747	.02403	.3142	.561	393.7	562.4	3.91	7.95	269.3	.26578	.0000003269	.0004377
34000	32920.0	436.9	−22:80	−30.44	242.7	1024.6	607.1	337.0	.000732	.02357	.3081	.555	384.5	549.3	3.81	7.77	263.0	.25955	.0000003258	.0004448
34500	33426.5	435.0	−24.65	−31.47	241.7	1022.5	605.8	333.0	.000718	.02311	.3022	.550	375.5	536.4	3.72	7.58	256.8	.25347	.0000003246	.0004520
35000	33930.7	433.2	−26.50	−32.50	240.7	1020.3	604.5	329.1	.000704	.02267	.2964	.544	366.7	523.8	3.64	7.41	250.8	.24753	.0000003235	.0004592
35500	34488.4	431.3	−28.35	−33.53	239.6	1018.1	603.2	324.8	.000689	.02217	.2899	.538	357.1	510.2	3.54	7.21	244.3	.24109	.0000003223	.0004678
36000	35043.5	429.5	−30.20	−34.56	238.6	1015.9	601.9	320.5	.000674	.02169	.2836	.533	347.8	496.9	3.45	7.03	237.9	.23482	.0000003212	.0004765
36500	35595.9	427.6	−32.05	−35.58	237.6	1013.7	600.6	316.3	.000659	.02121	.2774	.527	338.8	484.0	3.36	6.84	231.7	.22871	.0000003200	.0004854
37000	36145.7	425.8	−33.90	−36.61	236.5	1011.5	599.3	312.2	.000645	.02075	.2714	.521	330.0	471.4	3.27	6.67	225.7	.22275	.0000003189	.0004944
37500	36694.5	423.9	−35.75	−37.64	235.5	1009.3	598.0	308.1	.0006309	.02030	.2654	.5152	321.4	459.12	3.188	6.492	219.8	.21695	.0000003177	.000504
38000	37243.5	422.1	−37.60	−38.67	234.5	1007.1	596.7	304.1	.0006172	.01986	.2597	.5096	313.0	447.17	3.105	6.323	214.1	.21130	.0000003165	.000513
38500	37792.7	420.2	−39.45	−39.69	233.5	1004.9	595.4	300.1	.0006038	.01943	.2540	.5040	304.9	435.52	3.024	6.158	208.5	.20580	.0000003154	.000522
39000	38342.0	418.4	−41.30	−40.72	232.4	1002.7	594.1	296.1	.0005906	.01900	.2485	.4985	296.9	424.17	2.946	5.997	203.1	.20044	.0000003142	.000532
39500	38891.4	416.5	−43.15	−41.75	231.4	1000.5	592.8	292.3	.0005778	.01859	.2431	.4930	289.2	413.12	2.869	5.841	197.8	.19521	.0000003130	.000542
40000	39441.1	414.7	−45.00	−42.78	230.4	998.3	591.5	288.4	.0005652	.01819	.2378	.4877	281.6	402.34	2.794	5.689	192.6	.19012	.0000003119	.000552
40500	39983.4	414.9	−44.77	−42.65	230.5	998.5	591.6	284.7	.0005504	.01771	.2316	.4812	274.4	391.99	2.722	5.542	187.7	.18523	.0000003120	.000567
41000	40524.6	415.1	−44.55	−42.53	230.6	998.8	591.8	281.0	.0005360	.01724	.2255	.4749	267.3	381.93	2.652	5.400	182.9	.18048	.0000003122	.000582
41500	41065.0	415.4	−44.32	−42.40	230.8	999.1	591.9	277.4	.0005219	.01679	.2196	.4686	260.5	372.14	2.584	5.262	178.2	.17585	.0000003123	.000598
42000	41604.3	415.6	−44.09	−42.27	230.9	999.4	592.1	273.8	.0005083	.01635	.2139	.4624	253.8	362.61	2.518	5.127	173.6	.17135	.0000003125	.000615
42500	42142.7	415.8	−43.86	−42.15	231.0	999.6	592.3	270.3	.0004951	.01593	.2083	.4564	247.3	353.35	2.454	4.996	169.2	.16697	.0000003126	.000631
43000	42680.1	416.1	−43.64	−42.02	231.1	999.9	592.4	266.8	.0004822	.01551	.2029	.4504	241.0	344.34	2.391	4.869	164.9	.16272	.0000003127	.000649
43500	43216.5	416.3	−43.41	−41.89	231.3	1000.2	592.6	263.4	.0004696	.01511	.1976	.4445	234.9	335.58	2.330	4.745	160.7	.15857	.0000003129	.000666
44000	43751.9	416.5	−43.18	−41.77	231.4	1000.4	592.7	260.0	.0004575	.01472	.1925	.4387	228.9	327.05	2.271	4.624	156.6	.15454	.0000003130	.000684
44500	44286.4	416.7	−42.95	−41.64	231.5	1000.7	592.9	256.7	.0004456	.01434	.1875	.4330	223.1	318.76	2.214	4.507	152.6	.15063	.0000003132	.000703
45000	44781.4	417.0	−42.73	−41.52	231.6	1001.0	593.1	253.7	.0004349	.01399	.1830	.4277	217.9	311.26	2.162	4.401	149.0	.14708	.0000003133	.000720
45500	45250.6	417.2	−42.50	−41.39	231.8	1001.3	593.2	250.8	.0004250	.01367	.1788	.4228	213.0	304.32	2.113	4.303	145.7	.14380	.0000003135	.000738
46000	45719.8	417.4	−42.27	−41.26	231.9	1001.5	593.4	248.0	.0004153	.01336	.1747	.4180	208.3	297.53	2.066	4.207	142.5	.14060	.0000003136	.000755
46500	46189.0	417.6	−42.05	−41.14	232.0	1001.8	593.6	245.2	.0004058	.01306	.1707	.4132	203.6	290.90	2.020	4.113	139.3	.13746	.0000003137	.000773
47000	46658.1	417.9	−41.82	−41.01	232.1	1002.1	593.7	242.5	.0003965	.01276	.1668	.4084	199.1	284.41	1.975	4.021	136.2	.13440	.0000003139	.000792
47500	47127.2	418.1	−41.59	−40.88	232.3	1002.4	593.9	239.8	.0003875	.01247	.1630	.4038	194.7	278.07	1.931	3.932	133.1	.13140	.0000003140	.000810
48000	47596.3	418.3	−41.36	−40.76	232.4	1002.6	594.0	237.1	.0003786	.01218	.1593	.3991	190.3	271.88	1.888	3.844	130.2	.12847	.0000003142	.000830
48500	48065.3	418.6	−41.14	−40.63	232.5	1002.9	594.2	234.4	.0003700	.01190	.1557	.3945	186.1	265.81	1.846	3.758	127.3	.12561	.0000003143	.000850
49000	48534.3	418.8	−40.91	−40.51	232.7	1003.2	594.4	231.8	.0003615	.01163	.1521	.3900	181.9	259.89	1.805	3.675	124.4	.12281	.0000003145	.000870
49500	49003.3	419.0	−40.68	−40.38	232.8	1003.4	594.5	229.2	.0003533	.01137	.1486	.3855	177.9	254.10	1.765	3.593	121.7	.12007	.0000003146	.000890

Table 2A-2 - Hot Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A (continued)

H, ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ, slugs/ ft³	ρg lb/ ft³	σ, ρ/ρ_0	$\sigma^{1/2}$	q/M^2 lb/ ft²	p lb/ ft²	p lb/ in.²	p in. Hg	p mb	δ p/p_0	μ lb-sec/ ft²	ν ft²/ sec
50000	49472.3	419.2	−40.45	−40.25	232.9	1003.7	594.7	226.6	.0003452	.01111	.1452	.3811	173.9	248.43	1.725	3.513	119.0	.11740	.0000003148	.000912
50500	49941.2	419.5	−40.23	−40.13	233.0	1004.0	594.8	224.1	.0003374	.01085	.1419	.3767	170.0	242.90	1.687	3.434	116.3	.11478	.0000003149	.000933
51000	50410.1	419.7	−40.00	−40.00	233.2	1004.3	595.0	221.6	.0003297	.01061	.1387	.3724	166.2	237.48	1.649	3.358	113.7	.11222	.0000003150	.000956
51500	50882.6	419.8	−39.91	−39.95	233.2	1004.4	595.1	219.1	.0003222	.01037	.1355	.3682	162.5	232.15	1.612	3.282	111.2	.10970	.0000003151	.000978
52000	51354.6	419.9	−39.82	−39.90	233.3	1004.5	595.1	216.6	.0003149	.01013	.1325	.3640	158.9	226.94	1.576	3.209	108.7	.10724	.0000003151	.001001
52500	51825.7	420.0	−39.74	−39.85	233.3	1004.6	595.2	214.2	.0003078	.00990	.1295	.3598	155.3	221.86	1.541	3.137	106.2	.10484	.0000003152	.001024
53000	52296.3	420.0	−39.65	−39.80	233.4	1004.7	595.3	211.8	.0003008	.00968	.1266	.3558	151.8	216.90	1.506	3.067	103.9	.10250	.0000003153	.001048
53500	52766.0	420.1	−39.56	−39.75	233.4	1004.8	595.3	209.4	.0002941	.00946	.1237	.3517	148.4	212.06	1.473	2.998	101.5	.10021	.0000003153	.001072
54000	53235.2	420.2	−39.47	−39.71	233.5	1004.9	595.4	207.0	.0002874	.00925	.1209	.3478	145.1	207.33	1.440	2.931	99.3	.09797	.0000003154	.001097
54500	53703.6	420.3	−39.38	−39.66	233.5	1005.0	595.4	204.7	.0002810	.00904	.1182	.3438	141.9	202.72	1.408	2.866	97.1	.09579	.0000003154	.001123
55000	54171.4	420.4	−39.29	−39.61	233.6	1005.1	595.5	202.4	.0002747	.00884	.1156	.3399	138.7	198.21	1.376	2.802	94.9	.09366	.0000003155	.001149
55500	54638.4	420.5	−39.21	−39.56	233.6	1005.2	595.6	200.2	.0002685	.00864	.1130	.3361	135.7	193.81	1.346	2.740	92.8	.09158	.0000003155	.001175
56000	55104.8	420.6	−39.12	−39.51	233.7	1005.3	595.6	197.9	.0002625	.00845	.1104	.3323	132.7	189.51	1.316	2.680	90.7	.08955	.0000003156	.001202
56500	55570.5	420.7	−39.03	−39.46	233.7	1005.4	595.7	195.7	.0002567	.00826	.1080	.3286	129.7	185.32	1.287	2.620	88.7	.08757	.0000003157	.001230
57000	56035.5	420.7	−38.94	−39.41	233.7	1005.5	595.8	193.6	.0002509	.00807	.1056	.3249	126.9	181.22	1.258	2.562	86.8	.08563	.0000003157	.001258
57500	56499.8	420.8	−38.85	−39.36	233.8	1005.6	595.8	191.4	.0002453	.00789	.1032	.3213	124.1	177.22	1.231	2.506	84.9	.08375	.0000003158	.001287
58000	56963.5	420.9	−38.76	−39.31	233.8	1005.7	595.9	189.3	.0002399	.00772	.1009	.3177	121.3	173.32	1.204	2.451	83.0	.08190	.0000003158	.001317
58500	57426.4	421.0	−38.68	−39.26	233.9	1005.8	595.9	187.2	.0002346	.00755	.0987	.3141	118.7	169.50	1.177	2.397	81.2	.08010	.0000003159	.001347
59000	57888.7	421.1	−38.59	−39.22	233.9	1005.9	596.0	185.1	.0002294	.00738	.0965	.3106	116.0	165.78	1.151	2.344	79.4	.07834	.0000003159	.001377
59500	58350.2	421.2	−38.50	−39.17	234.0	1006.1	596.1	183.1	.0002243	.00722	.0944	.3072	113.5	162.14	1.126	2.293	77.6	.07662	.0000003160	.001409
60000	58811.0	421.3	−38.41	−39.12	234.0	1006.2	596.1	181.1	.0002193	.00706	.0923	.3038	111.0	158.59	1.101	2.242	75.9	.07494	.0000003160	.001441
60500	59271.3	421.4	−38.32	−39.07	234.1	1006.3	596.2	179.1	.0002145	.00690	.0902	.3004	108.6	155.12	1.077	2.193	74.3	.07330	.0000003161	.001474
61000	59730.7	421.5	−38.24	−39.02	234.1	1006.4	596.3	177.1	.0002097	.00675	.0882	.2971	106.2	151.73	1.054	2.145	72.6	.07170	.0000003161	.001507
61500	60189.6	421.5	−38.15	−38.97	234.2	1006.5	596.3	175.2	.0002051	.00660	.0863	.2938	103.9	148.42	1.031	2.099	71.1	.07014	.0000003162	.001542
62000	60647.8	421.6	−38.06	−38.92	234.2	1006.6	596.4	173.3	.0002006	.00645	.0844	.2905	101.6	145.19	1.008	2.053	69.5	.06861	.0000003163	.001576
62500	61105.2	421.7	−37.97	−38.87	234.3	1006.7	596.4	171.4	.0001962	.006313	.0825	.2873	99.4	142.03	.986	2.008	68.01	.067116	.0000003163	.001612
63000	61561.9	421.8	−37.88	−38.82	234.3	1006.8	596.5	169.5	.0001919	.006175	.0807	.2841	97.3	138.95	.965	1.965	66.53	.065659	.0000003164	.001649
63500	62018.0	421.9	−37.79	−38.77	234.4	1006.9	596.6	167.6	.0001877	.006039	.0790	.2810	95.2	135.94	.944	1.922	65.09	.064235	.0000003164	.001686
64000	62473.4	422.0	−37.71	−38.73	234.4	1007.0	596.6	165.8	.0001836	.005907	.0772	.2779	93.1	132.99	.924	1.880	63.68	.062845	.0000003165	.001724
64500	62928.2	422.1	−37.62	−38.68	234.5	1007.1	596.7	164.0	.0001796	.005779	.0756	.2749	91.1	130.12	.904	1.840	62.30	.061486	.0000003165	.001762
65000	63382.2	422.2	−37.53	−38.63	234.5	1007.2	596.8	162.2	.0001757	.005653	.0739	.2719	89.1	127.31	.884	1.800	60.96	.060159	.0000003166	.001802
65500	63835.5	422.2	−37.44	−38.58	234.6	1007.3	596.8	160.5	.0001719	.005530	.0723	.2689	87.2	124.56	.865	1.761	59.64	.058862	.0000003166	.001842
66000	64288.2	422.3	−37.35	−38.53	234.6	1007.4	596.9	158.7	.0001681	.005409	.0707	.2660	85.3	121.88	.846	1.723	58.36	.057595	.0000003167	.001884
66500	64791.7	422.4	−37.26	−38.48	234.7	1007.5	596.9	156.8	.0001641	.005279	.0690	.2627	83.3	118.97	.826	1.682	56.96	.056218	.0000003168	.001931
67000	65330.2	422.5	−37.18	−38.43	234.7	1007.6	597.0	154.8	.0001599	.005143	.0673	.2593	81.2	115.93	.805	1.639	55.51	.054782	.0000003168	.001982
67500	65869.7	422.6	−37.09	−38.38	234.8	1007.7	597.1	152.8	.0001557	.005010	.0655	.2560	79.1	112.96	.784	1.597	54.09	.053380	.0000003169	.002035
68000	66410.1	422.7	−37.00	−38.33	234.8	1007.8	597.1	150.9	.0001517	.004881	.0638	.2526	77.0	110.07	.764	1.556	52.70	.052011	.0000003169	.002089
68500	66991.5	423.0	−36.66	−38.14	235.0	1008.3	597.4	148.8	.0001474	.004743	.0620	.2490	74.9	107.03	.743	1.513	51.25	.050578	.0000003171	.002152
69000	67568.2	423.4	−36.31	−37.95	235.2	1008.7	597.6	146.7	.0001433	.004609	.0603	.2455	72.9	104.11	.723	1.472	49.85	.049195	.0000003174	.002215
69500	68140.2	423.7	−35.97	−37.76	235.4	1009.1	597.9	144.7	.0001393	.004481	.0586	.2420	70.9	101.28	.703	1.432	48.49	.047861	.0000003176	.002280
70000	68707.6	424.1	−35.63	−37.57	235.6	1009.5	598.1	142.8	.0001354	.004356	.0570	.2387	69.0	98.56	.684	1.394	47.19	.046573	.0000003178	.002347
70500	69270.2	424.4	−35.28	−37.38	235.8	1009.9	598.3	140.8	.0001317	.004237	.0554	.2354	67.2	95.93	.666	1.356	45.93	.045331	.0000003180	.002415
71000	69747.0	424.8	−34.94	−37.19	236.0	1010.3	598.6	139.2	.0001286	.004137	.0541	.2326	65.6	93.76	.651	1.326	44.89	.044304	.0000003182	.002475
71500	70224.8	425.1	−34.59	−37.00	236.2	1010.7	598.8	137.6	.0001256	.004040	.0528	.2298	64.1	91.63	.636	1.296	43.87	.043298	.0000003184	.002536
72000	70703.7	425.4	−34.25	−36.81	236.4	1011.1	599.1	136.1	.0001226	.003945	.0516	.2271	62.7	89.54	.622	1.266	42.87	.042313	.0000003187	.002599
72500	71183.6	425.8	−33.91	−36.61	236.5	1011.5	599.3	134.5	.0001197	.003852	.0504	.2244	61.3	87.50	.608	1.237	41.90	.041348	.0000003189	.002663
73000	71664.6	426.1	−33.56	−36.42	236.7	1011.9	599.6	133.0	.0001169	.003761	.0492	.2218	59.9	85.50	.594	1.209	40.94	.040403	.0000003191	.002730
73500	72146.6	426.5	−33.22	−36.23	236.9	1012.3	599.8	131.4	.0001141	.003672	.0480	.2191	58.5	83.54	.580	1.181	40.00	.039478	.0000003193	.002798
74000	72629.7	426.8	−32.88	−36.04	237.1	1012.8	600.0	129.9	.0001114	.003585	.0469	.2165	57.1	81.63	.567	1.154	39.08	.038572	.0000003195	.002868
74500	73113.8	427.2	−32.53	−35.85	237.3	1013.2	600.3	128.4	.0001088	.003499	.0458	.2139	55.8	79.75	.554	1.128	38.18	.037685	.0000003197	.002940

Table 2A-2 - Hot Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A (continued)

H ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ slugs/ ft³	ρg lb/ ft³	σ ρ/ρ_0	$\sigma^{1/2}$	q/M^2 lb/ ft²	p lb/ ft²	p lb/ in.²	p in. Hg	p mb	δ p/p_0	μ lb-sec/ ft²	ν ft²/ sec
75000	73598.9	427.5	-32.19	-35.66	237.5	1013.6	600.5	126.9	.0001062	.003416	.0447	.2114	54.5	77.91	.541	1.102	37.30	.036816	.0000003199	.003013
75500	74085.1	427.8	-31.84	-35.47	237.7	1014.0	600.8	125.4	.0001036	.003334	.0436	.2088	53.3	76.11	.529	1.076	36.44	.035966	.0000003202	.003089
76000	74572.3	428.2	-31.50	-35.28	237.9	1014.4	601.0	124.0	.0001012	.003255	.0426	.2063	52.0	74.35	.516	1.051	35.60	.035133	.0000003204	.003167
76500	75060.5	428.5	-31.16	-35.09	238.1	1014.8	601.2	122.5	.0000987	.003177	.0415	.2038	50.8	72.63	.504	1.027	34.77	.034319	.0000003206	.003247
77000	75549.8	428.9	-30.81	-34.90	238.3	1015.2	601.5	121.1	.0000964	.003100	.0405	.2013	49.7	70.94	.493	1.003	33.97	.033521	.0000003208	.003329
77500	76040.1	429.2	-30.47	-34.70	238.5	1015.6	601.7	119.7	.0000940	.003026	.0396	.1989	48.5	69.29	.481	.980	33.17	.032740	.0000003210	.003414
78000	76531.4	429.6	-30.13	-34.51	238.6	1016.0	602.0	118.3	.0000918	.002953	.0386	.1965	47.4	67.67	.470	.957	32.40	.031976	.0000003212	.003500
78500	77023.8	429.9	-29.78	-34.32	238.8	1016.4	602.2	116.9	.0000896	.002881	.0377	.1941	46.3	66.09	.459	.934	31.64	.031228	.0000003214	.003589
79000	77517.2	430.3	-29.44	-34.13	239.0	1016.8	602.4	115.5	.0000874	.002812	.0368	.1917	45.2	64.54	.448	.912	30.90	.030496	.0000003217	.003681
79500	78011.6	430.6	-29.09	-33.94	239.2	1017.2	602.7	114.2	.0000853	.002743	.0359	.1894	44.1	63.02	.438	.891	30.17	.029780	.0000003219	.003775
80000	78507.0	430.9	-28.75	-33.75	239.4	1017.6	602.9	112.8	.0000832	.002677	.0350	.1871	43.1	61.54	.427	.870	29.46	.029080	.0000003221	.003872
80500	79003.5	431.3	-28.41	-33.56	239.6	1018.0	603.2	111.5	.0000812	.002611	.0341	.1848	42.1	60.09	.417	.850	28.77	.028394	.0000003223	.003971
81000	79501.0	431.6	-28.06	-33.37	239.8	1018.4	603.4	110.1	.0000792	.002548	.0333	.1825	41.1	58.67	.407	.830	28.09	.027723	.0000003225	.004073
81500	79949.0	432.0	-27.72	-33.18	240.0	1018.8	603.7	109.0	.0000774	.002491	.0326	.1805	40.2	57.42	.399	.812	27.49	.027132	.0000003227	.004168
82000	80396.7	432.3	-27.38	-32.99	240.2	1019.3	603.9	107.8	.0000757	.002437	.0319	.1785	39.3	56.20	.390	.795	26.91	.026555	.0000003229	.004264
82500	80844.0	432.7	-27.03	-32.80	240.4	1019.7	604.1	106.6	.0000741	.002383	.0312	.1765	38.5	55.00	.382	.778	26.33	.025990	.0000003232	.004364
83000	81291.0	433.0	-26.69	-32.60	240.6	1020.1	604.4	105.5	.0000724	.002330	.0305	.1746	37.7	53.83	.374	.761	25.77	.025438	.0000003234	.004465
83500	81737.6	433.3	-26.34	-32.41	240.7	1020.5	604.6	104.4	.0000708	.002279	.0298	.1726	36.9	52.69	.366	.745	25.23	.024897	.0000003236	.004568
84000	82183.9	433.7	-26.00	-32.22	240.9	1020.9	604.9	103.3	.0000693	.002229	.0291	.1707	36.1	51.57	.358	.729	24.69	.024369	.0000003238	.004674
84500	82630.6	434.0	-25.66	-32.03	241.1	1021.3	605.1	102.2	.0000678	.002180	.0285	.1688	35.3	50.48	.351	.714	24.17	.023852	.0000003240	.004782
85000	83077.7	434.4	-25.31	-31.84	241.3	1021.7	605.3	101.1	.0000663	.002132	.0279	.1670	34.6	49.41	.343	.699	23.66	.023347	.0000003242	.004893
85500	83525.3	434.7	-24.97	-31.65	241.5	1022.1	605.6	100.0	.0000648	.002085	.0273	.1651	33.9	48.36	.336	.684	23.16	.022853	.0000003244	.005006
86000	83973.4	435.1	-24.63	-31.46	241.7	1022.5	605.8	98.9	.0000634	.002040	.0267	.1633	33.1	47.34	.329	.669	22.67	.022369	.0000003247	.005122
86500	84422.0	435.4	-24.28	-31.27	241.9	1022.9	606.0	97.9	.0000620	.001995	.0261	.1615	32.4	46.34	.322	.655	22.19	.021896	.0000003249	.005240
87000	84871.1	435.8	-23.94	-31.08	242.1	1023.3	606.3	96.8	.0000606	.001951	.0255	.1597	31.8	45.36	.315	.641	21.72	.021434	.0000003251	.005361
87500	85320.6	436.1	-23.59	-30.89	242.3	1023.7	606.5	95.8	.00005932	.001908	.02496	.1580	31.08	44.402	.3083	.6278	21.26	.020982	.0000003253	.005484
88000	85754.3	436.4	-23.25	-30.69	242.5	1024.1	606.8	94.8	.00005807	.001868	.02443	.1563	30.45	43.499	.3021	.6150	20.83	.020555	.0000003255	.005606
88500	86162.5	436.8	-22.91	-30.50	242.7	1024.5	607.0	93.9	.00005691	.001831	.02394	.1547	29.87	42.667	.2963	.6033	20.43	.020162	.0000003257	.005723
89000	86568.8	437.1	-22.56	-30.31	242.8	1024.9	607.2	93.0	.00005579	.001795	.02347	.1532	29.30	41.857	.2907	.5918	20.04	.019779	.0000003259	.005843
89500	86973.4	437.5	-22.22	-30.12	243.0	1025.3	607.5	92.1	.00005469	.001760	.02301	.1517	28.75	41.067	.2852	.5806	19.66	.019406	.0000003261	.005964
90000	87376.1	437.8	-21.88	-29.93	243.2	1025.7	607.7	91.3	.00005362	.001725	.02256	.1502	28.21	40.296	.2798	.5697	19.29	.019042	.0000003264	.006086
90500	87777.0	438.4	-21.53	-29.74	243.4	1026.1	608.0	90.4	.00005258	.001692	.02212	.1487	27.68	39.544	.2746	.5591	18.93	.018686	.0000003266	.006211
91000	88176.1	438.5	-21.19	-29.55	243.6	1026.5	608.2	89.6	.00005156	.001659	.02169	.1473	27.17	38.811	.2695	.5488	18.58	.018340	.0000003268	.006337
91500	88573.3	438.8	-20.84	-29.36	243.8	1026.9	608.4	88.8	.00005057	.001627	.02128	.1459	26.67	38.096	.2646	.5386	18.24	.018002	.0000003270	.006466
92000	89008.2	439.2	-20.50	-29.17	244.0	1027.3	608.7	87.9	.00004952	.001593	.02083	.1443	26.13	37.330	.2592	.5278	17.87	.017640	.0000003272	.006608
92500	89498.2	439.5	-20.16	-28.98	244.2	1027.7	608.9	86.9	.00004836	.001556	.02035	.1426	25.54	36.487	.2534	.5159	17.47	.017241	.0000003274	.006770
93000	89983.1	439.9	-19.81	-28.78	244.4	1028.1	609.2	85.9	.00004725	.001520	.01988	.1410	24.97	35.672	.2477	.5044	17.08	.016857	.0000003276	.006935
93500	90462.9	440.2	-19.47	-28.59	244.6	1028.5	609.4	84.9	.00004617	.001485	.01942	.1394	24.42	34.886	.2423	.4933	16.70	.016485	.0000003278	.007101
94000	90937.5	440.6	-19.13	-28.40	244.8	1028.9	609.6	84.0	.00004513	.001452	.01899	.1378	23.89	34.127	.2370	.4825	16.34	.016126	.0000003281	.007270
94500	91406.9	440.9	-18.78	-28.21	244.9	1029.3	609.9	83.1	.00004412	.001420	.01856	.1362	23.38	33.393	.2319	.4722	15.99	.015780	.0000003283	.007440
95000	91871.1	441.3	-18.44	-28.02	245.1	1029.7	610.1	82.2	.00004315	.001388	.01816	.1347	22.88	32.685	.2270	.4621	15.65	.015445	.0000003285	.007612
95500	92316.8	441.6	-18.09	-27.83	245.3	1030.1	610.3	81.4	.00004224	.001359	.01777	.1333	22.41	32.020	.2224	.4527	15.33	.015131	.0000003287	.007781
96000	92758.5	441.9	-17.75	-27.64	245.5	1030.5	610.6	80.5	.00004136	.001331	.01740	.1319	21.96	31.376	.2179	.4436	15.02	.014826	.0000003289	.007952
96500	93196.1	442.3	-17.41	-27.45	245.7	1030.9	610.8	79.7	.00004051	.001303	.01704	.1305	21.53	30.751	.2136	.4348	14.72	.014531	.0000003291	.008125
97000	93629.8	442.6	-17.06	-27.26	245.9	1031.3	611.1	78.9	.00003968	.001277	.01669	.1292	21.10	30.146	.2093	.4262	14.43	.014245	.0000003293	.008300
97500	94059.3	443.0	-16.72	-27.07	246.1	1031.7	611.3	78.2	.00003888	.001251	.01636	.1279	20.69	29.559	.2053	.4179	14.15	.013968	.0000003295	.008477
98000	94484.8	443.3	-16.38	-26.88	246.3	1032.1	611.5	77.4	.00003810	.001226	.01603	.1266	20.29	28.990	.2013	.4099	13.88	.013699	.0000003298	.008656
98500	94906.2	443.7	-16.03	-26.68	246.5	1032.5	611.8	76.7	.00003734	.001201	.01571	.1253	19.91	28.438	.1975	.4021	13.62	.013438	.0000003300	.008836
99000	95323.4	444.0	-15.69	-26.49	246.7	1032.9	612.0	76.0	.00003661	.001178	.01540	.1241	19.53	27.902	.1938	.3945	13.36	.013185	.0000003302	.009018
99500	95736.5	444.3	-15.34	-26.30	246.9	1033.3	612.2	75.2	.00003590	.001155	.01510	.1229	19.17	27.383	.1902	.3872	13.11	.012940	.0000003304	.009202
100000	96145.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	74.5	.00003521	.001133	.01482	.1217	18.82	26.879	.1867	.3800	12.87	.012702	.0000003306	.009388

Table 2A-3 - Cold Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A

H ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ slugs/ ft³	ρg lb/ ft³	σ ρ/ρ_0	$\sigma^{1/2}$	q/M^2 lb/ ft²	p lb/ ft²	p lb/ in.²	p in. Hg	p mb	p/p_0	μ lb-sec/ ft²	ν ft²/ sec
0	.0	399.7	-60.00	-51.11	222.0	980.0	580.7	661.5	.003085	.09924	1.2977	1.139	1481.4	2116.2	14.70	29.92	1013.3	1.00000	.0000003023	.0000980
500	559.4	407.2	-52.50	-46.94	226.2	989.2	586.1	654.8	.002967	.09546	1.2483	1.117	1451.7	2073.8	14.40	29.32	992.9	.97995	.0000003071	.0001035
1000	1115.5	414.7	-45.00	-42.78	230.4	998.3	591.5	648.2	.002855	.09186	1.2012	1.096	1422.6	2032.3	14.11	28.73	973.1	.96034	.0000003119	.0001092
1500	1668.6	422.2	-37.50	-38.61	234.5	1007.2	596.8	641.7	.002748	.08843	1.1563	1.075	1394.2	1991.7	13.83	28.16	953.6	.94115	.0000003166	.0001152
2000	2218.8	429.7	-30.00	-34.44	238.7	1016.2	602.1	635.3	.002647	.08515	1.1134	1.055	1366.4	1952.0	13.56	27.60	934.6	.92238	.0000003213	.0001214
2500	2766.1	437.2	-22.50	-30.28	242.9	1025.0	607.3	628.9	.002549	.08202	1.0725	1.036	1339.1	1913.1	13.29	27.05	916.0	.90400	.0000003260	.0001279
3000	3310.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	622.6	.002456	.07903	1.0334	1.017	1312.5	1875.0	13.02	26.51	897.7	.88601	.0000003306	.0001346
3500	3855.1	444.7	-15.00	-26.11	247.0	1033.7	612.5	616.4	.002407	.07746	1.0128	1.006	1286.3	1837.6	12.76	25.98	879.8	.86832	.0000003306	.0001373
4000	4397.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	610.2	.002359	.07591	.9926	.996	1260.6	1800.9	12.51	25.46	862.3	.85099	.0000003306	.0001401
4500	4937.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	604.1	.002312	.07439	.9728	.986	1235.4	1764.9	12.26	24.95	845.1	.83400	.0000003306	.0001430
5000	5475.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	598.0	.002266	.07291	.9534	.976	1210.8	1729.7	12.01	24.46	828.2	.81735	.0000003306	.0001459
5500	6011.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	592.0	.002221	.07145	.9343	.967	1186.6	1695.2	11.77	23.97	811.6	.80103	.0000003306	.0001489
6000	6545.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	586.1	.002177	.07003	.9157	.957	1162.9	1661.3	11.54	23.49	795.4	.78504	.0000003306	.0001519
6500	7077.1	444.7	-15.00	-26.11	247.0	1033.7	612.5	580.2	.002133	.06863	.8974	.947	1139.7	1628.2	11.31	23.02	779.6	.76937	.0000003306	.0001550
7000	7606.9	444.7	-15.00	-26.11	247.0	1033.7	612.5	574.4	.002090	.06726	.8795	.938	1117.0	1595.7	11.08	22.56	764.0	.75401	.0000003306	.0001581
7500	8134.7	444.7	-15.00	-26.11	247.0	1033.7	612.5	568.6	.002049	.06592	.8619	.928	1094.7	1563.8	10.86	22.11	748.8	.73896	.0000003306	.0001614
8000	8660.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	562.9	.002008	.06460	.8447	.919	1072.8	1532.6	10.64	21.67	733.8	.72421	.0000003306	.0001647
8500	9184.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	557.3	.001968	.06331	.8279	.910	1051.4	1502.0	10.43	21.24	719.2	.70975	.0000003306	.0001680
9000	9706.0	444.7	-15.00	-26.11	247.0	1033.7	612.5	551.7	.001928	.06205	.8113	.901	1030.4	1472.0	10.22	20.81	704.8	.69558	.0000003306	.0001714
9500	10225.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	546.1	.001890	.06081	.7951	.892	1009.8	1442.6	10.02	20.40	690.7	.68170	.0000003306	.0001749
10000	10743.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	540.7	.001852	.05959	.7793	.883	989.7	1413.8	9.82	19.99	676.9	.66809	.0000003306	.0001785
10500	11339.1	442.7	-16.94	-27.19	246.0	1031.5	611.1	534.4	.001818	.05848	.7647	.874	966.9	1381.3	9.59	19.53	661.4	.65271	.0000003294	.0001812
11000	11932.2	440.8	-18.89	-28.27	244.9	1029.2	609.8	528.2	.001784	.05738	.7504	.866	944.6	1349.5	9.37	19.08	646.1	.63768	.0000003282	.0001840
11500	12522.7	438.9	-20.83	-29.35	243.8	1026.9	608.4	522.1	.001750	.05631	.7363	.858	922.9	1318.4	9.16	18.64	631.2	.62299	.0000003270	.0001868
12000	13110.8	436.9	-22.78	-30.43	242.7	1024.7	607.1	516.1	.001717	.05526	.7226	.850	901.6	1288.0	8.94	18.21	616.7	.60864	.0000003258	.0001897
12500	13696.4	435.0	-24.72	-31.51	241.6	1022.4	605.7	510.1	.001685	.05423	.7091	.842	880.8	1258.3	8.74	17.79	602.5	.59462	.0000003246	.0001926
13000	14279.6	433.0	-26.67	-32.59	240.6	1020.1	604.4	504.2	.001654	.05321	.6958	.834	860.5	1229.3	8.54	17.38	588.6	.58091	.0000003234	.0001955
13500	14860.3	431.1	-28.61	-33.67	239.5	1017.8	603.0	498.3	.001623	.05222	.6829	.826	840.7	1201.0	8.34	16.98	575.0	.56752	.0000003222	.0001985
14000	15438.6	429.1	-30.56	-34.75	238.4	1015.5	601.7	492.5	.001593	.05125	.6701	.819	821.3	1173.3	8.15	16.59	561.8	.55444	.0000003210	.0002015
14500	16014.5	427.2	-32.50	-35.83	237.3	1013.2	600.3	486.8	.001563	.05030	.6577	.811	802.4	1146.2	7.96	16.21	548.8	.54165	.0000003197	.0002045
15000	16588.0	425.2	-34.44	-36.91	236.2	1010.9	598.9	481.2	.001534	.04936	.6454	.803	783.9	1119.8	7.78	15.83	536.2	.52915	.0000003185	.0002076
15500	17159.1	423.3	-36.39	-37.99	235.2	1008.6	597.6	475.6	.001506	.04844	.6334	.796	765.8	1094.0	7.60	15.47	523.8	.51694	.0000003173	.0002108
16000	17727.9	421.4	-38.33	-39.07	234.1	1006.3	596.2	470.1	.001478	.04754	.6217	.788	748.1	1068.7	7.42	15.11	511.7	.50501	.0000003161	.0002139
16500	18294.4	419.4	-40.28	-40.15	233.0	1003.9	594.8	464.6	.001450	.04666	.6101	.781	730.8	1044.0	7.25	14.76	499.9	.49335	.0000003149	.0002171
17000	18858.5	417.5	-42.22	-41.23	231.9	1001.6	593.4	459.2	.001423	.04579	.5988	.774	713.9	1019.9	7.08	14.42	488.3	.48195	.0000003136	.0002204
17500	19420.3	415.5	-44.17	-42.31	230.8	999.3	592.0	453.9	.001397	.04494	.5877	.767	697.4	996.3	6.92	14.09	477.0	.47081	.0000003124	.0002236
18000	19979.9	413.6	-46.11	-43.40	229.8	996.9	590.7	448.6	.001371	.04411	.5768	.759	681.3	973.3	6.76	13.76	466.0	.45993	.0000003112	.0002270
18500	20537.2	411.6	-48.06	-44.48	228.7	994.6	589.3	443.4	.001346	.04330	.5661	.752	665.6	950.8	6.60	13.44	455.2	.44929	.0000003099	.0002303
19000	21092.2	409.7	-50.00	-45.56	227.6	992.2	587.9	438.2	.001321	.04249	.5557	.745	650.2	928.8	6.45	13.13	444.7	.43890	.0000003087	.0002337
19500	21645.0	407.7	-51.94	-46.64	226.5	989.9	586.5	433.1	.001296	.04171	.5454	.739	635.1	907.3	6.30	12.83	434.4	.42874	.0000003075	.0002372
20000	22195.5	405.8	-53.89	-47.72	225.4	987.5	585.1	428.1	.001272	.04094	.5353	.732	620.4	886.3	6.15	12.53	424.4	.41881	.0000003062	.0002407
20500	22743.9	403.9	-55.83	-48.80	224.4	985.1	583.7	423.1	.001249	.04018	.5254	.725	606.0	865.8	6.01	12.24	414.5	.40911	.0000003050	.0002442
21000	23290.0	401.9	-57.78	-49.88	223.3	982.8	582.3	418.2	.001226	.03944	.5157	.718	592.0	845.7	5.87	11.96	404.9	.39963	.0000003037	.0002478
21500	23834.0	400.0	-59.72	-50.96	222.2	980.4	580.9	413.3	.001203	.03871	.5062	.712	578.3	826.1	5.74	11.68	395.5	.39036	.0000003025	.0002514
22000	24375.8	398.0	-61.67	-52.04	221.1	978.0	579.4	408.5	.001181	.03800	.4969	.705	564.9	806.9	5.60	11.41	386.4	.38131	.0000003012	.0002550
22500	24915.5	396.1	-63.61	-53.12	220.0	975.6	578.0	403.7	.001159	.03730	.4878	.698	551.7	788.2	5.47	11.14	377.4	.37246	.0000003000	.0002587
23000	25453.0	394.1	-65.56	-54.20	219.0	973.2	576.6	399.0	.001138	.03662	.4788	.692	538.9	769.9	5.35	10.89	368.6	.36381	.0000002987	.0002625
23500	25988.5	392.2	-67.50	-55.28	217.9	970.8	575.2	394.3	.001117	.03594	.4700	.686	526.4	752.0	5.22	10.63	360.1	.35536	.0000002975	.0002663
24000	26521.8	390.2	-69.44	-56.36	216.8	968.4	573.8	389.7	.001097	.03528	.4613	.679	514.2	734.5	5.10	10.39	351.7	.34710	.0000002962	.0002701
24500	27053.1	388.3	-71.39	-57.44	215.7	966.0	572.3	385.2	.001076	.03463	.4529	.673	502.2	717.5	4.98	10.14	343.5	.33903	.0000002949	.0002740

Table 2A-3 - Cold Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A (continued)

H ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ slugs/ ft³	ρg lb/ ft³	σ ρ/ρ_o	$\sigma^{1/2}$	q/M^2 lb/ ft²	p lb/ ft²	p lb/ in.²	p in. Hg	p mb	p/p_o	μ lb-sec/ ft²	ν ft²/ sec
25000	27582.2	386.4	-73.33	-58.52	214.6	963.6	570.9	380.6	.001057	.03400	.4446	.667	490.5	700.8	4.87	9.91	335.5	.33114	.0000002937	.0002779
25500	28109.4	384.4	-75.28	-59.60	213.6	961.1	569.5	376.2	.001037	.03337	.4364	.661	479.1	684.4	4.75	9.68	327.7	.32343	.0000002924	.0002819
26000	28634.5	382.5	-77.22	-60.68	212.5	958.7	568.0	371.8	.001018	.03276	.4284	.655	467.9	668.5	4.64	9.45	320.1	.31589	.0000002911	.0002859
26500	29157.6	380.5	-79.17	-61.76	211.4	956.3	566.6	367.4	.001000	.03216	.4206	.648	457.0	652.9	4.53	9.23	312.6	.30853	.0000002898	.0002900
27000	29678.7	378.6	-81.11	-62.84	210.3	953.8	565.1	363.1	.000981	.03157	.4128	.643	446.4	637.7	4.43	9.02	305.3	.30133	.0000002886	.0002941
27500	30197.8	376.6	-83.06	-63.92	209.2	951.4	563.7	358.8	.000963	.03099	.4053	.637	436.0	622.8	4.32	8.81	298.2	.29429	.0000002873	.0002982
28000	30714.9	374.7	-85.00	-65.00	208.2	948.9	562.2	354.6	.000946	.03043	.3979	.631	425.8	608.2	4.22	8.60	291.2	.28742	.0000002860	.0003024
28500	31242.4	374.7	-85.00	-65.00	208.2	948.9	562.2	350.4	.000923	.02970	.3884	.623	415.6	593.7	4.12	8.39	284.3	.28054	.0000002860	.0003098
29000	31755.9	374.7	-85.00	-65.00	208.2	948.9	562.2	346.2	.000901	.02900	.3793	.616	405.9	579.8	4.03	8.20	277.6	.27397	.0000002860	.0003173
29500	32256.0	374.7	-85.00	-65.00	208.2	948.9	562.2	342.2	.000881	.02834	.3706	.609	396.6	566.5	3.93	8.01	271.2	.26770	.0000002860	.0003247
30000	32743.1	374.7	-85.00	-65.00	208.2	948.9	562.2	338.4	.000861	.02771	.3623	.602	387.7	553.8	3.85	7.83	265.2	.26170	.0000002860	.0003321
30500	33217.8	374.7	-85.00	-65.00	208.2	948.9	562.2	334.7	.000842	.02710	.3543	.595	379.2	541.7	3.76	7.66	259.3	.25596	.0000002860	.0003396
31000	33680.5	374.7	-85.00	-65.00	208.2	948.9	562.2	331.0	.000824	.02652	.3467	.589	371.0	530.0	3.68	7.49	253.8	.25046	.0000002860	.0003470
31500	34131.6	374.7	-85.00	-65.00	208.2	948.9	562.2	327.5	.000807	.02596	.3394	.583	363.2	518.9	3.60	7.34	248.4	.24519	.0000002860	.0003545
32000	34571.7	374.7	-85.00	-65.00	208.2	948.9	562.2	324.1	.000790	.02542	.3324	.577	355.7	508.2	3.53	7.19	243.3	.24014	.0000002860	.0003620
32500	35001.0	374.7	-85.00	-65.00	208.2	948.8	562.2	320.9	.000774	.02491	.3257	.571	348.5	497.9	3.46	7.04	238.4	.23529	.0000002860	.0003694
33000	35420.1	374.7	-85.00	-65.00	208.2	948.9	562.2	317.7	.000759	.02442	.3193	.565	341.7	488.1	3.39	6.90	233.7	.23064	.0000002860	.0003769
33500	35818.4	374.7	-85.00	-65.00	208.2	948.9	562.2	314.7	.000745	.02396	.3132	.560	335.2	478.9	3.33	6.77	229.3	.22628	.0000002860	.0003841
34000	36214.0	374.7	-85.00	-65.00	208.2	948.9	562.2	311.7	.000731	.02350	.3074	.554	328.9	469.8	3.26	6.64	225.0	.22202	.0000002860	.0003915
34500	36608.2	374.7	-85.00	-65.00	208.2	948.9	562.2	308.7	.000717	.02306	.3016	.549	322.7	461.0	3.20	6.52	220.7	.21786	.0000002860	.0003990
35000	37001.1	374.7	-85.00	-65.00	208.2	948.9	562.2	305.8	.000703	.02263	.2959	.544	316.7	452.4	3.14	6.40	216.6	.21378	.0000002860	.0004066
35500	37392.8	374.7	-85.00	-65.00	208.2	948.9	562.2	303.0	.000690	.02221	.2904	.539	310.8	444.0	3.08	6.28	212.6	.20979	.0000002860	.0004143
36000	37783.3	374.7	-85.00	-65.00	208.2	948.9	562.2	300.1	.000677	.02180	.2850	.534	305.0	435.7	3.03	6.16	208.6	.20589	.0000002860	.0004222
36500	38172.6	374.7	-85.00	-65.00	208.2	948.8	562.2	297.4	.000665	.02139	.2797	.529	299.3	427.6	2.97	6.05	204.8	.20208	.0000002860	.0004301
37000	38560.7	374.7	-85.00	-65.00	208.2	948.9	562.2	294.6	.000653	.02100	.2746	.524	293.8	419.7	2.91	5.93	201.0	.19834	.0000002860	.0004382
37500	38947.6	374.7	-85.00	-65.00	208.2	948.9	562.2	291.9	.0006406	.02061	.2695	.5191	288.4	412.00	2.861	5.825	197.3	.19469	.0000002860	.000446
38000	39333.3	374.7	-85.00	-65.00	208.2	948.9	562.2	289.2	.0006288	.02023	.2646	.5144	283.1	404.43	2.809	5.718	193.6	.19111	.0000002860	.000455
38500	39717.9	374.7	-85.00	-65.00	208.2	948.9	562.2	286.5	.0006173	.01986	.2597	.5096	277.9	397.03	2.757	5.614	190.1	.18761	.0000002860	.000463
39000	40101.3	374.7	-85.00	-65.00	208.2	948.9	562.2	283.9	.0006060	.01950	.2550	.5049	272.8	389.78	2.707	5.511	186.6	.18419	.0000002860	.000472
39500	40483.5	374.7	-85.00	-65.00	208.2	948.9	562.2	281.3	.0005950	.01914	.2503	.5003	267.9	382.68	2.658	5.411	183.2	.18083	.0000002860	.000481
40000	40864.6	374.7	-85.00	-65.00	208.2	948.9	562.2	278.7	.0005842	.01880	.2458	.4958	263.0	375.74	2.609	5.313	179.9	.17755	.0000002860	.000490
40500	41244.5	374.7	-85.00	-65.00	208.2	948.9	562.2	276.2	.0005736	.01846	.2413	.4913	258.3	368.94	2.562	5.216	176.6	.17434	.0000002860	.000499
41000	41623.2	374.7	-85.00	-65.00	208.2	948.9	562.2	273.7	.0005633	.01812	.2370	.4868	253.6	362.28	2.516	5.122	173.5	.17119	.0000002860	.000508
41500	42000.8	374.7	-85.00	-65.00	208.2	948.9	562.2	271.2	.0005532	.01780	.2327	.4824	249.0	355.77	2.471	5.030	170.3	.16812	.0000002860	.000517
42000	42377.3	374.7	-85.00	-65.00	208.2	948.9	562.2	268.8	.0005432	.01748	.2286	.4781	244.6	349.39	2.426	4.940	167.3	.16510	.0000002860	.000526
42500	42766.0	372.7	-87.00	-66.11	207.0	946.4	560.7	266.3	.0005361	.01725	.2255	.4749	240.0	342.92	2.381	4.849	164.2	.16204	.0000002847	.000531
43000	43153.5	370.7	-89.00	-67.22	205.9	943.8	559.2	263.8	.0005290	.01702	.2226	.4718	235.6	336.59	2.337	4.759	161.2	.15905	.0000002834	.000536
43500	43539.7	368.7	-91.00	-68.33	204.8	941.3	557.7	261.4	.0005221	.01680	.2197	.4687	231.3	330.40	2.294	4.672	158.2	.15613	.0000002820	.000540
44000	43924.7	366.7	-93.00	-69.44	203.7	938.7	556.2	259.0	.0005153	.01658	.2168	.4656	227.0	324.35	2.252	4.586	155.3	.15327	.0000002807	.000545
44500	44308.3	364.7	-95.00	-70.56	202.6	936.1	554.7	256.6	.0005087	.01637	.2140	.4626	222.9	318.42	2.211	4.502	152.5	.15047	.0000002794	.000549
45000	44690.7	362.7	-97.00	-71.67	201.5	933.6	553.1	254.2	.0005022	.01616	.2113	.4596	218.8	312.62	2.171	4.420	149.7	.14773	.0000002780	.000554
45500	45071.9	360.7	-99.00	-72.78	200.4	931.0	551.6	251.9	.0004958	.01595	.2086	.4567	214.9	306.95	2.132	4.340	147.0	.14504	.0000002767	.000558
46000	45451.7	358.7	-101.00	-73.89	199.3	928.4	550.1	249.6	.0004895	.01575	.2060	.4538	211.0	301.39	2.093	4.261	144.3	.14242	.0000002753	.000562
46500	45830.2	356.7	-103.00	-75.00	198.2	925.8	548.5	247.4	.0004834	.01555	.2034	.4510	207.0	295.96	2.055	4.185	141.7	.13985	.0000002740	.000567
47000	46207.5	354.7	-105.00	-76.11	197.0	923.2	547.0	245.1	.0004774	.01536	.2008	.4482	203.4	290.64	2.018	4.109	139.2	.13734	.0000002726	.000571
47500	46583.5	352.7	-107.00	-77.22	195.9	920.6	545.5	242.9	.0004715	.01517	.1984	.4454	199.8	285.44	1.982	4.036	136.7	.13488	.0000002713	.000575
48000	46958.1	350.7	-109.00	-78.33	194.8	918.0	543.9	240.8	.0004657	.01498	.1959	.4426	196.2	280.34	1.947	3.964	134.2	.13247	.0000002699	.000580
48500	47331.4	348.7	-111.00	-79.44	193.7	915.4	542.3	238.6	.0004601	.01480	.1936	.4399	192.8	275.36	1.912	3.893	131.8	.13012	.0000002686	.000584
49000	47703.5	346.7	-113.00	-80.56	192.6	912.8	540.8	236.5	.0004545	.01462	.1912	.4373	189.3	270.48	1.878	3.824	129.5	.12781	.0000002672	.000588
49500	48074.2	344.7	-115.00	-81.67	191.5	910.1	539.2	234.4	.0004491	.01445	.1889	.4347	186.0	265.70	1.845	3.757	127.2	.12555	.0000002658	.000592

Table 2A-3 - Cold Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A (continued)

H ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ slugs/ft³	ρg lb/ft³	σ ρ/ρ_0	$\sigma^{1/2}$	q/M^2 lb/ft²	p lb/ft²	p lb/in.²	p in. Hg	p mb	p/p_0	μ lb-sec/ft²	ν ft²/sec
50000	48469.1	342.7	−117.00	−82.78	190.4	907.5	537.7	232.2	.0004432	.01426	.1865	.4318	182.5	260.71	1.810	3.686	124.8	.12319	.0000002645	.000597
50500	48974.6	340.7	−119.00	−83.89	189.3	904.8	536.1	229.4	.0004351	.01400	.1831	.4279	178.1	254.45	1.767	3.598	121.8	.12024	.0000002631	.000605
51000	49495.3	338.7	−121.00	−85.00	188.2	902.2	534.5	226.5	.0004269	.01373	.1796	.4238	173.7	248.16	1.723	3.509	118.8	.11727	.0000002617	.000613
51500	50031.3	336.7	−123.00	−86.11	187.0	899.5	532.9	223.6	.0004185	.01346	.1761	.4196	169.3	241.85	1.679	3.419	115.8	.11428	.0000002604	.000622
52000	50582.8	334.7	−125.00	−87.22	185.9	896.8	531.3	220.7	.0004100	.01319	.1725	.4153	164.9	235.52	1.636	3.330	112.8	.11129	.0000002590	.000632
52500	51108.0	334.7	−125.00	−87.22	185.9	896.8	531.3	217.9	.0003997	.01286	.1682	.4101	160.8	229.65	1.595	3.247	110.0	.10852	.0000002590	.000648
53000	51633.3	334.7	−125.00	−87.22	185.9	896.8	531.3	215.2	.0003898	.01254	.1640	.4050	156.7	223.92	1.555	3.166	107.2	.10581	.0000002590	.000664
53500	52158.5	334.7	−125.00	−87.22	185.9	896.8	531.3	212.5	.0003801	.01223	.1599	.3999	152.8	218.34	1.516	3.087	104.5	.10318	.0000002950	.000681
54000	52683.7	334.7	−125.00	−87.22	185.9	896.8	531.3	209.8	.0003706	.01192	.1559	.3949	149.0	212.90	1.478	3.010	101.9	.10060	.0000002590	.000699
54500	53208.9	334.7	−125.00	−87.22	185.9	896.8	531.3	207.2	.0003614	.01163	.1520	.3899	145.3	207.59	1.442	2.935	99.4	.09810	.0000002590	.000717
55000	53734.1	334.7	−125.00	−87.22	185.9	896.8	531.3	204.6	.0003523	.01134	.1482	.3850	141.7	202.42	1.406	2.862	96.9	.09565	.0000002590	.000735
55500	54259.3	334.7	−125.00	−87.22	185.9	896.8	531.3	202.0	.0003436	.01105	.1445	.3802	138.2	197.37	1.371	2.791	94.5	.09327	.0000002590	.000754
56000	54784.6	334.7	−125.00	−87.22	185.9	896.8	531.3	199.5	.0003350	.01078	.1409	.3754	134.7	192.45	1.336	2.721	92.1	.09094	.0000002590	.000773
56500	55309.8	334.7	−125.00	−87.22	185.9	896.8	531.3	197.0	.0003266	.01051	.1374	.3707	131.4	187.65	1.303	2.653	89.8	.08867	.0000002590	.000793
57000	55835.0	334.7	−125.00	−87.22	185.9	896.8	531.3	194.5	.0003185	.01025	.1340	.3661	128.1	182.98	1.271	2.587	87.6	.08646	.0000002590	.000813
57500	56360.2	334.7	−125.00	−87.22	185.9	896.8	531.3	192.1	.0003106	.00999	.1307	.3615	124.9	178.42	1.239	2.523	85.4	.08431	.0000002590	.000834
58000	56885.4	334.7	−125.00	−87.22	185.9	896.8	531.3	189.7	.0003028	.00974	.1274	.3569	121.8	173.97	1.208	2.460	83.3	.08221	.0000002590	.000855
58500	57410.7	334.7	−125.00	−87.22	185.9	896.8	531.3	187.3	.0002953	.00950	.1242	.3525	118.7	169.63	1.178	2.398	81.2	.08016	.0000002590	.000877
59000	57935.9	334.7	−125.00	−87.22	185.9	896.8	531.3	184.9	.0002879	.00926	.1211	.3480	115.8	165.40	1.149	2.339	79.2	.07816	.0000002590	.000900
59500	58461.1	334.7	−125.00	−87.22	185.9	896.8	531.3	182.6	.0002807	.00903	.1181	.3437	112.9	161.28	1.120	2.280	77.2	.07621	.0000002590	.000923
60000	58986.3	334.7	−125.00	−87.22	185.9	896.8	531.3	180.3	.0002737	.00881	.1152	.3394	110.1	157.26	1.092	2.223	75.3	.07431	.0000002590	.000946
60500	59511.5	334.7	−125.00	−87.22	185.9	896.8	531.3	178.1	.0002669	.00859	.1123	.3351	107.3	153.34	1.065	2.168	73.4	.07246	.0000002590	.000970
61000	60036.7	334.7	−125.00	−87.22	185.9	896.8	531.3	175.8	.0002603	.00837	.1095	.3309	104.7	149.52	1.038	2.114	71.6	.07065	.0000002590	.000995
61500	60562.0	334.7	−125.00	−87.22	185.9	896.8	531.3	173.6	.0002538	.00816	.1068	.3268	102.1	145.79	1.012	2.061	69.8	.06889	.0000002590	.001021
62000	61087.2	334.7	−125.00	−87.22	185.9	896.8	531.3	171.4	.0002474	.00796	.1041	.3227	99.5	142.16	.987	2.010	68.1	.06717	.0000002590	.001047
62500	61618.7	336.4	−123.28	−86.27	186.9	899.1	532.7	169.3	.0002400	.007721	.1010	.3177	97.0	138.57	.962	1.959	66.35	.065480	.0000002602	.001084
63000	62164.3	338.1	−121.56	−85.31	187.9	901.4	534.1	167.1	.0002326	.007483	.0978	.3128	94.5	134.98	.937	1.909	64.63	.063785	.0000002614	.001124
63500	62723.9	339.9	−119.83	−84.35	188.8	903.7	535.4	164.8	.0002253	.007247	.0948	.3078	92.0	131.40	.913	1.858	62.92	.062093	.0000002625	.001166
64000	63297.4	341.6	−118.11	−83.40	189.8	906.0	536.8	162.6	.0002180	.007015	.0917	.3029	89.5	127.83	.888	1.807	61.20	.060404	.0000002637	.001210
64500	63884.7	343.3	−116.39	−82.44	190.7	908.3	538.1	160.3	.0002109	.006785	.0887	.2979	87.0	124.27	.863	1.757	59.50	.058723	.0000002649	.001256
65000	64485.8	345.0	−114.67	−81.48	191.7	910.6	539.5	158.0	.0002039	.006559	.0858	.2929	84.5	120.73	.838	1.707	57.81	.057051	.0000002661	.001305
65500	65100.5	346.7	−112.94	−80.52	192.6	912.8	540.8	155.7	.0001969	.006336	.0829	.2878	82.1	117.22	.814	1.657	56.12	.055390	.0000002673	.001357
66000	65728.7	348.5	−111.22	−79.57	193.6	915.1	542.2	153.3	.0001901	.006118	.0800	.2828	79.6	113.73	.790	1.608	54.45	.053743	.0000002684	.001412
66500	66370.3	350.2	−109.50	−78.61	194.5	917.3	543.5	151.0	.0001835	.005903	.0772	.2778	77.2	110.28	.766	1.559	52.80	.052110	.0000002696	.001469
67000	67007.1	351.9	−107.78	−77.65	195.5	919.6	544.8	148.7	.0001771	.005697	.0745	.2729	74.9	106.95	.743	1.512	51.21	.050540	.0000002708	.001529
67500	67670.7	353.6	−106.06	−76.70	196.5	921.8	546.2	146.4	.0001707	.005491	.0718	.2680	72.5	103.60	.719	1.465	49.60	.048953	.0000002719	.001593
68000	68361.1	355.4	−104.33	−75.74	197.4	924.1	547.5	143.9	.0001643	.005286	.0691	.2629	70.2	100.21	.696	1.417	47.98	.047355	.0000002731	.001662
68500	69078.1	357.1	−102.61	−74.78	198.4	926.3	548.8	141.5	.0001580	.005082	.0665	.2578	67.8	96.82	.672	1.369	46.36	.045751	.0000002743	.001736
69000	69821.4	358.8	−100.89	−73.83	199.3	928.6	550.2	139.0	.0001517	.004880	.0638	.2526	65.4	93.42	.649	1.321	44.73	.044146	.0000002754	.001816
69500	70590.9	360.5	−99.17	−72.87	200.3	930.8	551.5	136.4	.0001455	.004681	.0612	.2474	63.0	90.03	.625	1.273	43.11	.042543	.0000002766	.001901
70000	71386.4	362.2	−97.44	−71.91	201.2	933.0	552.8	133.9	.0001394	.004484	.0586	.2421	60.7	86.65	.602	1.225	41.49	.040947	.0000002777	.001993
70500	72207.8	364.0	−95.72	−70.96	202.2	935.2	554.1	131.2	.0001333	.004290	.0561	.2368	58.3	83.30	.578	1.178	39.88	.039362	.0000002789	.002092
71000	73054.8	365.7	−94.00	−70.00	203.2	937.4	555.4	128.6	.0001274	.004099	.0536	.2315	56.0	79.98	.555	1.131	38.29	.037792	.0000002800	.002198
71500	73830.3	365.5	−94.21	−70.11	203.0	937.2	555.3	126.2	.0001228	.003952	.0517	.2273	53.9	77.05	.535	1.089	36.89	.036409	.0000002799	.002279
72000	74605.4	365.3	−94.41	−70.23	202.9	936.9	555.1	123.9	.0001184	.003809	.0498	.2232	52.0	74.23	.515	1.060	35.54	.035077	.0000002797	.002363
72500	75380.2	365.1	−94.62	−70.34	202.8	936.6	554.9	121.6	.0001141	.003672	.0480	.2191	50.1	71.52	.497	1.011	34.24	.033795	.0000002796	.002450
73000	76154.5	364.9	−94.83	−70.46	202.7	936.4	554.8	119.4	.0001100	.003540	.0463	.2151	48.2	68.91	.479	.974	32.99	.032561	.0000002795	.002540
73500	76928.4	364.7	−95.03	−70.57	202.6	936.1	554.6	117.2	.0001061	.003413	.0446	.2112	46.5	66.39	.461	.939	31.79	.031372	.0000002793	.002634
74000	77701.9	364.4	−95.24	−70.69	202.5	935.8	554.5	115.0	.0001023	.003290	.0430	.2074	44.8	63.97	.444	.904	30.63	.030227	.0000002792	.002730
74500	78475.1	364.2	−95.45	−70.80	202.4	935.6	554.3	112.9	.0000986	.003172	.0415	.2037	43.1	61.63	.428	.871	29.51	.029124	.0000002791	.002831

Table 2A-3 - Cold Atmosphere at EvenValues of Geopotential Altitude, MIL-STD-210A (continued)

H ft	H_p ft	T °R	t °F	t °C	T K	a fps	a kn	$a\sigma^{1/2}$ kn	ρ slugs/ ft³	ρg lb/ ft³	σ ρ/ρ_o	$\sigma^{1/2}$	q/M^2 lb/ ft²	p lb/ ft²	p lb/ in.²	p in. Hg	p mb	p/p_o	μ lb·sec/ ft²	ν ft²/ sec
75000	79247.8	364.0	-95.66	-70.92	202.2	935.3	554.2	110.8	.0000950	.003058	.0400	.2000	41.6	59.39	.412	.840	28.43	.028062	.0000002789	.002935
75500	80020.2	363.8	-95.86	-71.03	202.1	935.0	554.0	108.8	.0000916	.002948	.0385	.1963	40.1	57.22	.397	.809	27.40	.027040	.0000002788	.003043
76000	80579.3	363.6	-96.07	-71.15	202.0	934.8	553.8	107.3	.0000892	.002872	.0375	.1938	39.0	55.70	.387	.788	26.67	.026323	.0000002786	.003122
76500	81129.0	363.4	-96.28	-71.26	201.9	934.5	553.7	105.9	.0000870	.002798	.0366	.1913	38.0	54.25	.377	.767	25.98	.025636	.0000002785	.003202
77000	81669.3	363.2	-96.48	-71.38	201.8	934.2	553.5	104.5	.0000848	.002728	.0357	.1889	37.0	52.86	.367	.747	25.31	.024979	.0000002784	.003283
77500	82200.2	363.0	-96.69	-71.49	201.7	934.0	553.4	103.2	.0000827	.002661	.0348	.1865	36.1	51.53	.358	.729	24.67	.024350	.0000002782	.003364
78000	82722.7	362.8	-96.90	-71.61	201.6	933.7	553.2	101.9	.0000807	.002596	.0340	.1843	35.2	50.25	.349	.711	24.06	.023747	.0000002781	.003446
78500	83236.8	362.6	-97.10	-71.72	201.4	933.4	553.1	100.7	.0000788	.002535	.0331	.1821	34.3	49.03	.341	.693	23.48	.023170	.0000002779	.003528
79000	83742.6	362.4	-97.31	-71.84	201.3	933.2	552.9	99.5	.0000769	.002476	.0324	.1799	33.5	47.86	.332	.677	22.92	.022617	.0000002778	.003610
79500	84239.8	362.2	-97.52	-71.95	201.2	932.9	552.7	98.3	.0000752	.002419	.0316	.1779	32.7	46.74	.325	.661	22.38	.022087	.0000002777	.003693
80000	84809.8	362.0	-97.72	-72.07	201.1	932.6	552.6	97.0	.0000732	.002356	.0308	.1755	31.8	45.49	.316	.643	21.78	.021496	.0000002775	.003790
80500	85376.2	361.8	-97.93	-72.18	201.0	932.4	552.4	95.7	.0000713	.002295	.0300	.1732	31.0	44.28	.308	.626	21.20	.020926	.0000002774	.003890
81000	85939.1	361.6	-98.14	-72.30	200.9	932.1	552.3	94.4	.0000695	.002236	.0292	.1710	30.2	43.12	.299	.610	20.65	.020376	.0000002773	.003990
81500	86498.2	361.3	-98.34	-72.41	200.7	931.8	552.1	93.2	.0000677	.002179	.0285	.1688	29.4	42.00	.292	.594	20.11	.019845	.0000002771	.004093
82000	87053.8	361.1	-98.55	-72.53	200.6	931.6	551.9	92.0	.0000660	.002123	.0278	.1666	28.6	40.91	.284	.578	19.59	.019332	.0000002770	.001497
82500	87605.6	360.9	-98.76	-72.64	200.5	931.3	551.8	90.8	.0000643	.002070	.0271	.1645	27.9	39.86	.277	.564	19.09	.018837	.0000002768	.004302
83000	88153.6	360.7	-98.97	-72.76	200.4	931.0	551.6	89.6	.0000627	.002019	.0264	.1625	27.2	38.85	.270	.549	18.60	.018359	.0000002767	.004410
83500	88698.0	360.5	-99.17	-72.87	200.3	930.8	551.5	88.5	.0000612	.001969	.0257	.1605	26.5	37.87	.263	.536	18.13	.017897	.0000002766	.004519
84000	89238.5	360.3	-99.38	-72.99	200.2	930.5	551.3	87.4	.0000597	.001921	.0251	.1585	25.9	36.93	.256	.522	17.68	.017451	.0000002764	.004629
84500	89775.1	360.1	-99.59	-73.10	200.1	930.2	551.2	86.3	.0000583	.001875	.0245	.1566	25.2	36.02	.250	.509	17.25	.017021	.0000002763	.004741
85000	90307.9	359.9	-99.79	-73.22	199.9	930.0	551.0	85.2	.0000569	.001830	.0239	.1547	24.6	35.14	.244	.497	16.82	.016604	.0000002761	.004855
85500	90836.7	359.7	-100.00	-73.33	199.8	929.7	550.8	84.2	.0000555	.001787	.0234	.1529	24.0	34.29	.238	.485	16.42	.016202	.0000002760	.004970
86000	91361.6	359.5	-100.21	-73.45	199.7	929.4	550.7	83.2	.0000542	.001745	.0228	.1510	23.4	33.46	.232	.473	16.02	.015813	.0000002759	.005087
86500	91882.6	359.3	-100.41	-73.56	199.6	929.2	550.5	82.2	.0000530	.001704	.0223	.1493	22.9	32.67	.227	.462	15.64	.015437	.0000002757	.005205
87000	92399.5	359.1	-100.62	-73.68	199.5	928.9	550.4	81.2	.0000518	.001665	.0218	.1476	22.3	31.90	.222	.451	15.27	.015073	.0000002756	.005325
87500	92912.3	358.9	-100.83	-73.79	199.4	928.6	550.2	80.3	.00005058	.001627	.02126	.1459	21.81	31.155	.2164	.4405	14.92	.014722	.0000002755	.005446
88000	93421.1	358.7	-101.03	-73.91	199.3	928.4	550.0	79.3	.00004944	.001591	.02080	.1442	21.30	30.436	.2114	.4303	14.57	.014382	.0000002753	.005569
88500	93925.8	358.4	-101.24	-74.02	199.1	928.1	549.9	78.4	.00004834	.001555	.02034	.1426	20.82	29.740	.2065	.4205	14.24	.014053	.0000002752	.005693
89000	94426.3	358.2	-101.45	-74.14	199.0	927.8	549.7	77.5	.00004727	.001521	.01989	.1410	20.35	29.067	.2019	.4110	13.92	.013736	.0000002750	.005818
89500	94922.6	358.0	-101.66	-74.25	198.9	927.6	549.6	76.7	.00004624	.001488	.01945	.1395	19.89	28.416	.1973	.4018	13.61	.013428	.0000002749	.005945
90000	95414.7	357.8	-101.86	-74.37	198.8	927.3	549.4	75.8	.00004524	.001456	.01903	.1380	19.45	27.787	.1930	.3929	13.30	.013130	.0000002748	.006073
90500	95902.5	357.6	-102.07	-74.48	198.7	927.0	549.3	75.0	.00004427	.001424	.01863	.1365	19.02	27.178	.1887	.3843	13.01	.012842	.0000002746	.006203
91000	96386.1	357.4	-102.28	-74.60	198.6	926.8	549.1	74.1	.00004334	.001394	.01823	.1350	18.61	26.588	.1846	.3759	12.73	.012564	.0000002745	.006333
91500	96865.3	357.2	-102.48	-74.71	198.4	926.5	548.9	73.3	.00004243	.001365	.01785	.1336	18.21	26.017	.1807	.3679	12.46	.012294	.0000002743	.006465
92000	97340.2	357.0	-102.69	-74.83	198.3	926.2	548.8	72.6	.00004156	.001337	.01748	.1322	17.83	25.465	.1768	.3600	12.19	.012033	.0000002742	.006598
92500	97810.7	356.8	-102.90	-74.94	198.2	926.0	548.6	71.8	.00004071	.001310	.01713	.1309	17.45	24.930	.1731	.3525	11.94	.011781	.0000002741	.006732
93000	98276.8	356.6	-103.10	-75.06	198.1	925.7	548.5	71.0	.00003989	.001283	.01678	.1295	17.09	24.413	.1695	.3452	11.69	.011536	.0000002739	.006868
93500	98738.4	356.4	-103.31	-75.17	198.0	925.4	548.3	70.3	.00003909	.001258	.01645	.1282	16.74	23.911	.1661	.3381	11.45	.011299	.0000002738	.007004
94000	99195.5	356.2	-103.52	-75.29	197.9	925.2	548.1	69.6	.00003832	.001233	.01612	.1270	16.40	23.426	.1627	.3312	11.22	.011070	.0000002736	.007141
94500	99648.2	356.0	-103.72	-75.40	197.8	924.9	548.0	68.9	.00003757	.001209	.01581	.1257	16.07	22.956	.1594	.3246	10.99	.010846	.0000002735	.007280
95000	100096.3	355.8	-103.93	-75.52	197.6	924.6	547.8	68.2	.00003685	.001186	.01550	.1245	15.75	22.501	.1563	.3181	10.77	.010633	.0000002734	.007419
95500	100539.8	355.6	-104.14	-75.63	197.5	924.3	547.7	67.5	.00003615	.001163	.01521	.1233	15.44	22.060	.1532	.3119	10.56	.010424	.0000002732	.007559
96000	100978.7	355.3	-104.34	-75.75	197.4	924.1	547.5	66.9	.00003547	.001141	.01492	.1222	15.14	21.633	.1502	.3059	10.36	.010222	.0000002731	.007700
96500	101413.0	355.1	-104.55	-75.86	197.3	923.8	547.3	66.2	.00003481	.001120	.01464	.1210	14.85	21.219	.1474	.3000	10.16	.010027	.0000002729	.007841
97000	101842.6	354.9	-104.76	-75.98	197.2	923.5	547.2	65.6	.00003417	.001099	.01438	.1199	14.57	20.818	.1446	.2944	9.97	.009838	.0000002728	.007983
97500	102267.5	354.7	-104.97	-76.09	197.1	923.3	547.0	65.0	.00003355	.001080	.01412	.1188	14.30	20.430	.1419	.2889	9.78	.009654	.0000002727	.008126
98000	102687.7	354.5	-105.17	-76.21	197.0	923.0	546.9	64.4	.00003295	.001060	.01386	.1177	14.04	20.054	.1393	.2835	9.60	.009476	.0000002725	.008270
98500	103103.1	354.3	-105.38	-76.32	196.8	922.7	546.7	63.8	.00003237	.001042	.01362	.1167	13.78	19.689	.1367	.2784	9.43	.009304	.0000002724	.008413
99000	103513.7	354.1	-105.59	-76.44	196.7	922.5	546.5	63.2	.00003181	.001024	.01338	.1157	13.54	19.336	.1343	.2734	9.26	.009137	.0000002722	.008558
99500	103919.5	353.9	-105.79	-76.55	196.6	922.2	546.4	62.7	.00003127	.001006	.01315	.1147	13.30	18.993	.1319	.2685	9.09	.008975	.0000002721	.008703
100000	104320.5	353.7	-106.00	-76.67	196.5	921.9	546.2	62.1	.00003074	.000989	.01293	.1137	13.06	18.661	.1296	.2639	8.94	.008818	.0000002720	.008848

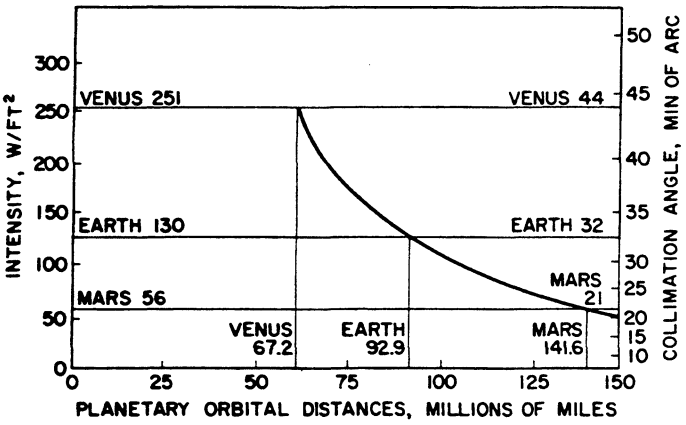


Figure 2A-8 - Solar Intensity and Collimation Angle. (Ref. 109)

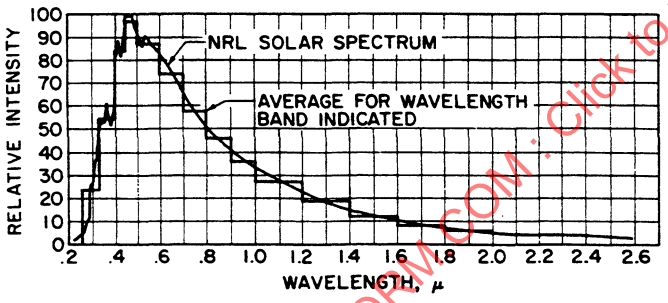


Figure 2A-9 - NRL Solar Spectrum; 100 on Relative Intensity Scale = 2.04 W/ft²-μ. (Ref. 109)

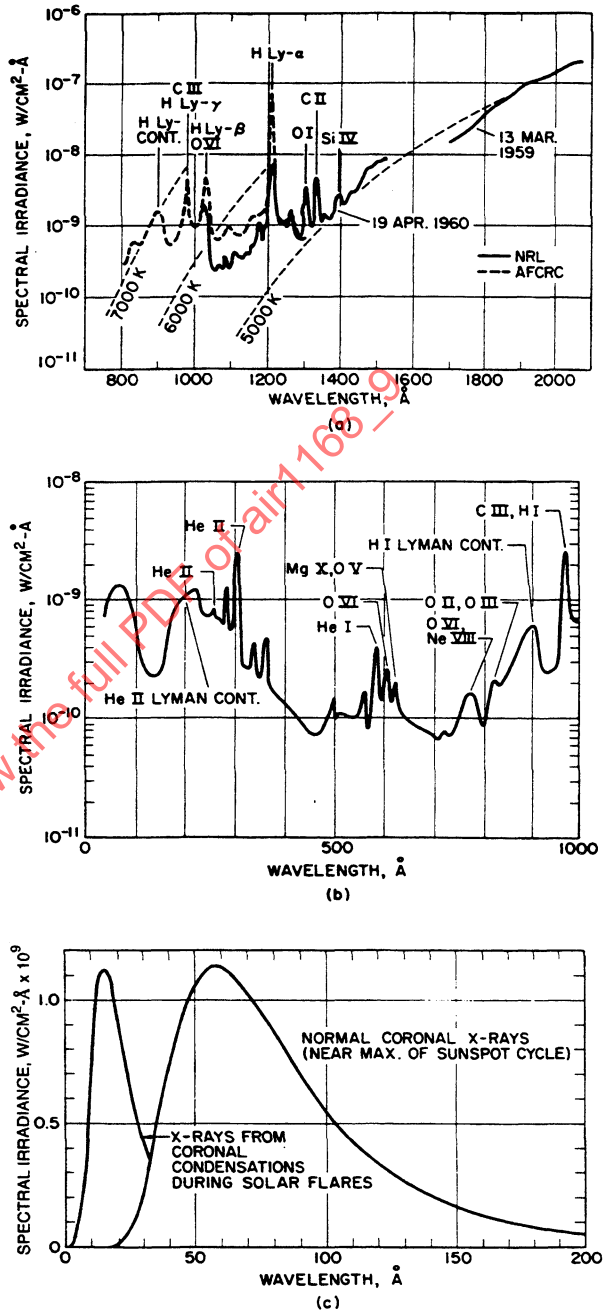


Figure 2A-10 - Solar Spectral Irradiance Data Above Earth's Atmosphere: (a) Ultraviolet observed with photographic spectrograph (NRL) and a photoelectric monochromator (AFCRC) with lines shown in an effective line width of 10Å; (b) Ultraviolet irradiance derived by Hinteregger et al. (1960) with an effective line width of 10Å; (c) X-ray irradiance. (Ref. 107; also see Ref. 120)

Table 2A-4 - Solar Spectral Irradiance Data (0.22-7.0 μ)

λ	H_λ	P_λ	λ	H_λ	P_λ	λ	H_λ	P_λ	λ	H_λ	P_λ	λ	H_λ	P_λ
0.22	0.0030	0.02	0.36	0.116	5.47	0.50	0.198	23.5	0.68	0.151	46.7	2.6	0.00445	96.90
0.225	0.0042	0.03	0.365	0.129	5.89	0.505	0.197	24.2	0.69	0.148	17.8	2.7	0.00390	97.21
0.23	0.0052	0.05	0.37	0.133	6.36	0.51	0.196	24.9	0.70	0.144	48.8	2.8	0.00343	97.47
0.235	0.0054	0.07	0.375	0.132	6.84	0.515	0.189	25.6	0.71	0.141	49.8	2.9	0.00303	97.72
0.24	0.0058	0.09	0.38	0.123	7.29	0.52	0.187	26.3	0.72	0.137	50.3	3.0	0.00268	97.90
0.245	0.0064	0.11	0.385	0.115	7.72	0.525	0.192	26.9	0.73	0.134	51.8	3.1	0.00230	98.08
0.25	0.0064	0.13	0.39	0.112	8.13	0.53	0.195	27.6	0.74	0.130	52.7	3.2	0.00214	98.24
0.255	0.010	0.16	0.395	0.120	8.54	0.535	0.197	28.3	0.75	0.127	53.7	3.3	0.00191	98.39
0.26	0.013	0.20	0.40	0.154	9.03	0.54	0.198	29.0	0.80	0.1127	57.9	3.4	0.00171	98.52
0.265	0.020	0.27	0.405	0.188	9.65	0.545	0.198	29.8	0.85	0.1003	61.7	3.5	0.00153	98.63
0.27	0.025	0.34	0.41	0.194	10.3	0.55	0.195	30.5	0.90	0.0895	65.1	3.6	0.00139	98.74
0.275	0.022	0.43	0.415	0.192	11.0	0.555	0.192	31.2	0.95	0.0803	68.1	3.7	0.00125	98.83
0.28	0.024	0.51	0.42	0.192	11.7	0.56	0.190	31.8	1.0	0.0725	70.9	3.8	0.00114	98.91
0.285	0.034	0.62	0.425	0.189	12.4	0.565	0.189	32.5	1.1	0.0606	75.7	3.9	0.00103	98.99
0.29	0.052	0.77	0.43	0.178	13.0	0.57	0.187	33.2	1.2	0.0501	79.6	4.0	0.00095	99.05
0.295	0.063	0.98	0.435	0.182	13.7	0.575	0.187	33.9	1.3	0.0406	82.9	4.1	0.00087	99.13
0.30	0.061	1.23	0.44	0.203	14.4	0.58	0.187	34.5	1.4	0.0328	85.5	4.2	0.00080	99.18
0.305	0.067	1.43	0.445	0.215	15.1	0.585	0.185	35.2	1.5	0.0267	87.6	4.3	0.00073	99.23
0.31	0.076	1.69	0.45	0.220	15.9	0.59	0.184	35.9	1.6	0.0220	89.4	4.4	0.00067	99.29
0.315	0.082	1.97	0.455	0.219	16.7	0.595	0.183	36.5	1.7	0.0182	90.83	4.5	0.00061	99.33
0.32	0.085	2.26	0.46	0.216	17.5	0.60	0.181	37.2	1.8	0.0152	92.03	4.6	0.00056	99.38
0.325	0.102	2.60	0.465	0.215	18.2	0.61	0.177	38.4	1.9	0.01274	93.02	4.7	0.00051	99.41
0.33	0.115	3.02	0.47	0.217	19.0	0.62	0.174	39.7	2.0	0.01079	93.87	4.8	0.00048	99.45
0.335	0.111	3.40	0.475	0.220	19.8	0.63	0.170	40.9	2.1	0.00917	94.58	4.9	0.00044	99.48
0.34	0.111	3.80	0.48	0.216	20.6	0.64	0.166	42.1	2.2	0.00785	95.20	5.0	0.00042	99.51
0.345	0.117	4.21	0.485	0.203	21.3	0.65	0.162	43.3	2.3	0.00676	95.71	6.0	0.00021	99.74
0.35	0.118	4.63	0.49	0.199	22.0	0.66	0.159	44.5	2.4	0.00585	96.18	7.0	0.00012	99.86
0.355	0.116	5.04	0.495	0.204	22.8	0.67	0.155	45.6	2.5	0.00509	96.57			

SOURCE: Ref. 119. See also Ref. 120.

H_λ units are W/cm^2-μ.

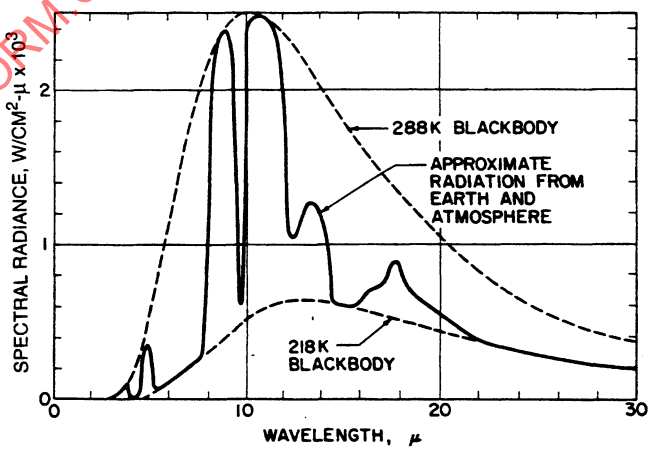


Figure 2A-11 - Typical Spectral Radiance Curve for Thermal Radiation Leaving the Earth; the 288K Blackbody Curve Approximates Radiation from the Earth's Surface, and the 218K Blackbody Curve Approximates the Radiation from the Atmosphere in Those Spectral Regions Where the Atmosphere is Opaque. (Ref. 107)

Table 2A-5 - Solar Spectral Irradiance Data[1] (850-2600 Å)

λ	H_λ	P_λ
850	2.2×10^{-6}	1.3×10^{-4}
900	5.0×10^{-6}	1.4×10^{-4}
950	3.0×10^{-6}	1.5×10^{-4}
1000	3.6×10^{-6}	1.7×10^{-4}
1050	2.0×10^{-6}	1.8×10^{-4}
1100	1.2×10^{-6}	1.8×10^{-4}
1150	1.6×10^{-6}	1.9×10^{-4}
1200	$.114 \times 10^{-6}$	2.0×10^{-4}
1250	3.0×10^{-6}	6.0×10^{-4}
1300	3.6×10^{-6}	6.2×10^{-4}
1350	5.2×10^{-6}	6.3×10^{-4}
1400	5.2×10^{-6}	6.4×10^{-4}
1450	1.0×10^{-5}	6.7×10^{-4}
1500	1.9×10^{-5}	7×10^{-4}
1550	3.4×10^{-5}	8×10^{-4}
1600	6.4×10^{-5}	1.0×10^{-3}
1650	1.0×10^{-4}	1.2×10^{-3}
1700	1.64×10^{-4}	1.8×10^{-3}
1750	2.4×10^{-4}	2.1×10^{-3}
1800	3.8×10^{-4}	3.2×10^{-3}
1850	5.6×10^{-4}	4.9×10^{-3}
1900	8.2×10^{-4}	7×10^{-3}
1950	1.1×10^{-3}	1.1×10^{-2}
2000	1.4×10^{-3}	1.5×10^{-2}
2050	1.8×10^{-3}	2.0×10^{-2}
2100	2.9×10^{-3}	0.03
2150	4.8×10^{-3}	0.04
2200	6.2×10^{-3}	0.06
2250	7.0×10^{-3}	0.08
2300	7.2×10^{-3}	0.11
2350	6.4×10^{-3}	0.14
2400	6.8×10^{-3}	0.16
2450	7.8×10^{-3}	0.18
2500	7.6×10^{-3}	0.21
2550	1.12×10^{-2}	0.25
2600	1.4×10^{-2}	0.29

SOURCE: Ref. 108. See also Ref. 120.

[1] H_λ is the spectral irradiance averaged over a 50 Å band centered on λ.

H_λ units are W/m^2-Å

Table 2A-6 - Intensities of Solar X-rays (W/m^2)

Solar Phenomenon	2–8Å	8–20Å	20–200Å
Sunspot, min. (quiet sun)	0.003×10^{-6}	0.04×10^{-5}	0.13×10^{-3}
Sunspot, max (quiet sun)	2×10^{-6}	2.3×10^{-5}	1.0×10^{-3}
Class 3 Bright Surge Prominence, 7-24-59	13×10^{-6}	8.9×10^{-5}	0.8×10^{-3}
Class 2+ flare, 8-24-59	26×10^{-6}	16×10^{-5}	2.1×10^{-3}
Class 2+ flare, 8-31-59	$>222 \times 10^{-6}$	$>45 \times 10^{-5}$	9.2×10^{-3}

SOURCE: Ref. 108. See also Ref. 120.

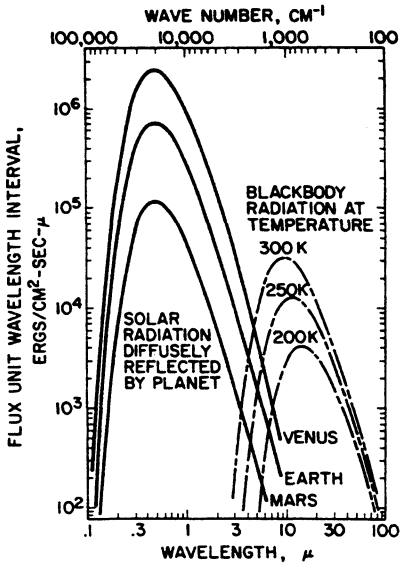


Figure 2A-12 - Reflected Solar or Emitted Planetary Radiation as a Function of Wavelength or Wave Number; Emitted Radiation is Merely Blackbody Radiation at the Specified Temperature (Emissivity of 1); Reflected or Scattered Solar Radiation Takes into Account the Change of Solar Constant due to Average Distance from Sun and Assumes an Albedo (Diffuse Reflectivity) of 0.7 for Venus, 0.4 for Earth, and 0.15 for Mars; Distribution of the Solar Spectrum is Taken to be that of a 5783K Blackbody. (Ref. 110)

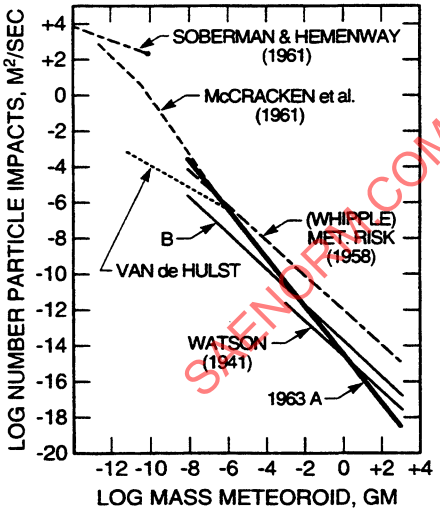


Figure 2A-13 - Cumulative Meteoroid Impact Rates near the Earth. (Ref. 111)

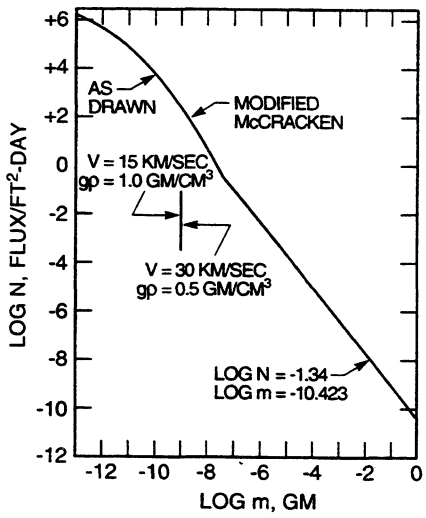


Figure 2A-14 - Interim Earth to Moon Yearly Average Micrometeorite Sporadic Flux; for Shower Meteoroids the Ratio of Shower Flux to Sporadic Flux is Designated as F; for $m \geq 10^{-2}$ gm, use Values of F from NASA-MSC Doc. No. EC-1; for $m < 10^{-2}$ gm, NASA-MSC will Furnish Revised Values of F. Near-Earth is Tentatively Defined as Earth to Moon; Shower Data Supplied by MSC. (Ref. 114)

Table 2A-7A - Earth and Atmosphere Radiation: Average Short Wave Solar Energy Reflected by the Atmosphere and Earth

Latitude, deg	Short Wave Energy Reflected, W/cm^2			
	Jan.	21 Mar.	Jul.	23 Sept.
0–10	0.0150	0.0156	0.0171	0.0165
10–20	0.0123	0.0144	0.0192	0.0165
20–30	0.0116	0.0145	0.0161	0.0143
30–40	0.0101	0.0136	0.0152	0.0129
40–50	0.0075	0.0136	0.0183	0.0124
50–60	0.0043	0.0125	0.0206	0.0170
60–90	0.0017	0.0033	0.0224	0.0024

SOURCE: Ref. 107.

Table 2A-7B - Earth and Atmosphere Radiation: Total Long Wave Radiation from the Earth and Atmosphere[1]

Latitude, deg	Long Wave Energy Radiated, W/cm^2			
	Jan.	21 Mar.	Jul.	23 Sept.
0–10	0.0203	0.0212	0.0209	0.0206
10–20	0.0206	0.0210	0.0210	0.0211
20–30	0.0203	0.0204	0.0213	0.0213
30–40	0.0193	0.0194	0.0216	0.0213
40–50	0.0175	0.0175	0.0202	0.0201
50–60	0.0164	0.0164	0.0195	0.0185
60–90	0.0156	0.0152	0.0189	0.0177

SOURCE: Ref. 107.

[1] Values averaged over one day as a function of geographical latitude and season. Instantaneous values depend on the prevailing meteorological situation.

SECTION 2B. PROPERTIES OF GASES

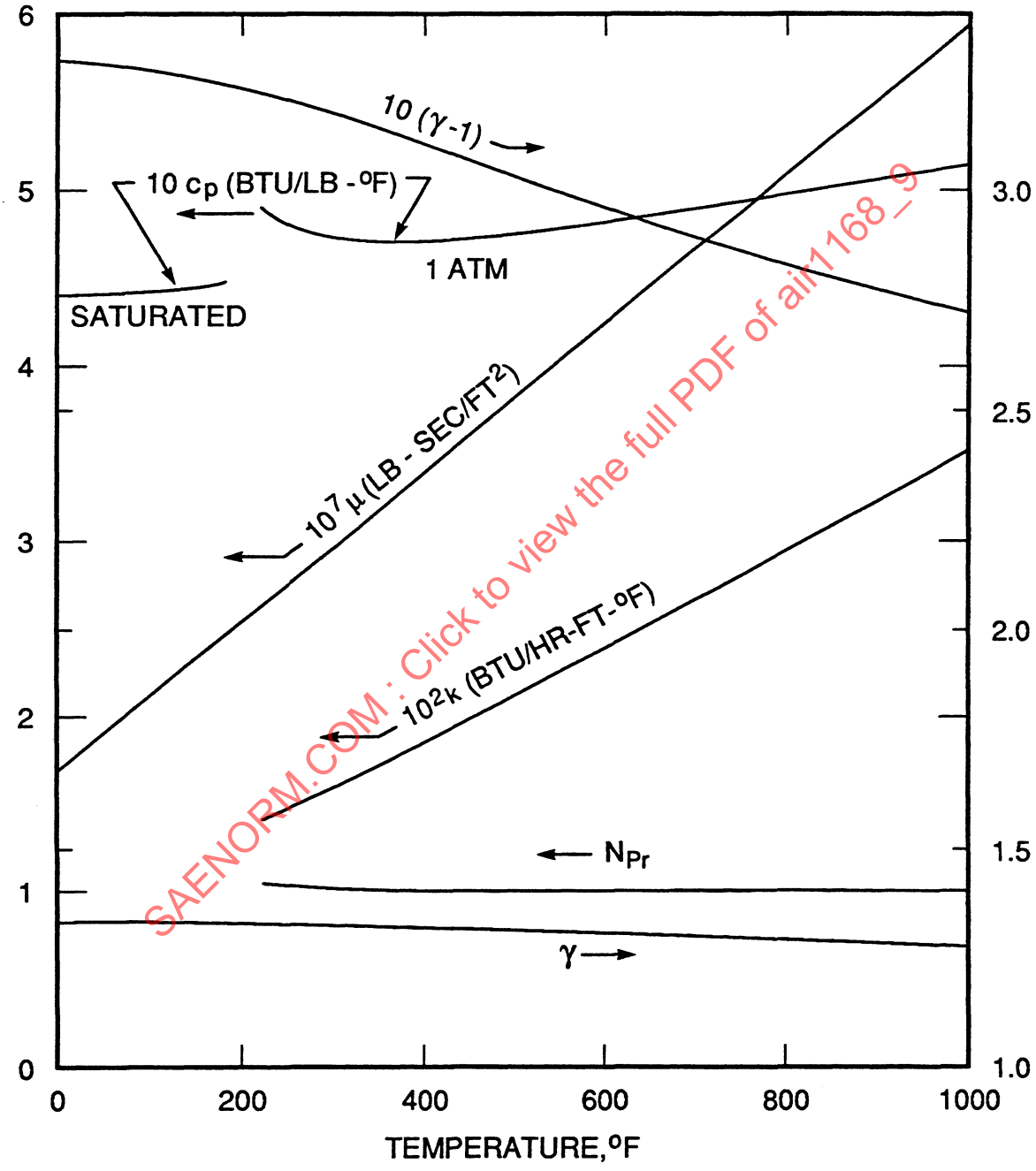


Figure 2B-1 - Properties of Water Vapor, γ, N_{Pr}, k, μ, c_p, $(\gamma-1)$; R = 85.81 ft-lb/lb-°F, $g\rho_{std}$ = 0.04755 lb/ft^3, P_{std} = 14.696 psi, P_{cr} = 3206.4 psia, t_{cr} = 705.4°F, t_{std} = 59 °F. (Refs. 11, 23, 38, 45, 61)

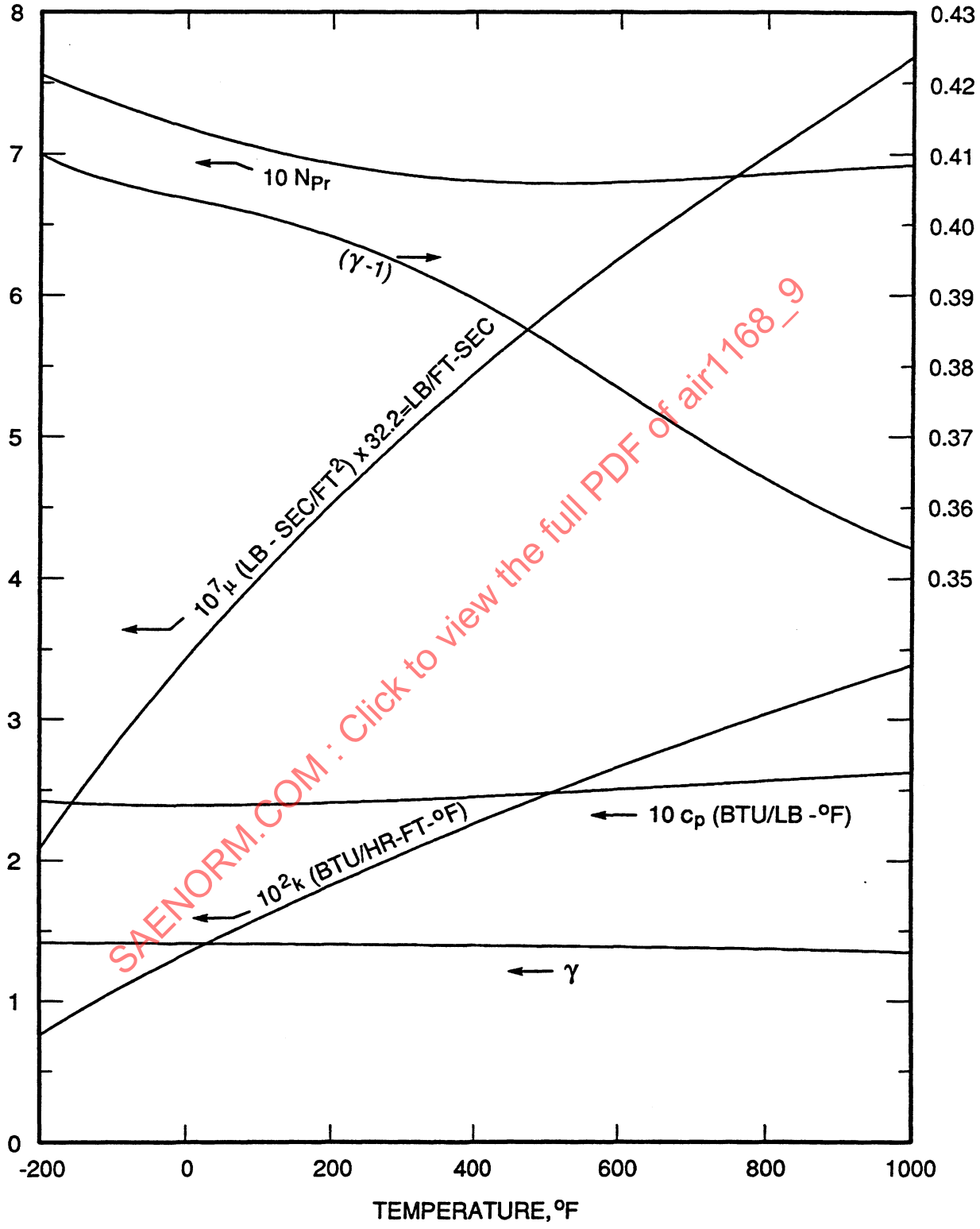


Figure 2B-2 - Properties of Air, k, c_p, N_{Pr}, μ, γ, $(\gamma-1)$; R = 53.30 ft-lb/lb-°F, $g\rho_{std}$ = 0.07655 lb/ft^3, P_{std} = 14.696 psi, P_{cr} = 547 psia, t_{cr} = -220°F, t_{std} = 59°F. (Refs. 11, 23, 38, 45, 61; for properties of air at low pressure and high temperature, see Ref. 115)

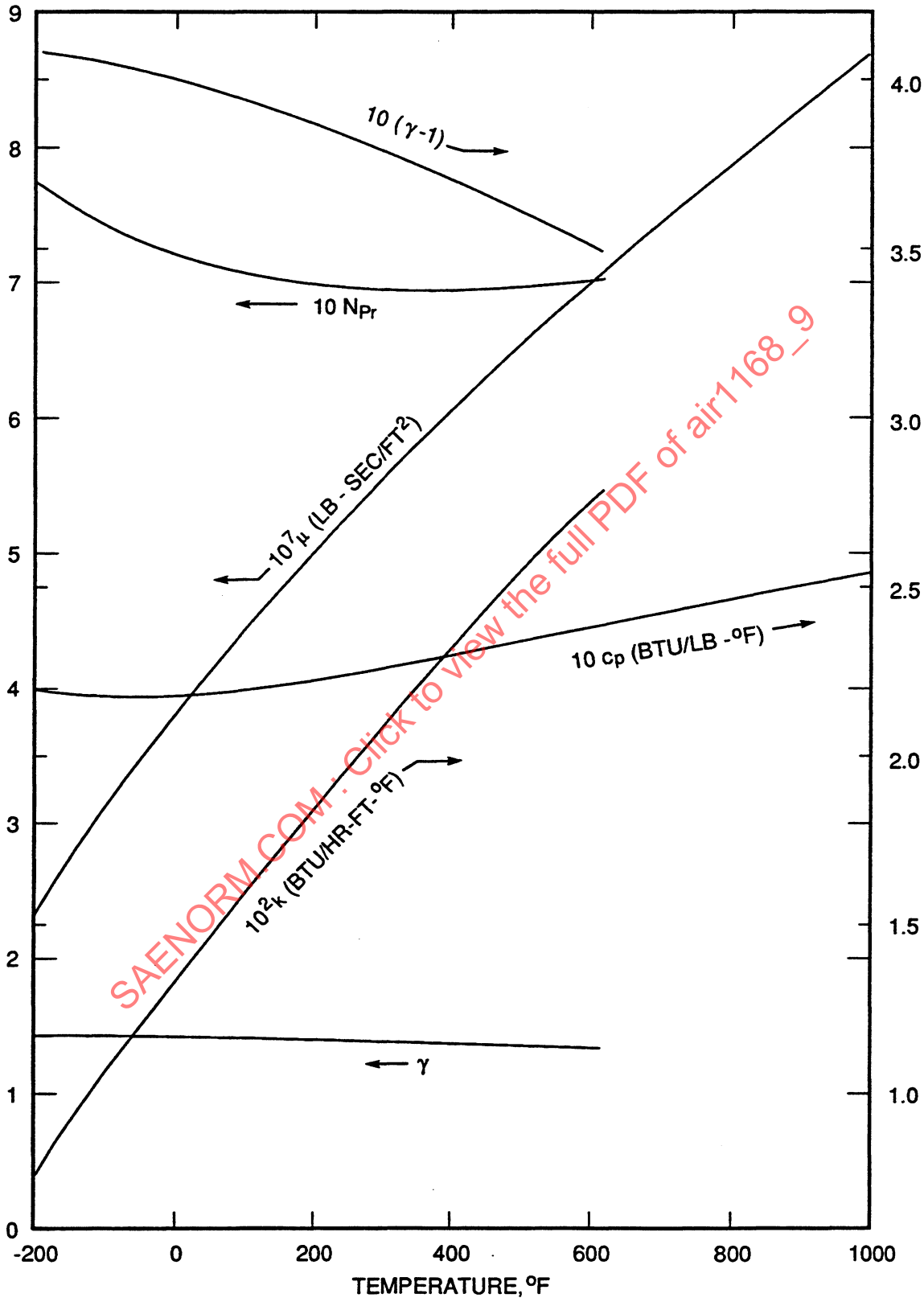


Figure 2B-3 - Oxygen Properties k, c_p, μ, γ, (γ-1), N_{Pr}; R = 48.31 ft-lb/lb-°F, $g\rho_{std}$ = 0.08445 lb/ft^3, P_{std} = 14.696 psi, P_{cr} = 730 psia, t_{cr} = -182°F, t_{std} = 59°F. (Refs. 11, 23, 38, 45, 61)

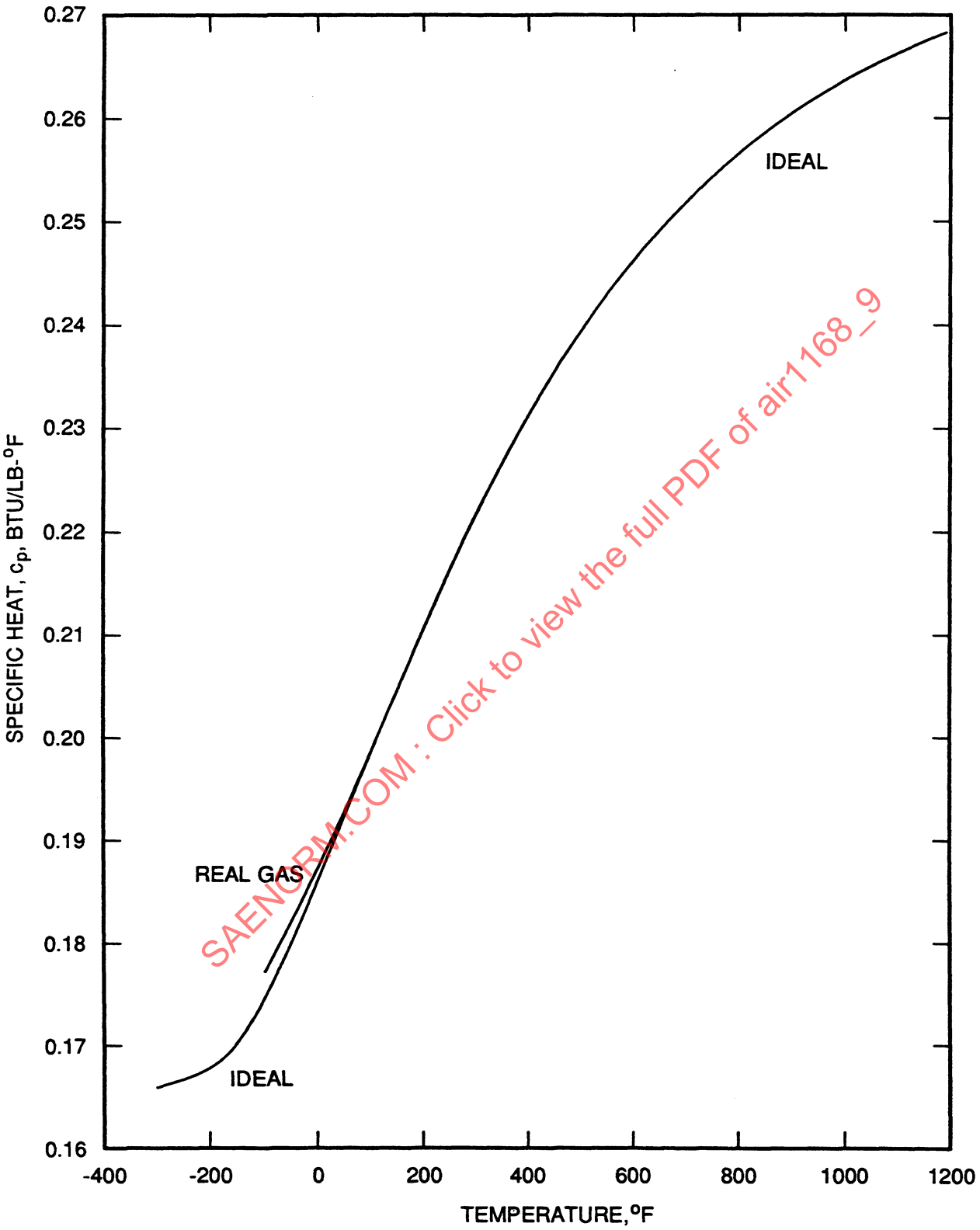


Figure 2B-4 - Ozone Gas Property c_p; R = 32.21 ft-lb/lb-°F; $g\rho_{std}$ = 0.1267 lb/ft^3, P_{std} = 14.696 psi; P_{cr} = 802.4 psia, t_{cr} = 0.2°F, t_{std} = 59°F. (Refs. 12, 41)

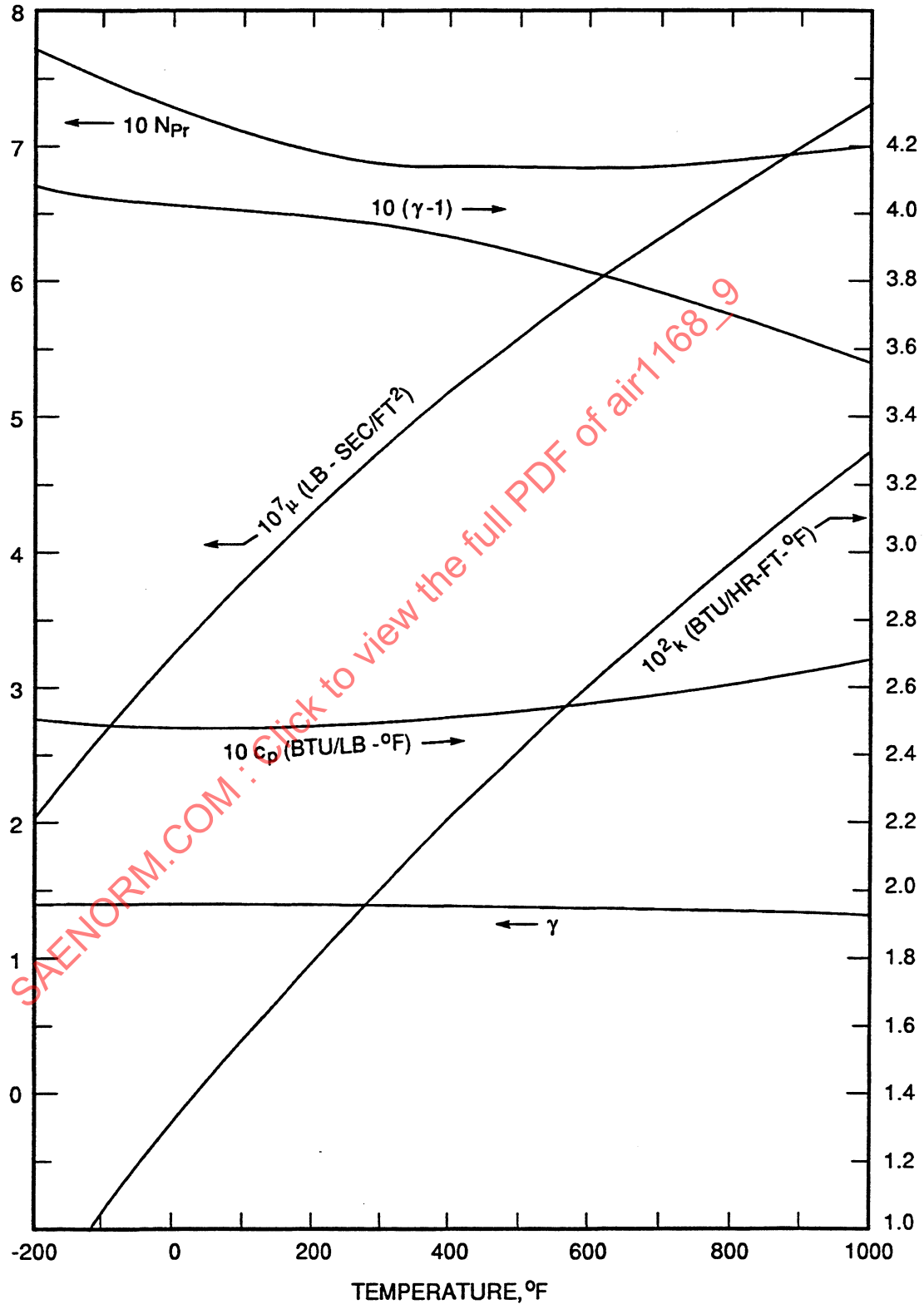


Figure 2B-5 - Nitrogen Properties k, c_p, μ, γ, (γ-1), N_{Pr}; R = 55.16 ft-lb/lb-°F, $g\rho_{std}$ = 0.07396 lb/ft^3, P_{std} = 14.696 psi, P_{cr} = 492 psia, t_{cr} = -233°F, t_{std} = 59°F. (Refs. 11, 23, 38, 45, 61)

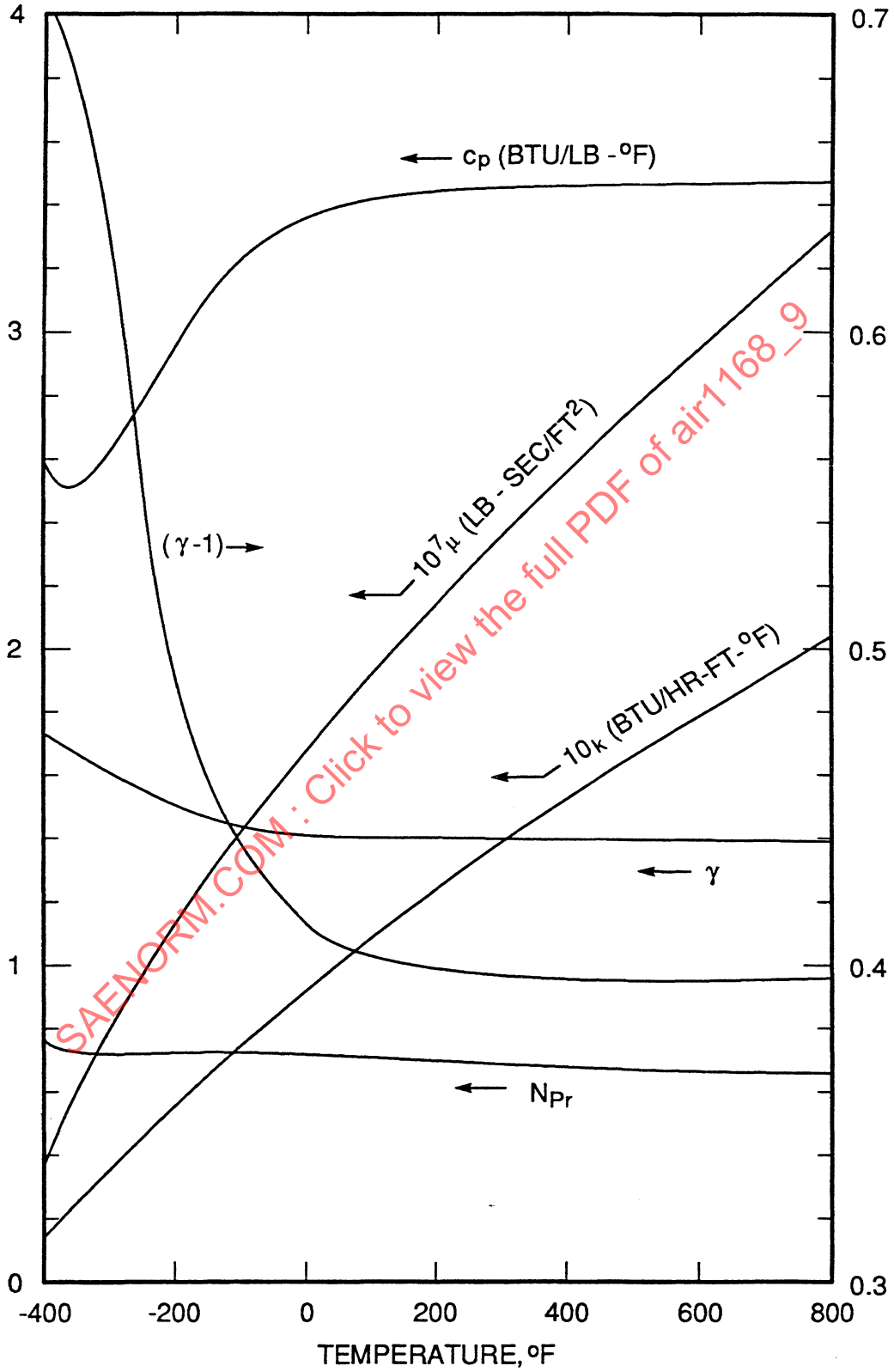


Figure 2B-6 - Hydrogen Properties k, c_p, μ, γ, N_{Pr}, (γ-1); R = 766.5 ft-lb/lb-°F, $g\rho_{std}$ = 0.005321 lb/ft³, P_{std} = 14.696 psi, P_{cr} = 188 psia, t_{cr} = -400°F, t_{std} = 59°F. (Refs. 11, 23, 38, 45, 61)

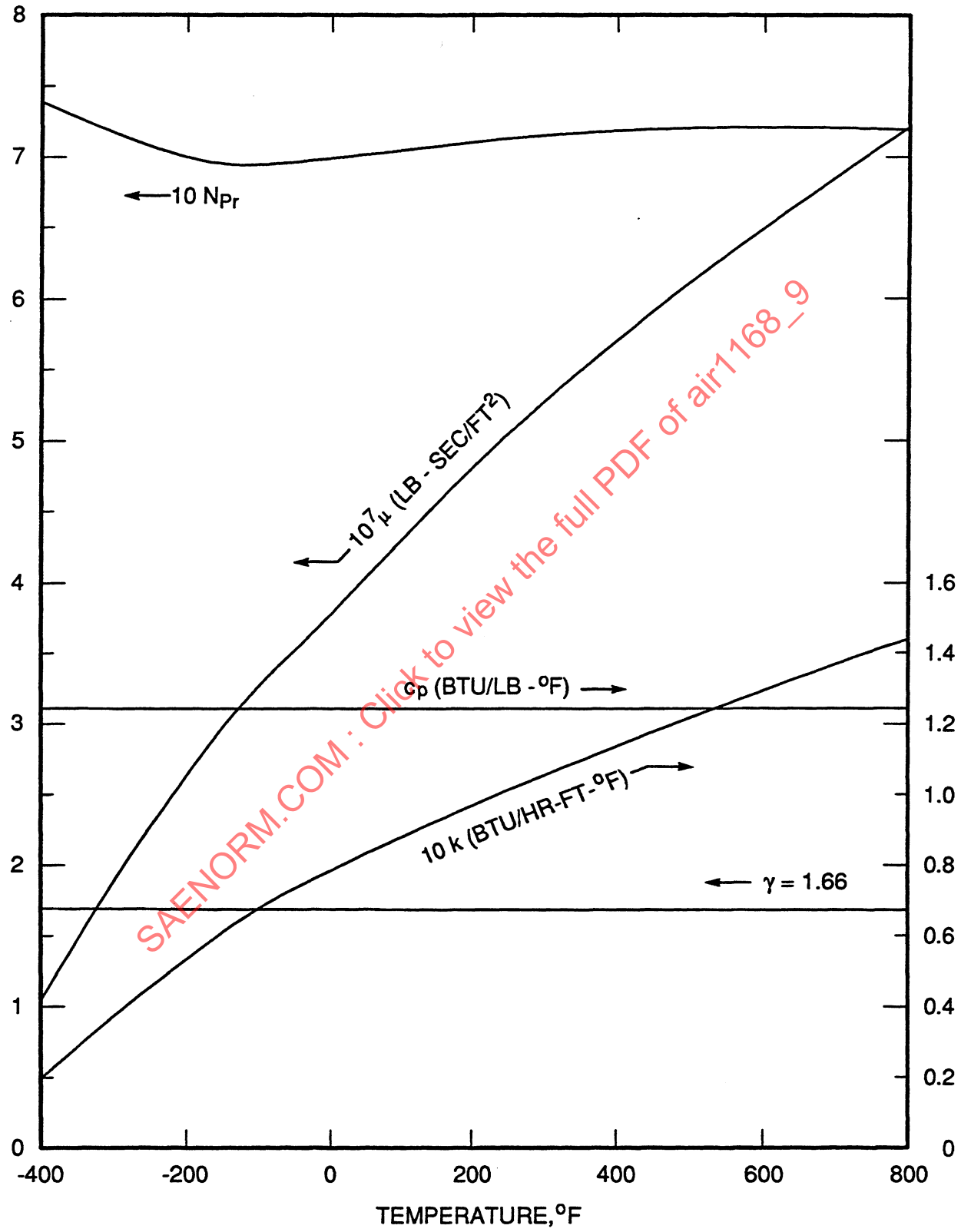


Figure 2B-7 - Helium Properties k, c_p, μ, γ, N_{Pr}; R = 386.3 ft-lb/lb-°F, $g\rho_{std}$ = 0.01056 lb/ft^3; P_{std} = 14.696 psi, P_{cr} = 33 psia, t_{cr} = -450°F, t_{std} = 59°F. (Refs. 11, 23, 38, 45, 61)

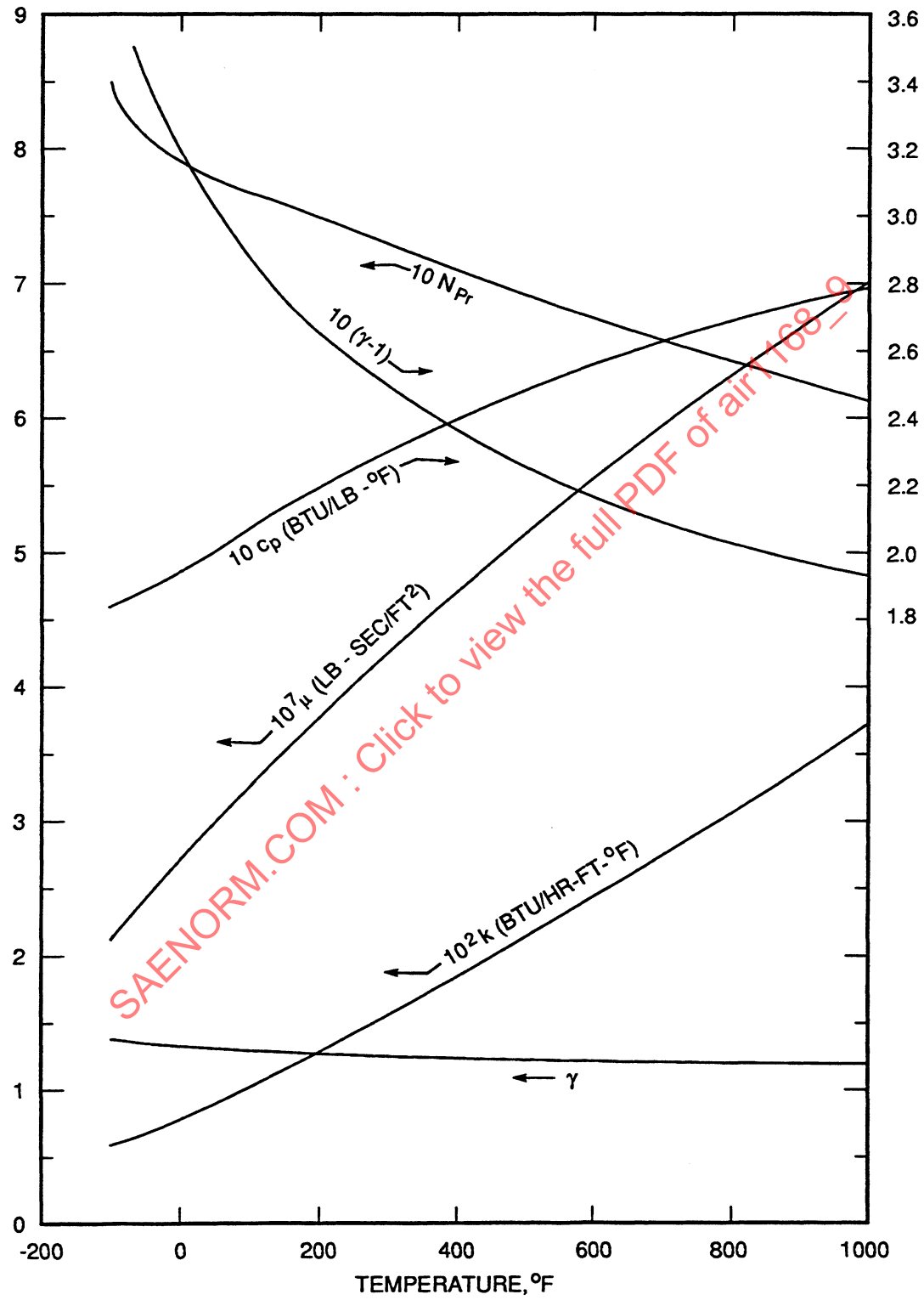


Figure 2B-8 - Carbon Dioxide Properties k, c_p, μ, N_{Pr}, γ, (γ-1); R = 35.13 ft-lb/lb-°F, $g\rho_{std}$ = 0.1161 lb/ft^3, P_{std} = 14.696 psi, P_{cr} = 1073 psia, t_{cr} = 88°F, t_{std} = 59°F. (Refs. 11, 23, 38, 45, 61)

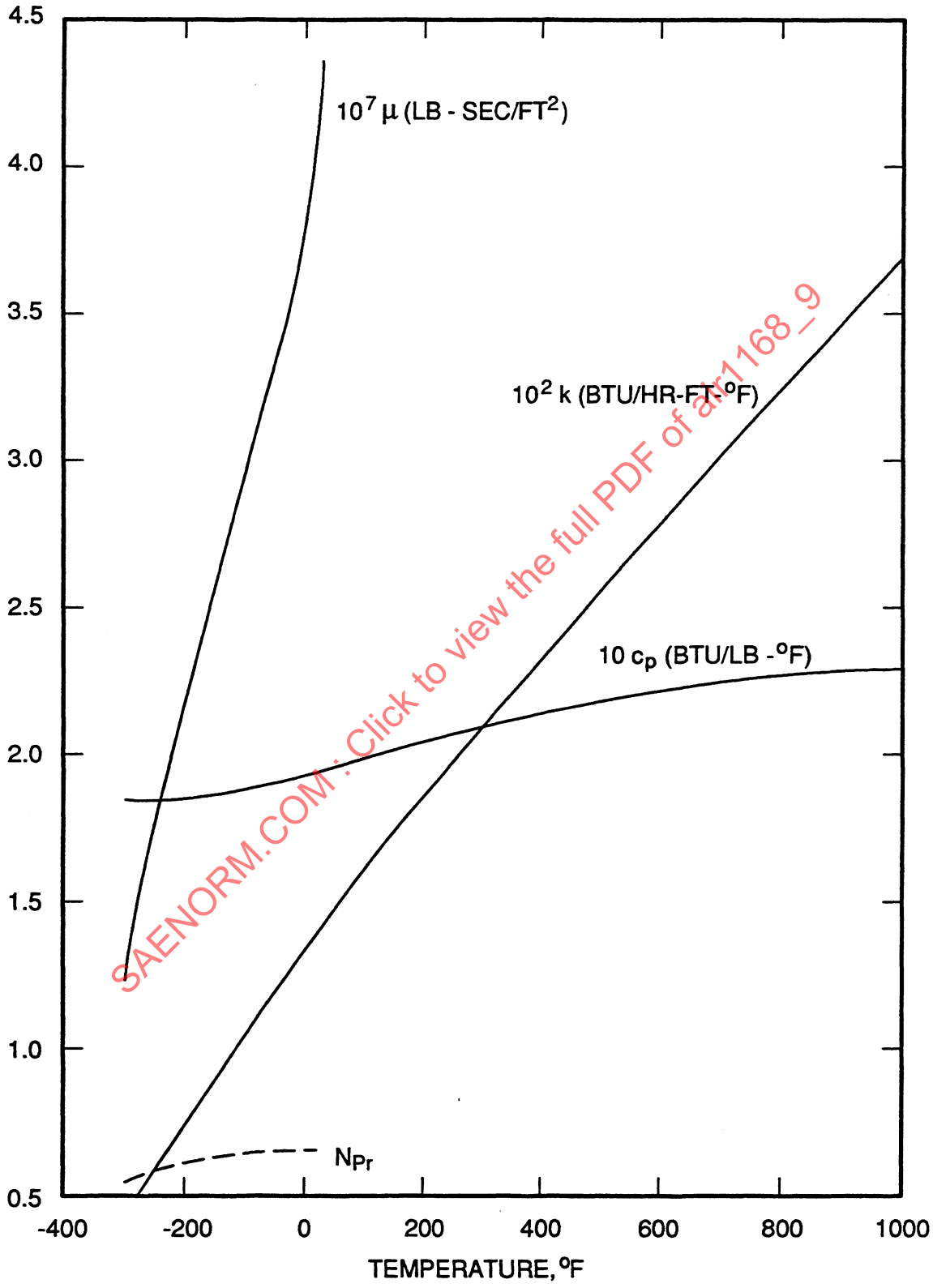


Figure 2B-9 - Fluorine Gas Properties k, c_p, μ, N_{Pr}; R = 40.68 ft-lb/lb-°F, $g\rho_{std}$ = 0.1003 lb/ft^3, P_{std} = 14.696 psi, P_{cr} = 808 psia, t_{cr} = -202.2°F, t_{std} = 59°F. (Refs. 5, 16, 26, 44, 69, 76)

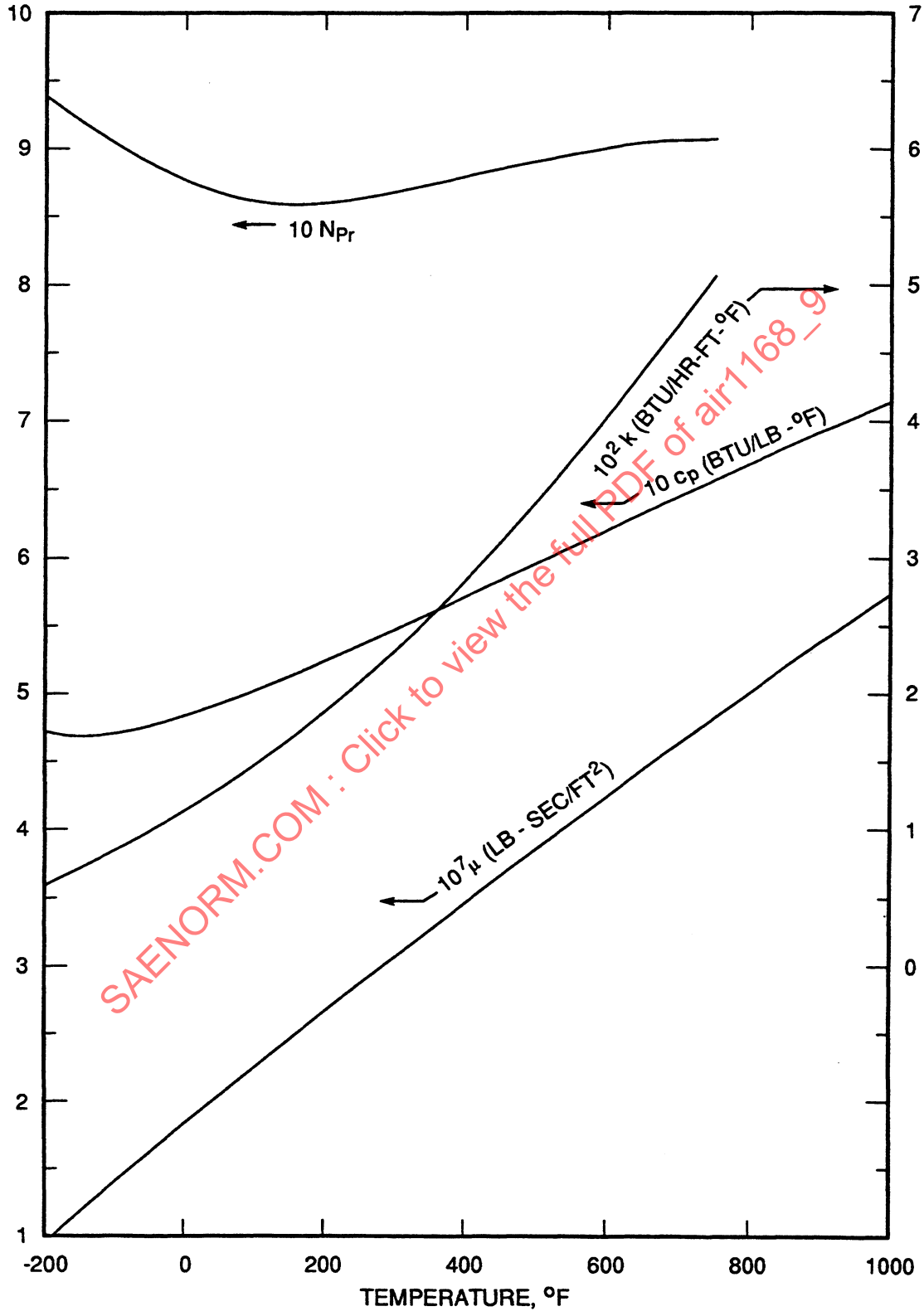


Figure 2B-10 - Ammonia Properties k, c_p, N_{Pr}, μ; R = 90.77 ft-lb/lb-°F, $g\rho_{std}$ = 0.0459 lb/ft^3, P_{std} = 14.696 psi, P_{cr} = 1639 psia, t_{cr} = 270°F, t_{std} = 59°F. (Refs. 5, 11, 23, 49)

SECTION 2C. PROPERTIES OF LIQUIDS

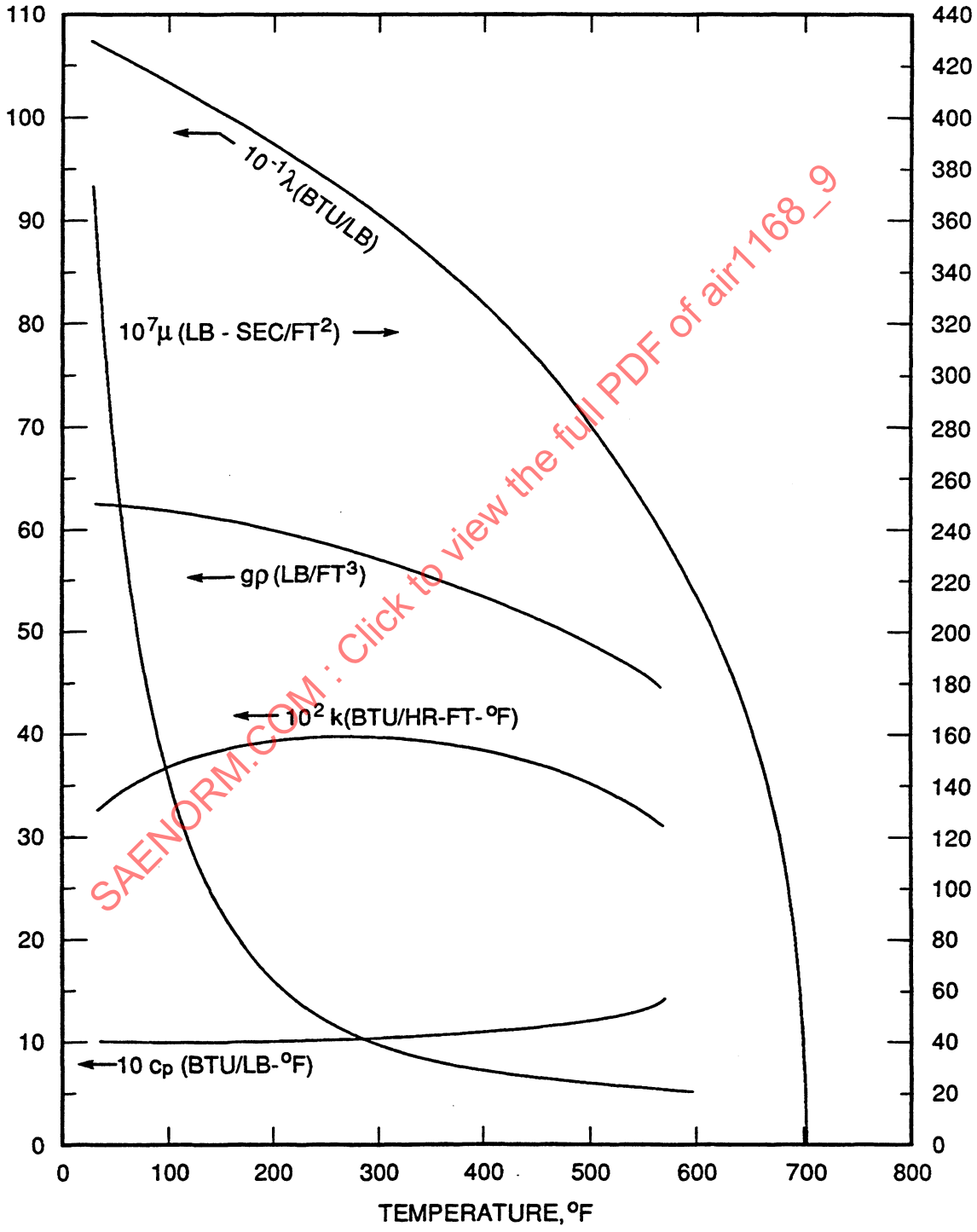


Figure 2C-1 - Water (Saturated) Properties c_p, k, μ, $g\rho$, λ. (Refs. 14, 46, 51)

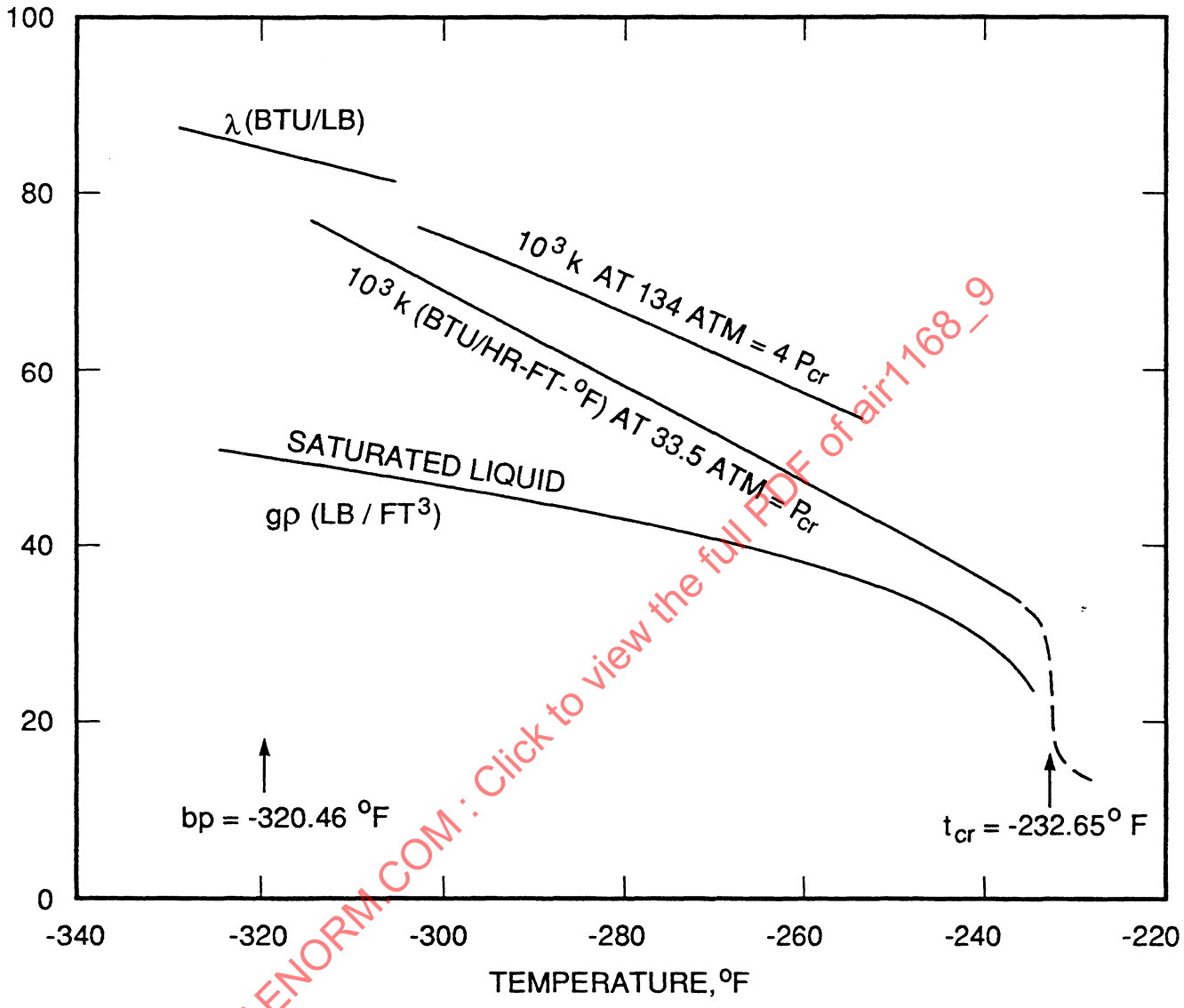


Figure 2C-2 - Liquid Nitrogen Properties k, gρ, λ. (Refs. 15, 87)

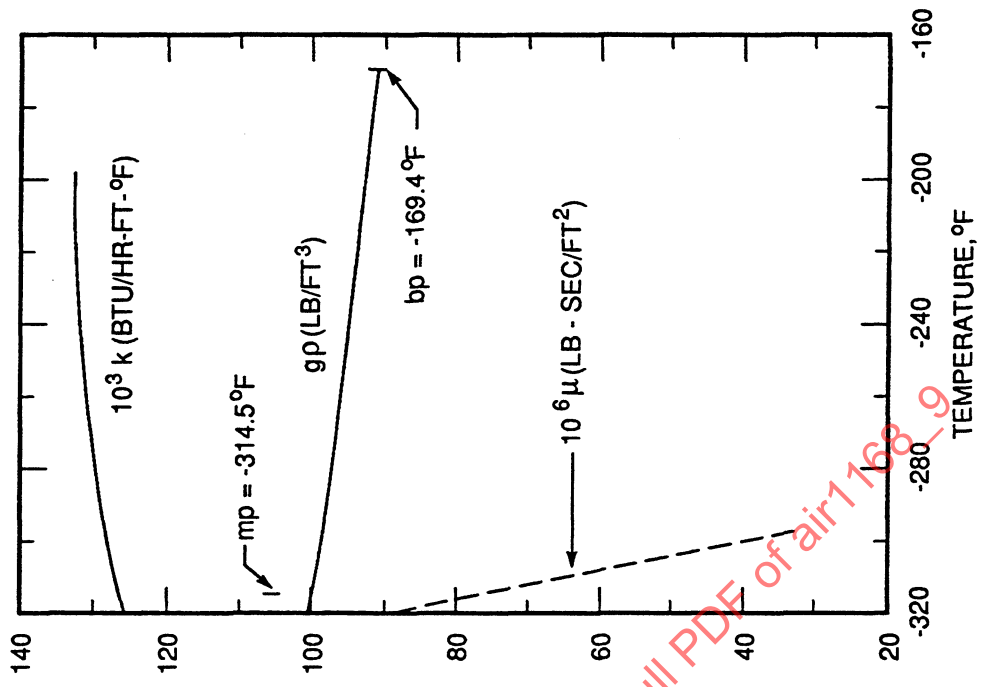


Figure 2C-4 - Liquid Ozone Properties k, gρ, μ. (Ref. 12)

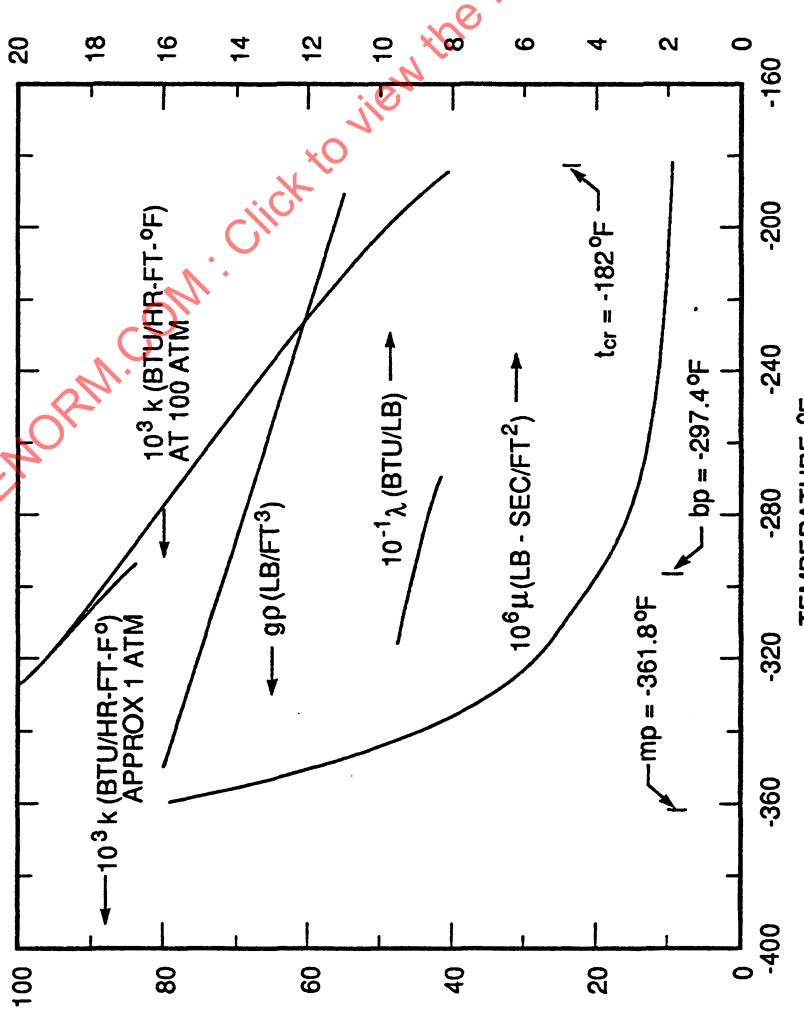


Figure 2C-3 - Liquid Oxygen Properties k, gρ, λ, μ. (Refs. 3, 15, 32, 83)

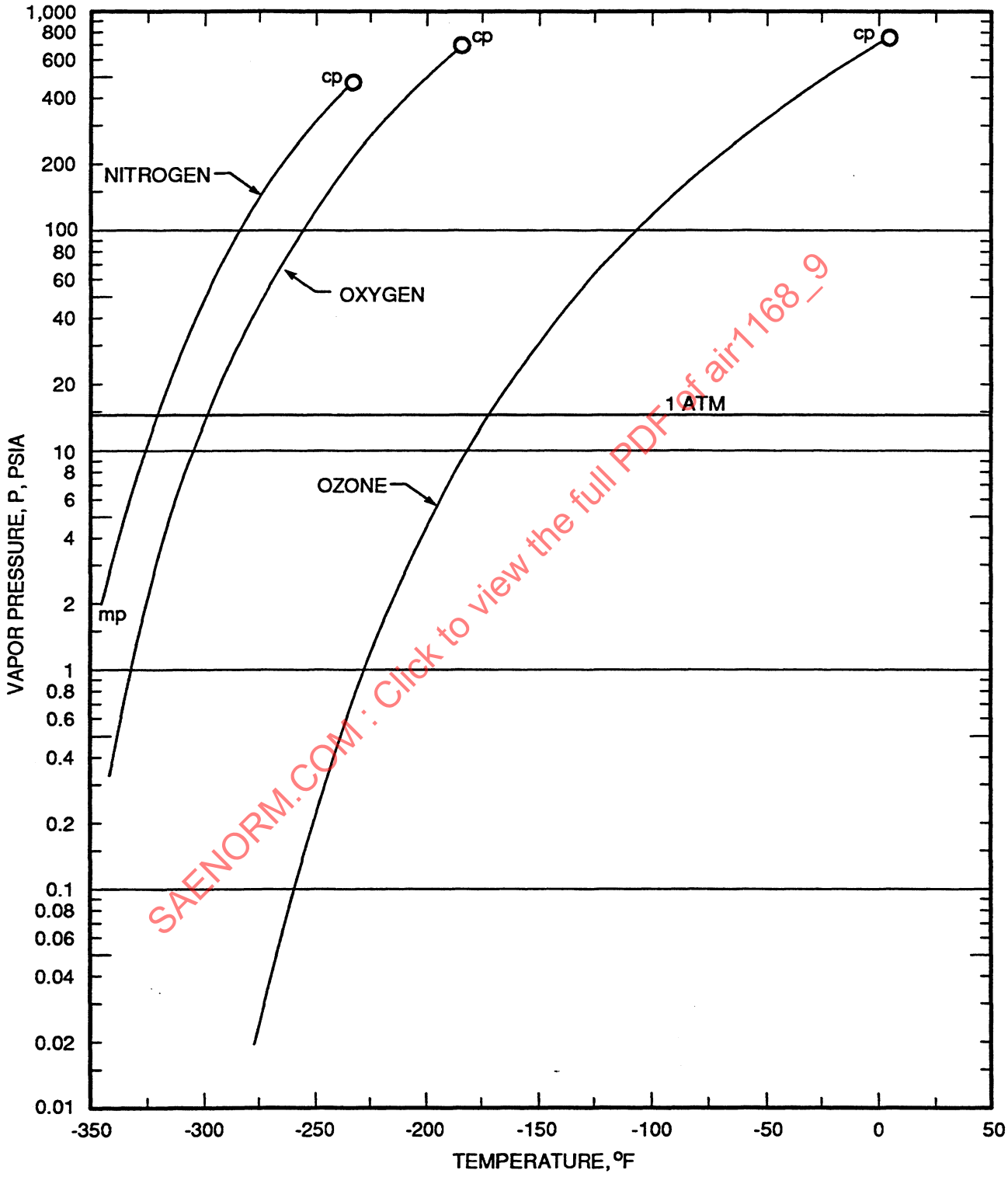


Figure 2C-5 - Vapor Pressure of Low Temperature Liquids. (Refs. 12, 38)

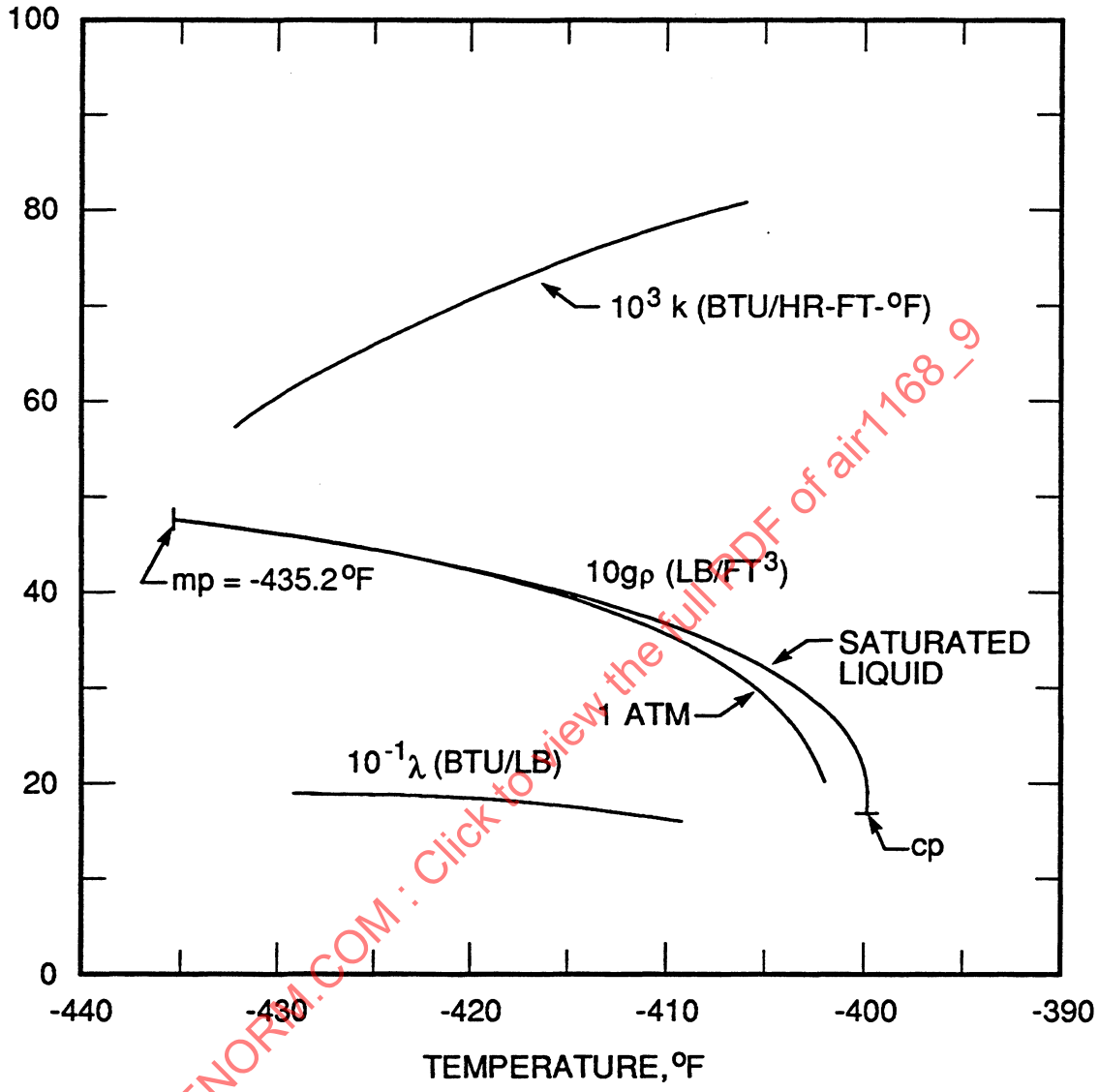


Figure 2C-6 - Liquid Hydrogen Properties k, gρ, λ. (Ref. 15)

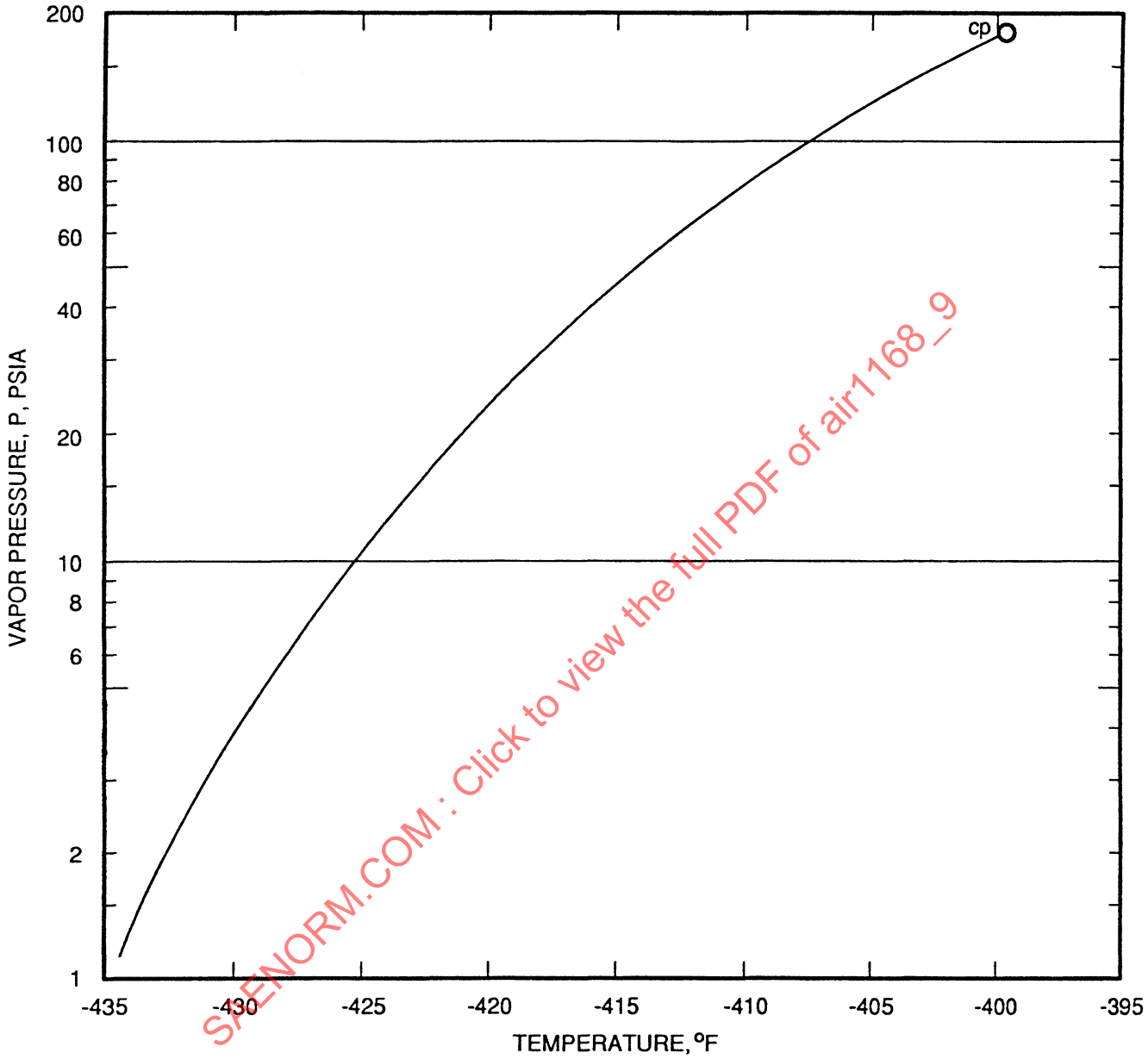


Figure 2C-7 - Vapor Pressure of Hydrogen. (Ref. 38)

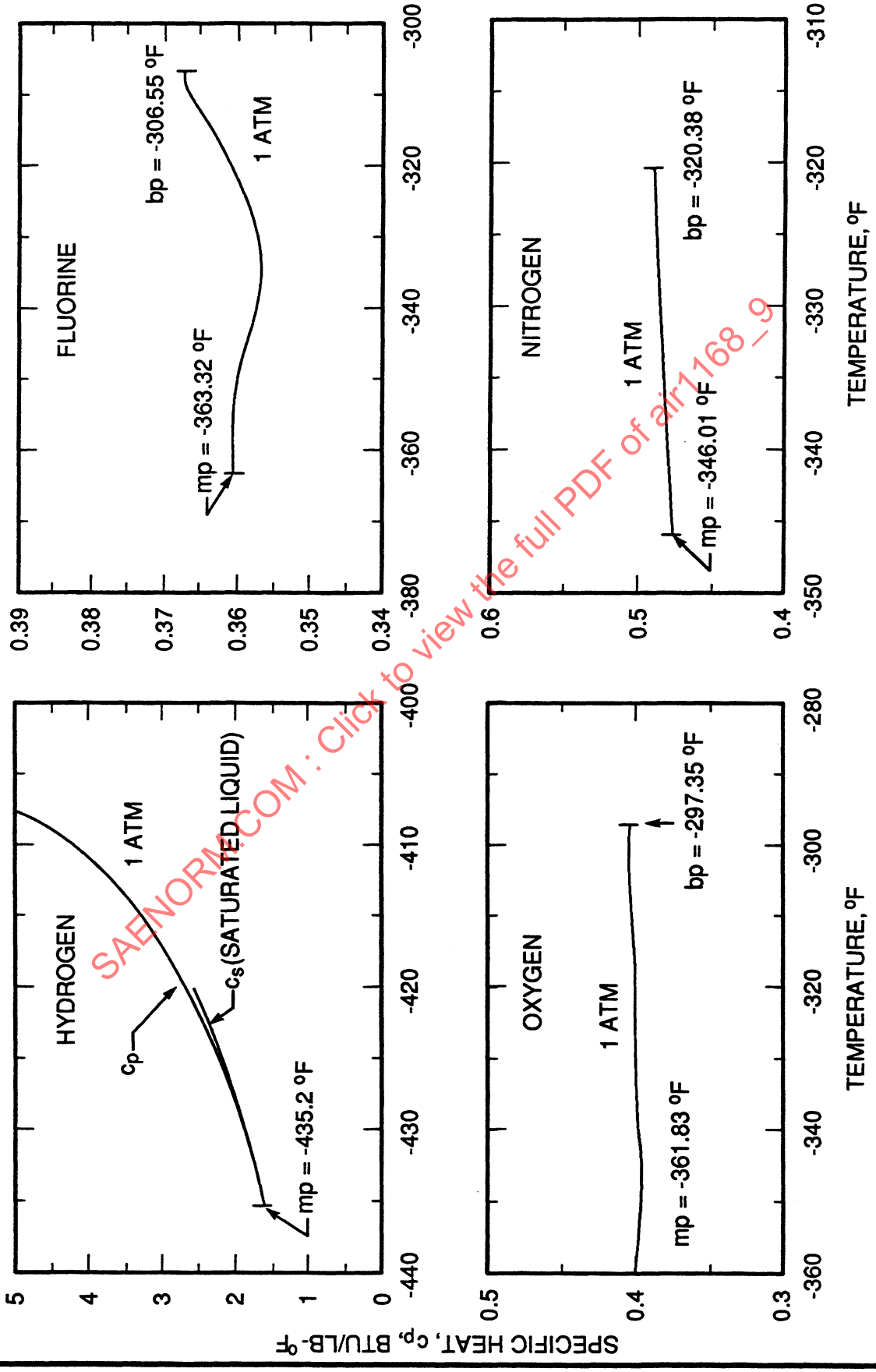


Figure 2C-8 - Specific Heat of Liquids. (Refs. 15, 30-32, 76)

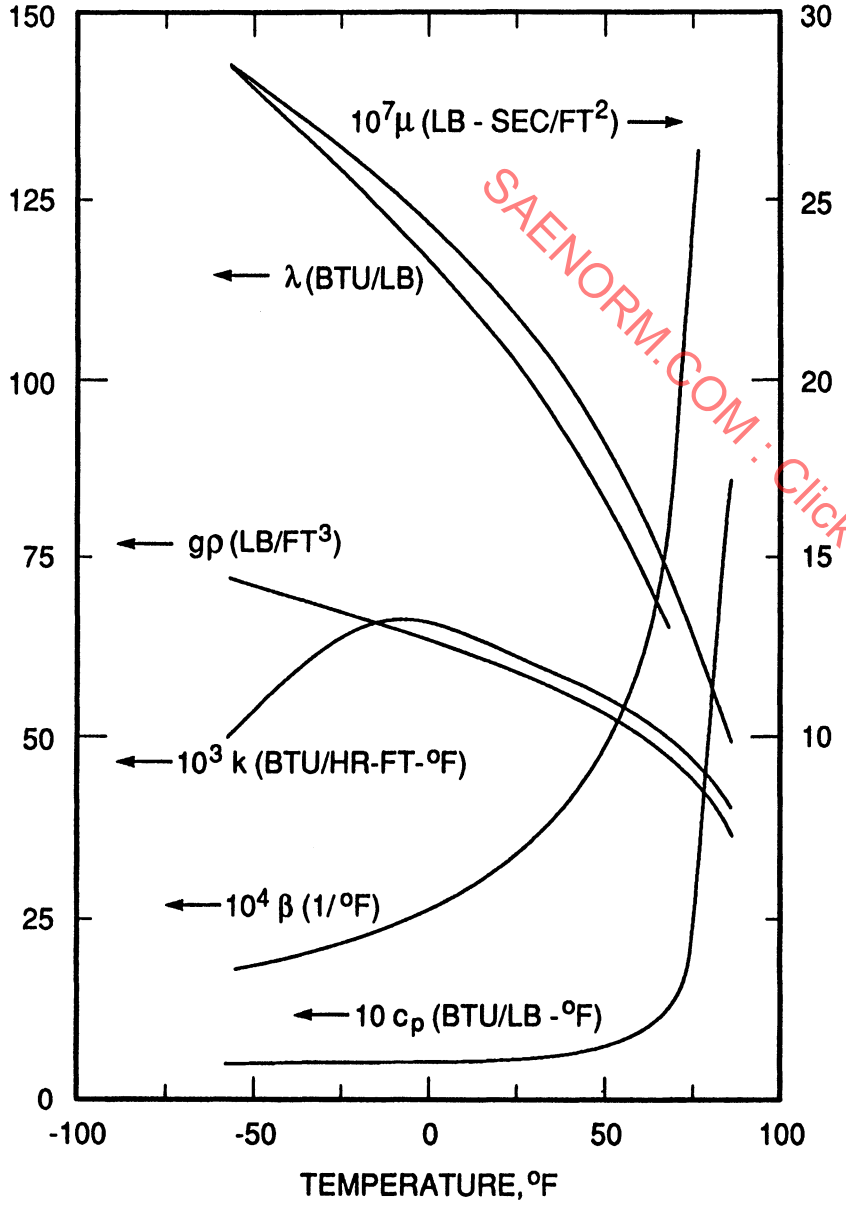


Figure 2C-9 - Liquid Carbon Dioxide (Saturated) Properties k, c_p, gρ, λ, β, μ; P_{cr} = 1070.6 psia, t_{cr} = 87.9°F. (Refs. 51 and 81)

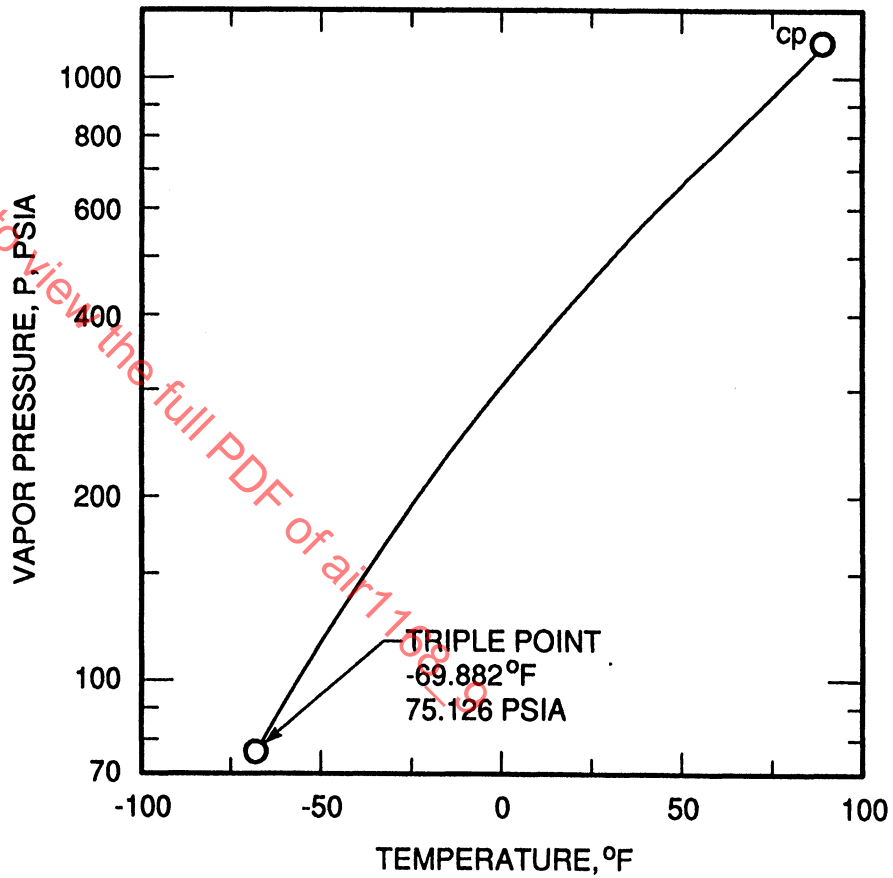


Figure 2C-10 - Vapor Pressure of Liquid Carbon Dioxide. (Ref. 38)

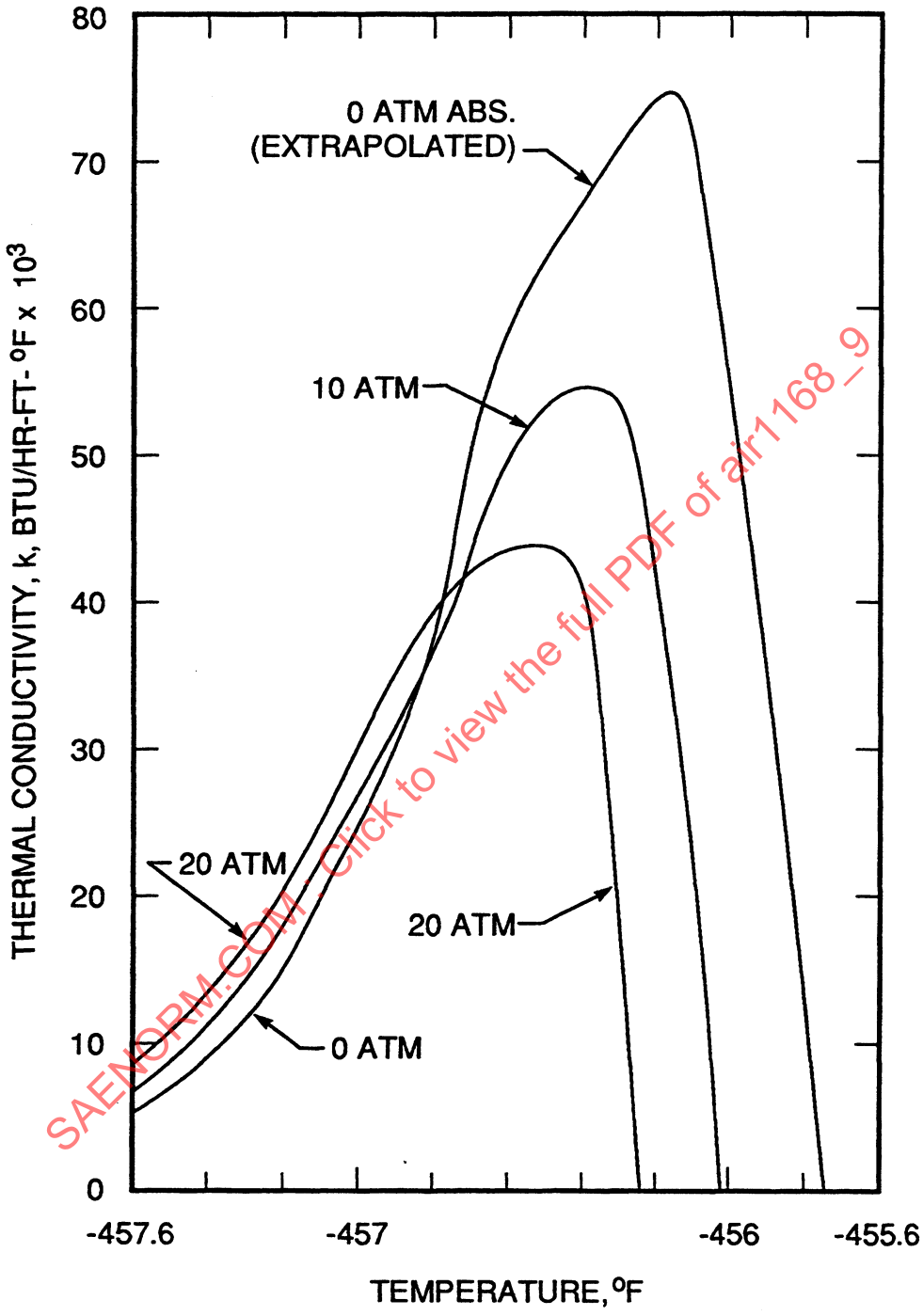


Figure 2C-11 - Thermal Conductivity of Liquid Helium. (Ref. 47)

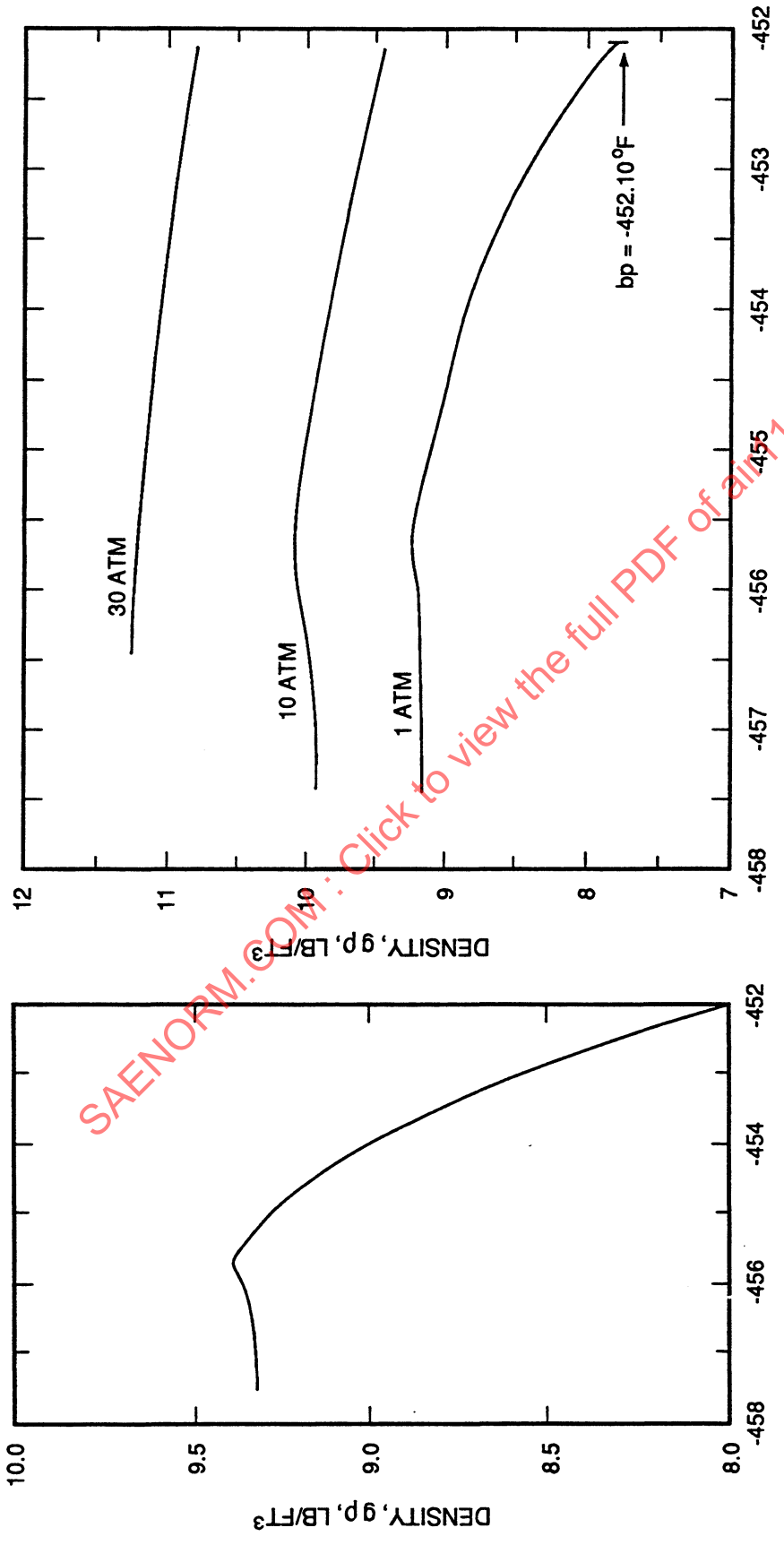


Figure 2C-12 - Density of Liquid Helium; P_{cr} = 33.21 psia; (a) Saturated Liquid, (b) Constant Pressure.

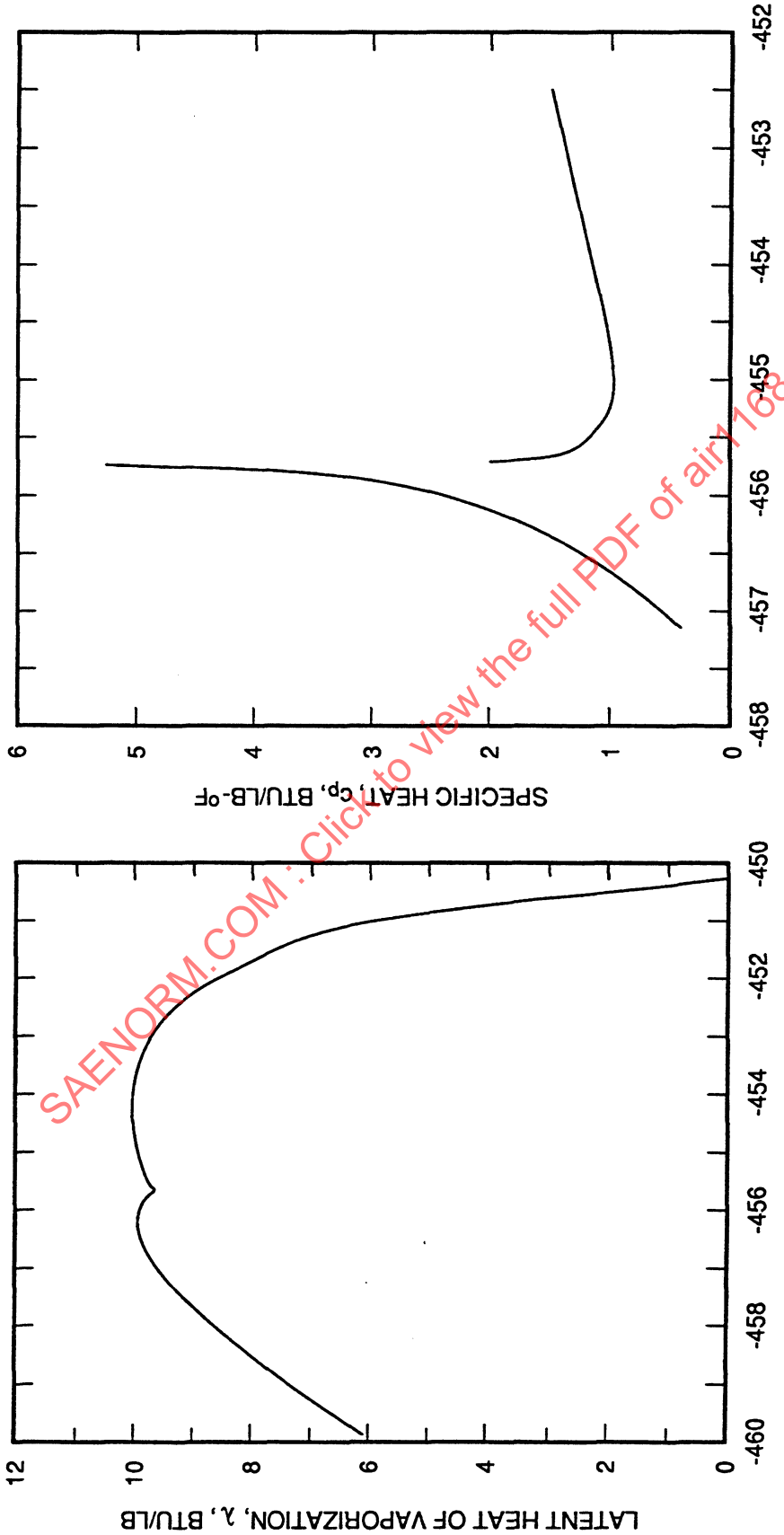


Figure 2C-13 - Saturated Liquid Helium, λ, c_p; t_{cr} = -450.33°F, bp = -452.10°F.

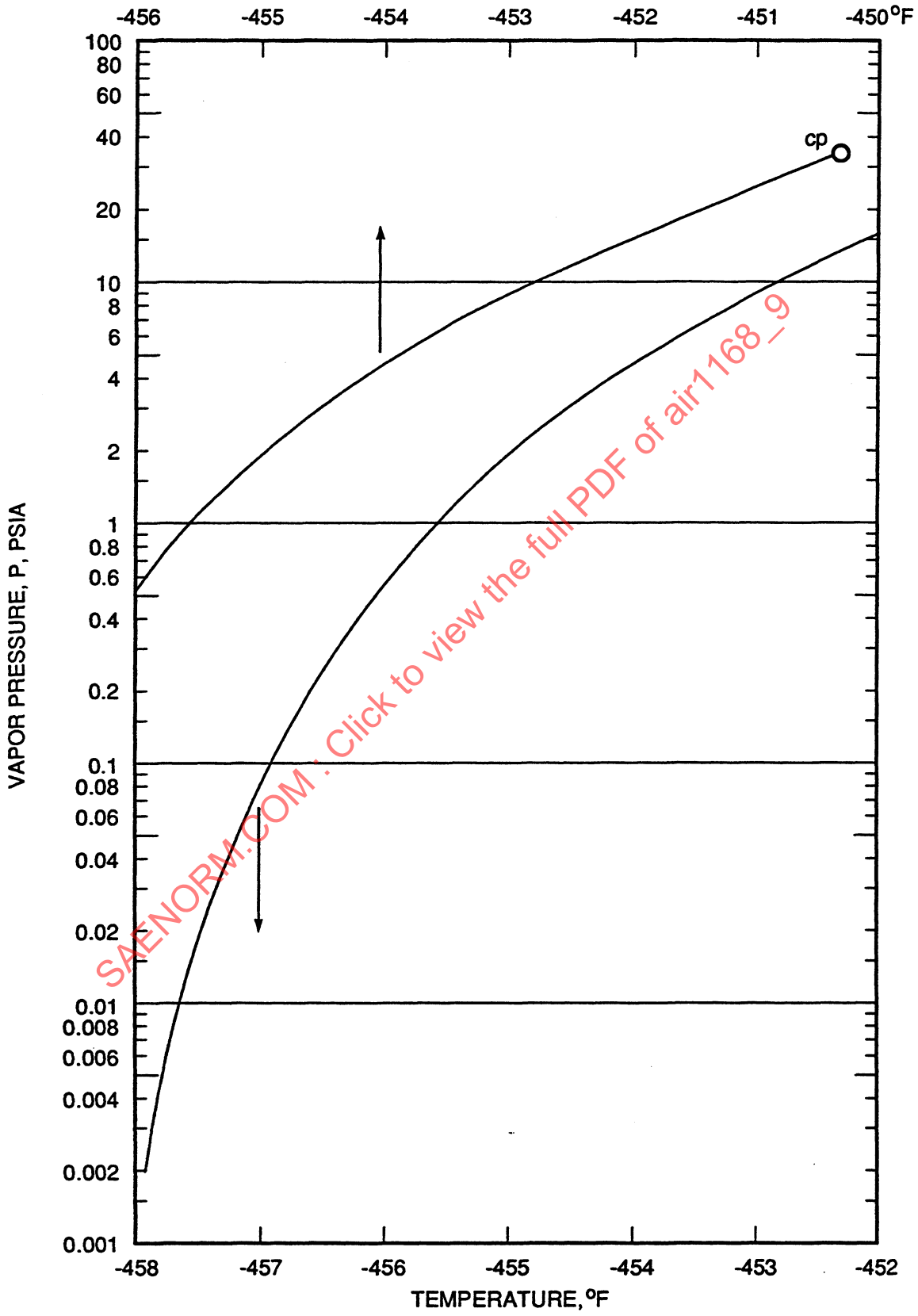


Figure 2C-14 - Vapor Pressure of Helium. (Ref. 47)

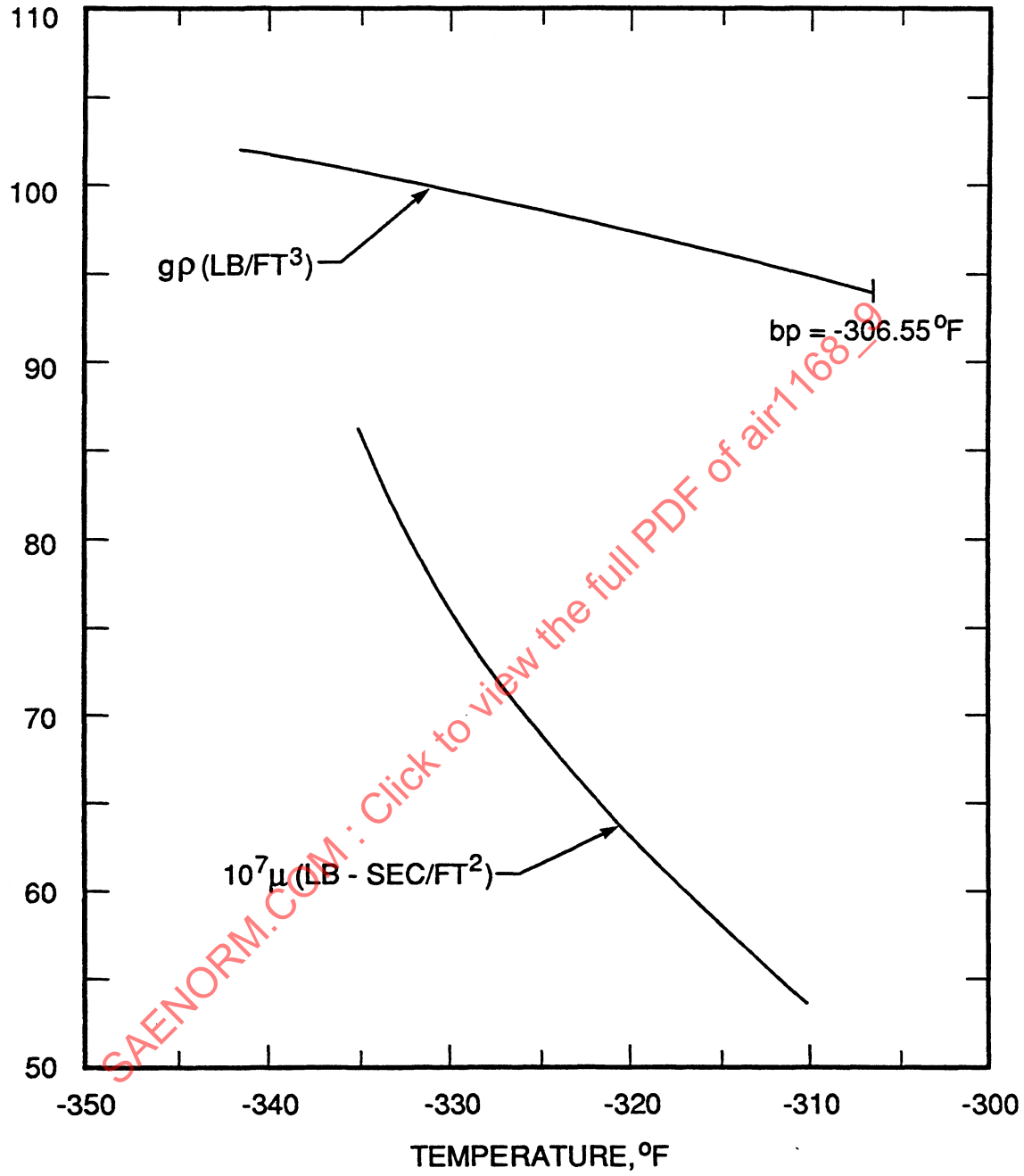


Figure 2C-15 - Liquid Fluorine Properties gρ, μ; mp = -363.32°F. (Refs. 5, 76)

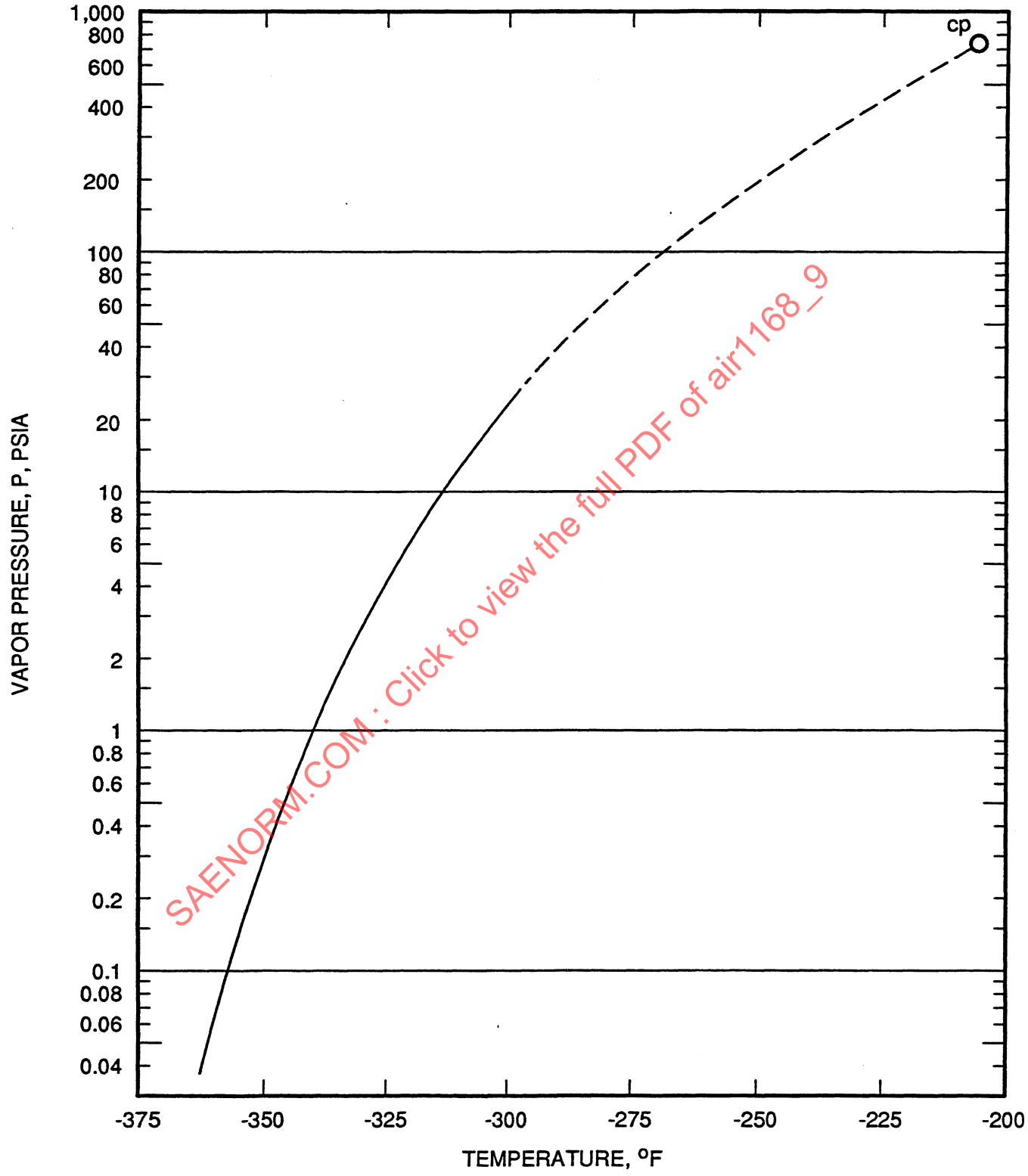


Figure 2C-16 - Vapor Pressure of Fluorine. (Refs. 5, 76)

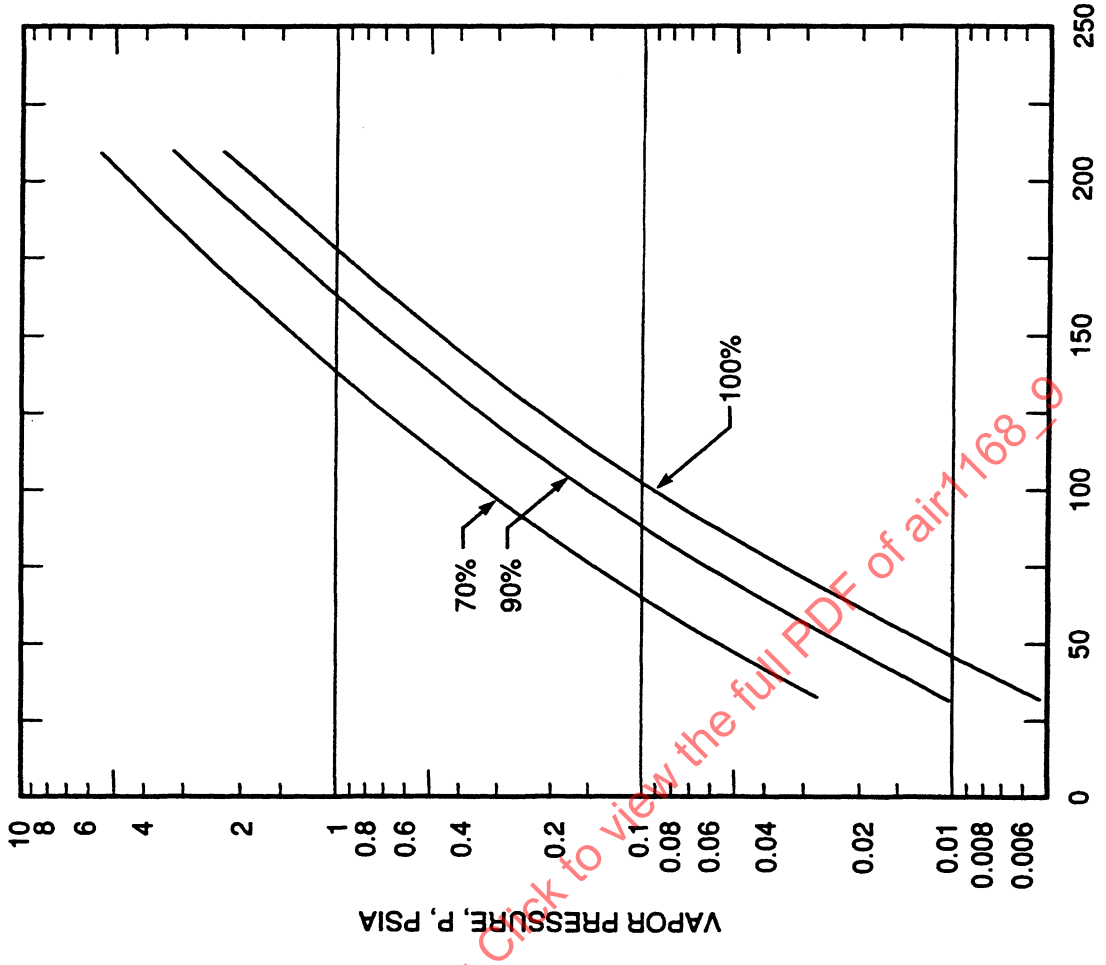


Figure 2C-18 - Vapor Pressure of Aqueous Hydrogen Peroxide Solutions. (by weight of Hydrogen Peroxide); (Ref. 10)

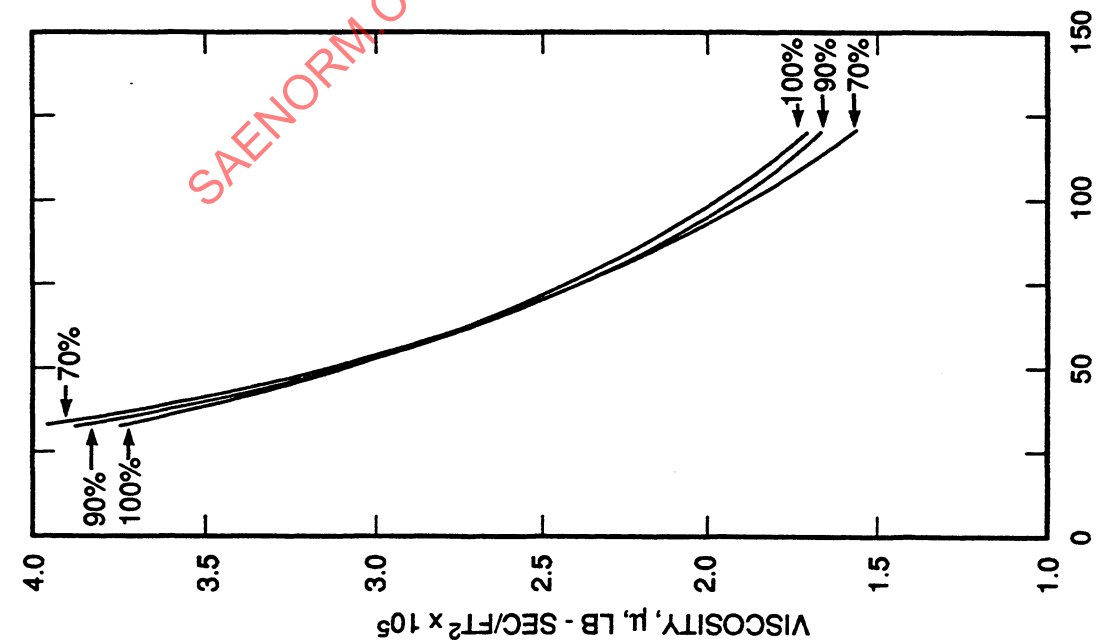


Figure 2C-17 - Viscosity of Aqueous Hydrogen Peroxide Solutions. (by weight of Hydrogen Peroxide); (Ref. 10)

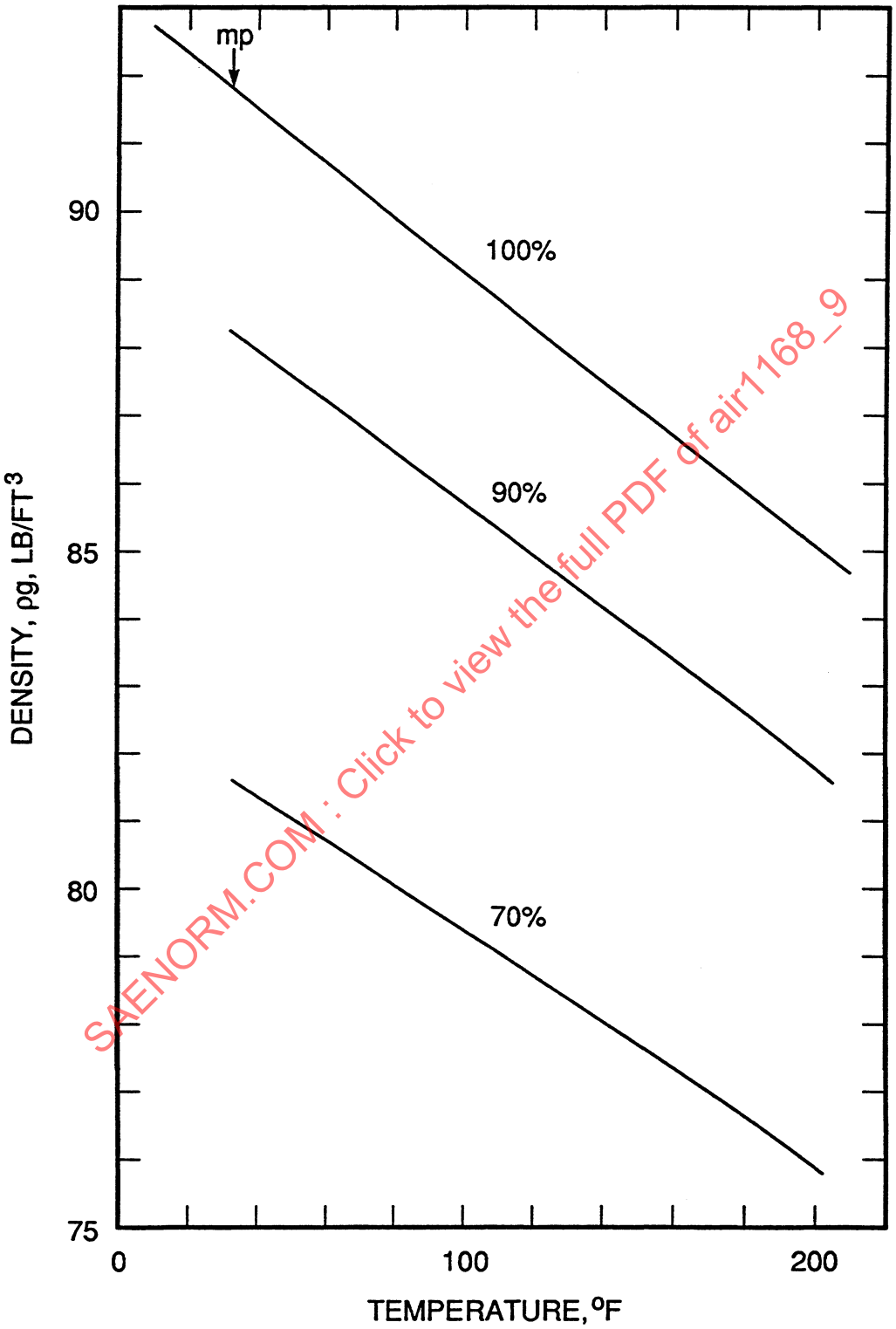


Figure 2C-19 - Density of Aqueous Hydrogen Peroxide Solutions. (by Weight of Hydrogen Peroxide); (Ref. 10)

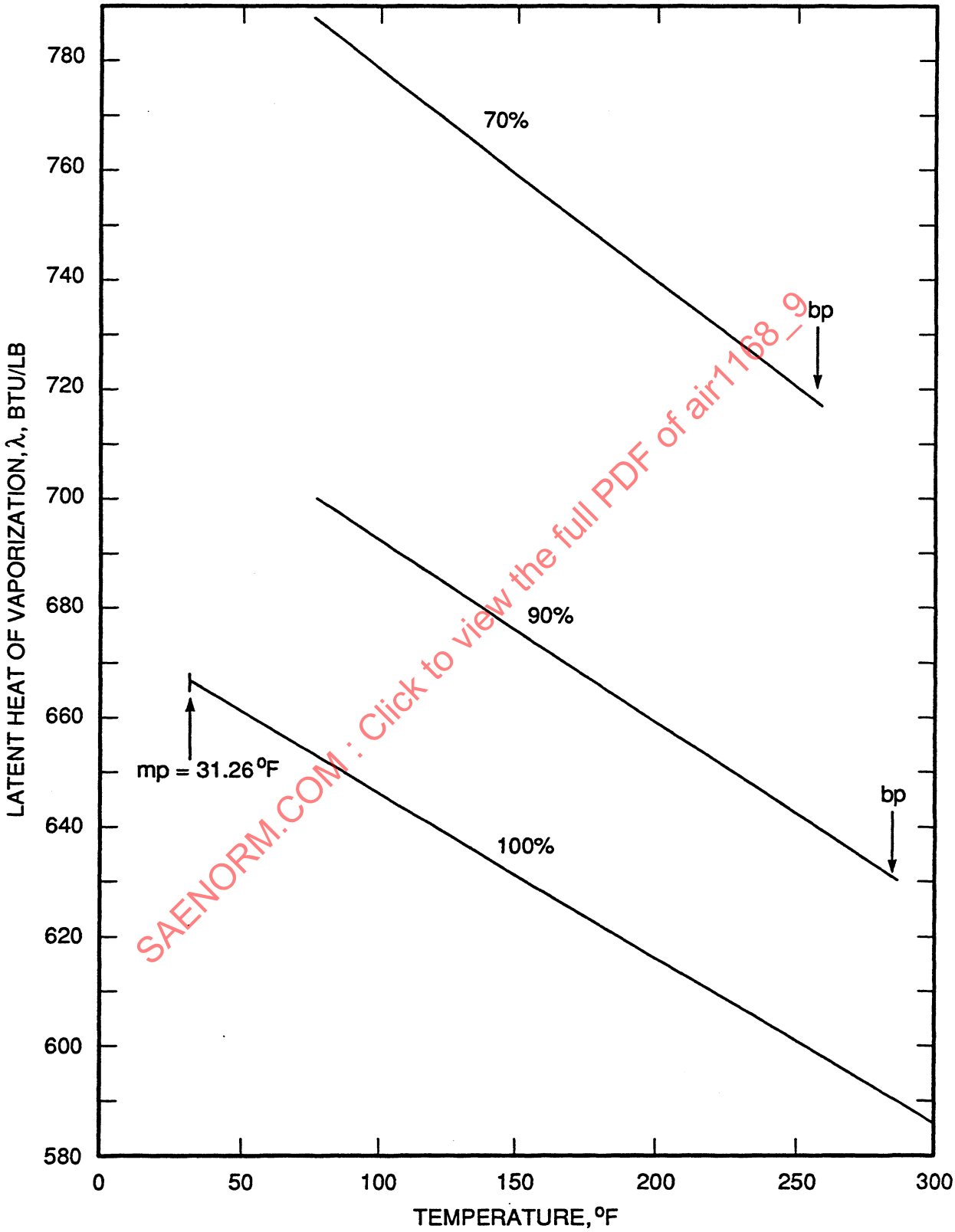


Figure 2C-20 - Latent Heat of Vaporization of Aqueous Hydrogen Peroxide Solutions. (by Weight of Hydrogen Peroxide); (Ref. 10)

Table 2C-1 - Aqueous Hydrogen Peroxide Solutions

H_2O_2, % by wt.	Mean Specific Heat from 32 to 80.6°F, Btu/lb -°F	Thermal Conductivity, Btu/hr-ft-°F at Temperature,°F: 32	77	Freezing[1] Point,°F	Boiling Point,°F
100	0.628	—	—	31.26[2]	302.4
90	0.660	—	—	11.3	286.2
70	0.725	—	—	−40.5	257.8
98.2	—	0.321	0.339		
50.0	—	—	0.347		
0.0	1.0	0.324	0.353	32	212

SOURCE: Ref. 10.
[1] The solutions have a marked tendency to supercool.
[2] H_2O_2 contracts on freezing.

Table 2C-2 - Properties of Liquids

Substance	Molecular Weight	Normal Melting Point, °F	Normal Boiling Point, °F	Heat of Fusion At nmp Btu/lb	Heat of Vaporization At nbp Btu/lb	Critical Temp. °F	Critical Press. psia	Coef. of Volumetric Expansion $\beta \times 10^3$ at 68 °F 1/°F
Liquid Metals								
Lithium, Li	6.94	354	2403	284.4	8424			
Mercury, Hg	200.61	−37.97	675	5.04	125.5			
Potassium, K	39.096	147	1400	26.3	892.8			
Sodium, Na	22.997	208	1621	48.69	1809			
Low Temperature Liquids								
Fluorine, F_2	38.00	−363.3	−306.6	5.78	74.1	−200.2	808.3	
Helium, He	4.003	[1]	−452.1	[1]	8.847	−450.3	33.21	
Hydrogen, H_2	2.0162	−435.2	−423.6	25	194.4	−399.8	188.1	
Nitrogen, N_2	28.016	−346.0	−320.4	11	85.7	−232.7	492.2	
Oxygen, O_2	32.000	−361.8	−297.4	5.94	91.6	−181.1	736.9	
Ozone, O_3	48.000	−314.7	−169.4	—	128 ± 4	+ 10.2	802.4	
Miscellaneous Liquids								
Alcohol isopropyl, C_3H_8O	60.09	−129.1	180.0	[2]	316.1	470.2		
Ammonia, NH_3	17.032	−107.9	−28.0	—	589.3	270.2	1639	1.344
Carbon dioxide, CO_2	44.01	[3]	[4]	[3]	—	87.9	1070.6	7.78
Carbon tetrachloride, CCl_4	153.84	−9.3	170.2	9.1	83.9	541.7	661	0.687
Ethylene glycol, $C_2H_6O_2$	62.07	9.3	387	73.3	344	—	—	0.608
Glycerin, $C_3H_8O_3$	92.09	64.8	555	85.5				
Hydrogen peroxide, H_2O_2	34	31.26	302.4	158.1	584.5			
Water, H_2O	18	32.00	212.00	143.4	970.3	705.4	3206.2	0.111

SOURCES: Refs. 2–5, 15, 38, 42, 47, 59.
(1) Helium melts at −457.96 °F, 382 psia; heat of fusion < 1.8 Btu/lb.
(2) 38.5 Btu/lb at −127.2 °F.
(3) Carbon dioxide melts at −68.8 °F, 76.4 psia; heat of fusion is 81.4 Btu/lb.
(4) Sublimes at −109.3 °F under normal pressure.

Table 2C-3 - Aviation Fuels and Oils

Substance	Molecular Weight	Density at 60 °F, lb/ft³	Freezing Point, °F	Normal Boiling Point, °F	Heat of Vaporization At nbp Btu/lb	Vapor Press. at 60 °F, psia	Critical Temp. °F	Critical Press. psia	Viscosity at 60 °F $\mu \times 10^7$, lb-sec/ft²
Fuels									
Aviation gasoline	—	43.9	−76	—	162	2.9	—	—	137
JP-4	125	48.3	−76	—	156[1]	1.3	642	530	182
JP-6	135–160	—	−65	250	115	—	—	—	398
Pentaborane	63.17	39.3	−52.2	139.7	212	25.9	—	—	~700
Hydraulic Fluids									
MIL-O-5606	—	53.5	—	—	—	—	—	—	3820
Oronite 8200	—	58.0	—	—	—	—	—	—	~18,000
Lubricants									
Engine oil	—	52.8	—	—	—	—	—	—	220,000

SOURCES: Refs. 2–9, 39, 51, 66, 77.
[1] Maximum.

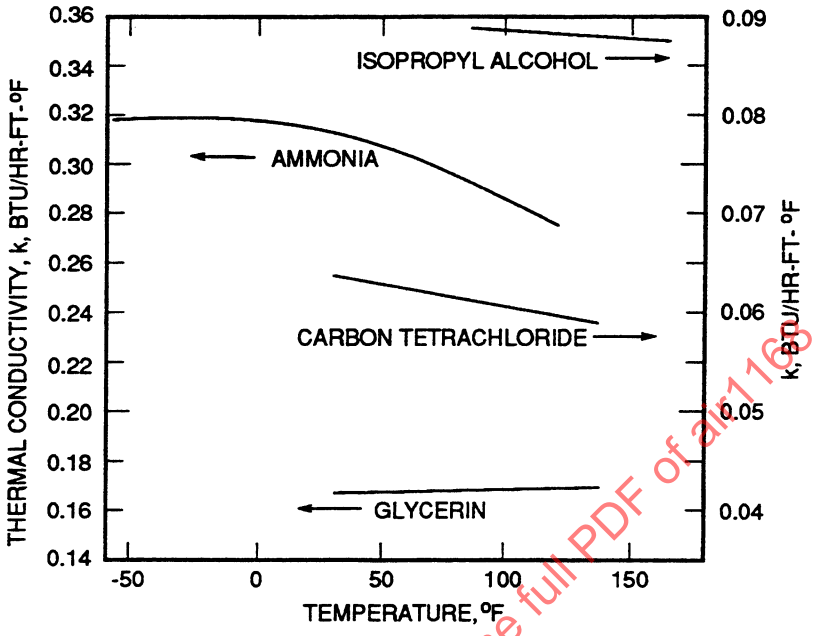


Figure 2C-21 - Thermal Conductivity of Liquids. (Refs. 13, 14, 51, 65, 81)

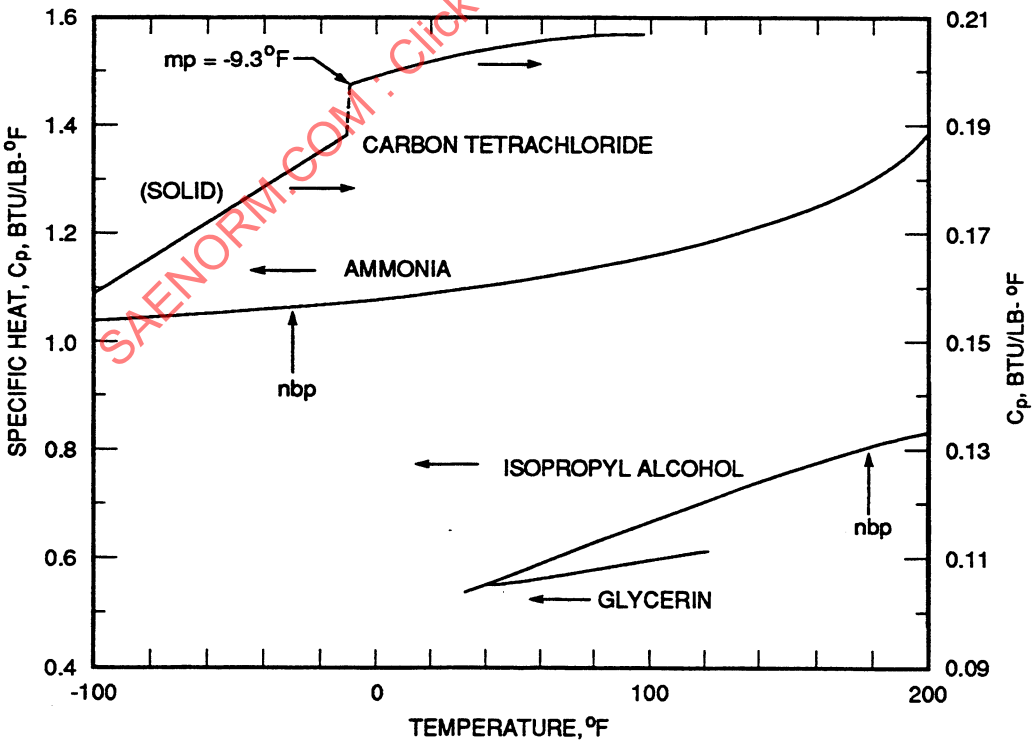


Figure 2C-22 - Specific Heat of Liquids. (Refs. 13, 14, 51, 65, 81)

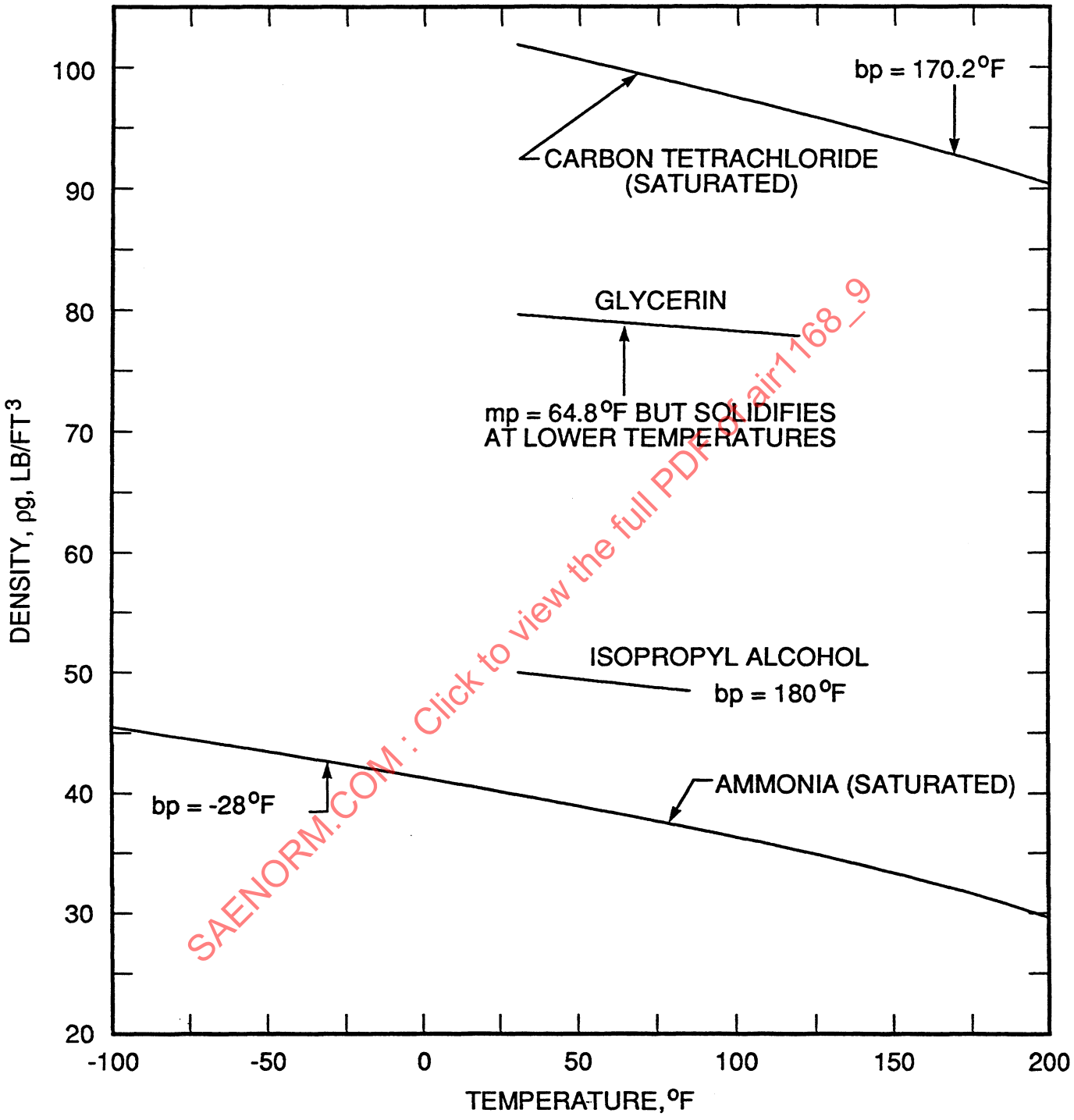


Figure 2C-23 - Density of Liquids. (Refs. 13, 14, 51, 65, 81)

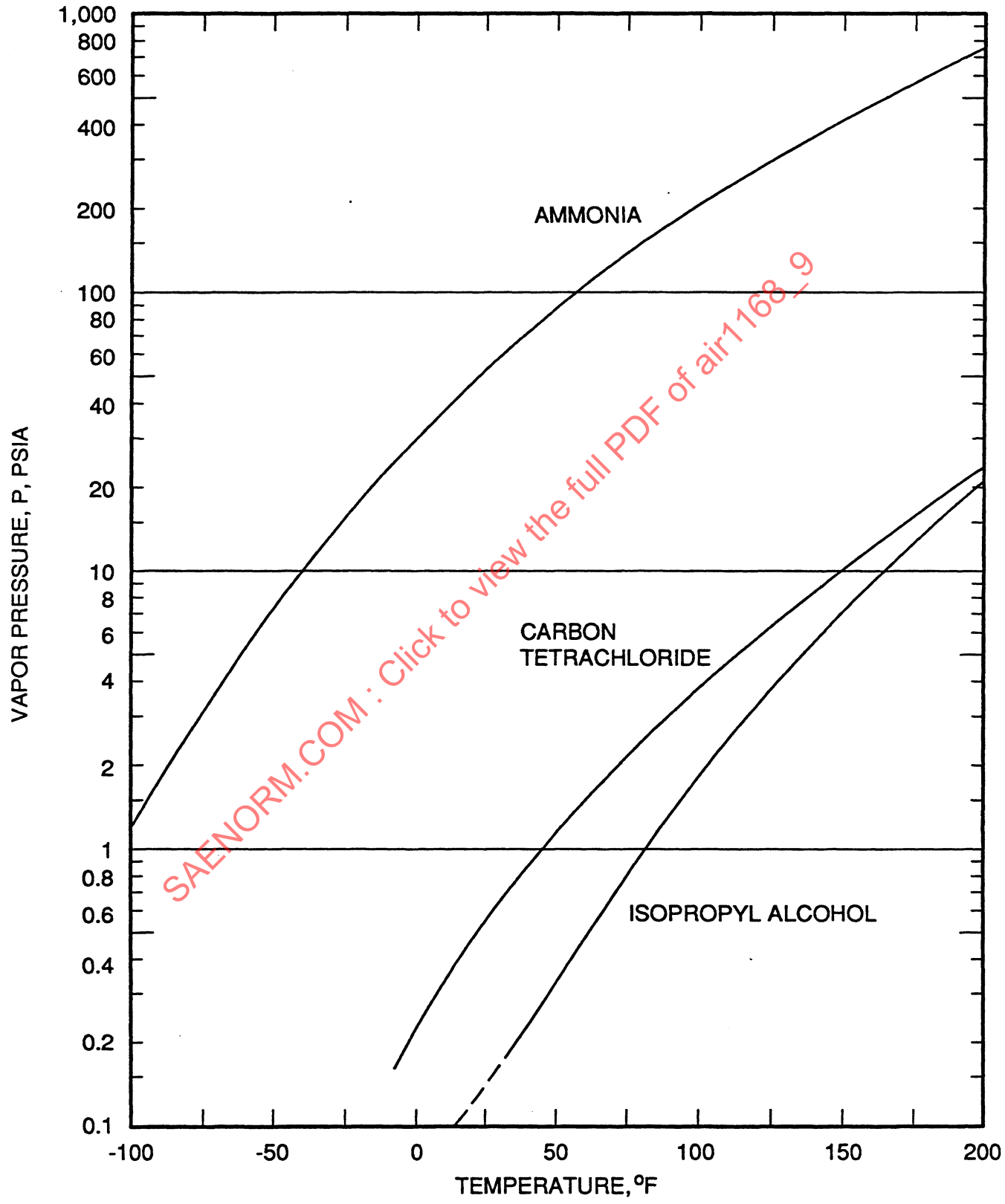


Figure 2C-24 - Vapor Pressure of Liquids. (Refs. 13, 14, 51, 65, 81)

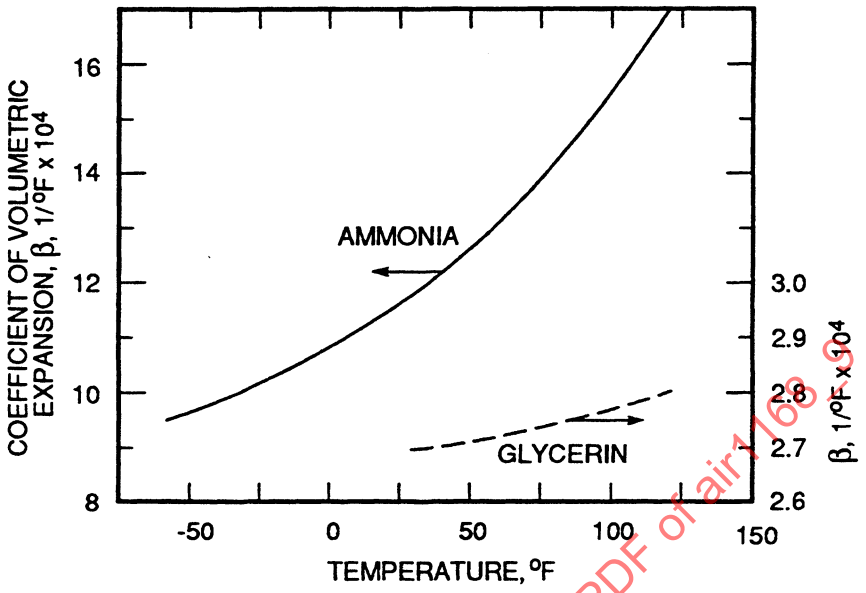


Figure 2C-25 - Coefficient of Volumetric Expansion, Ammonia and Glycerin. (Refs. 14, 51, 65)

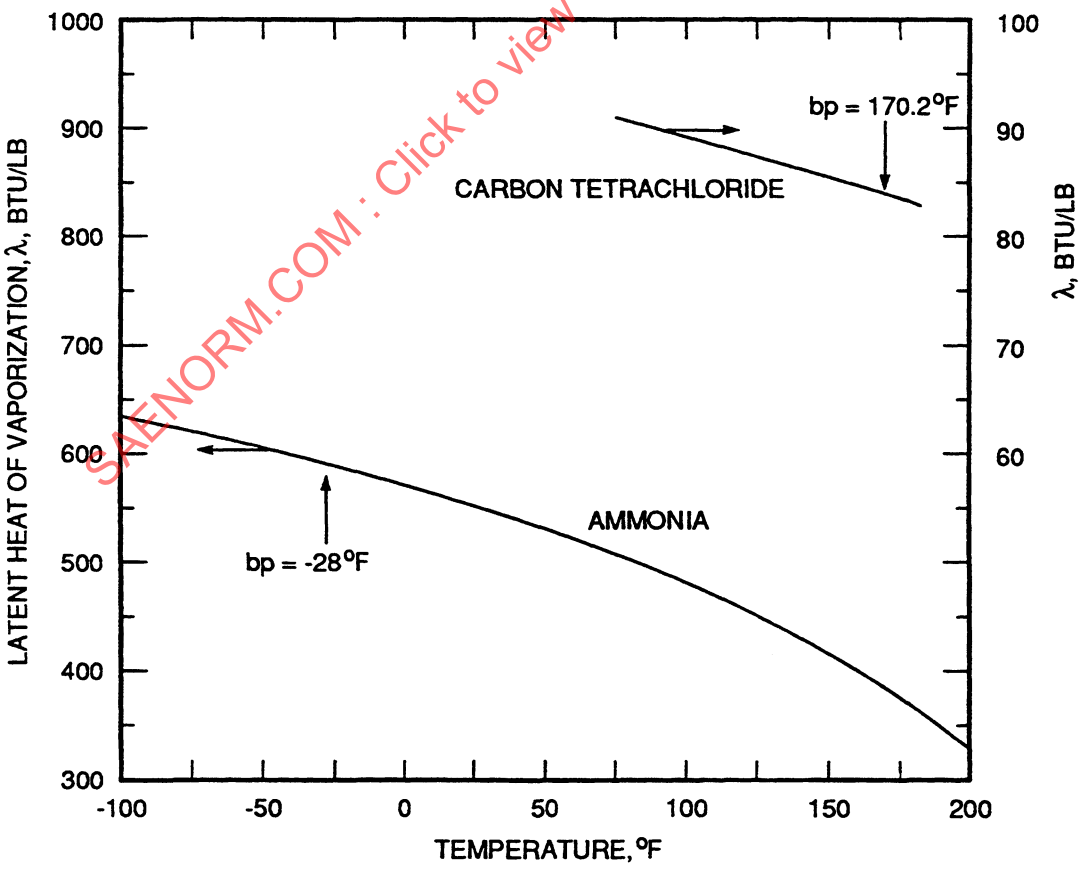


Figure 2C-26 - Latent Heat of Vaporization, Ammonia and Carbon Tetrachloride. (Refs. 14, 51, 65, 81)

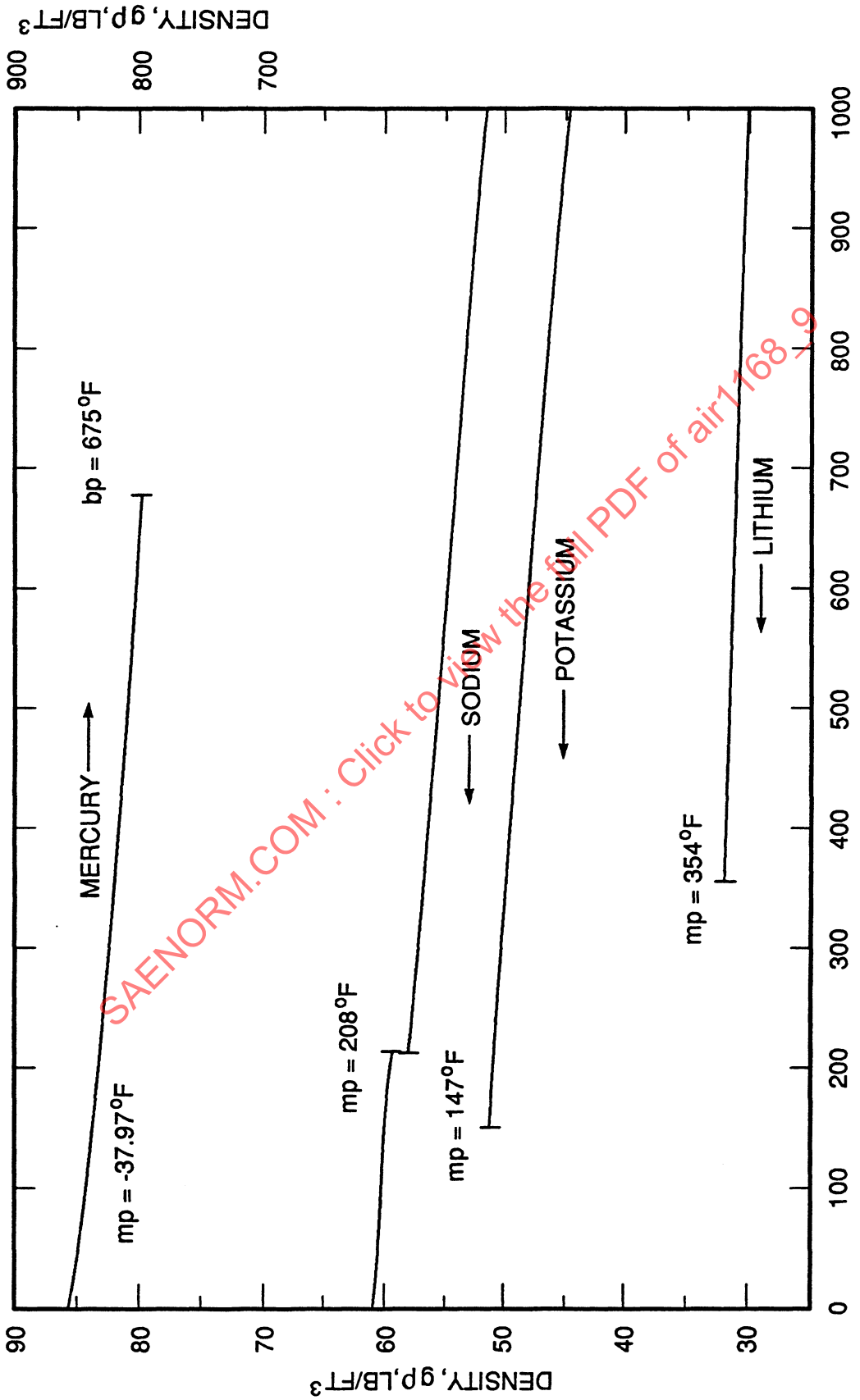


Figure 2C-27 - Density of Liquid Metals. (Refs. 59, 70)

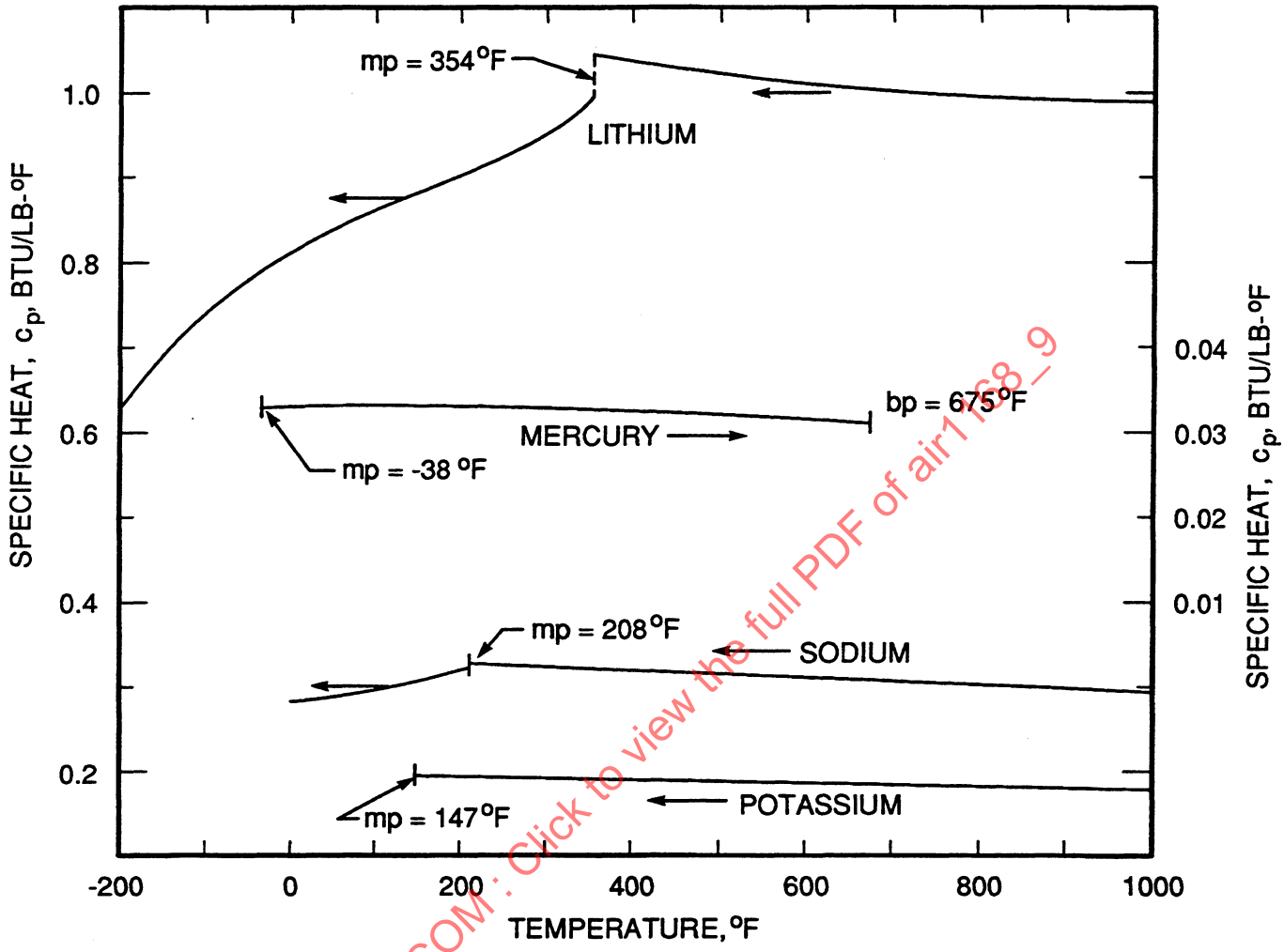


Figure 2C-28 - Specific Heat of Liquid Metals. (Refs. 59, 70)

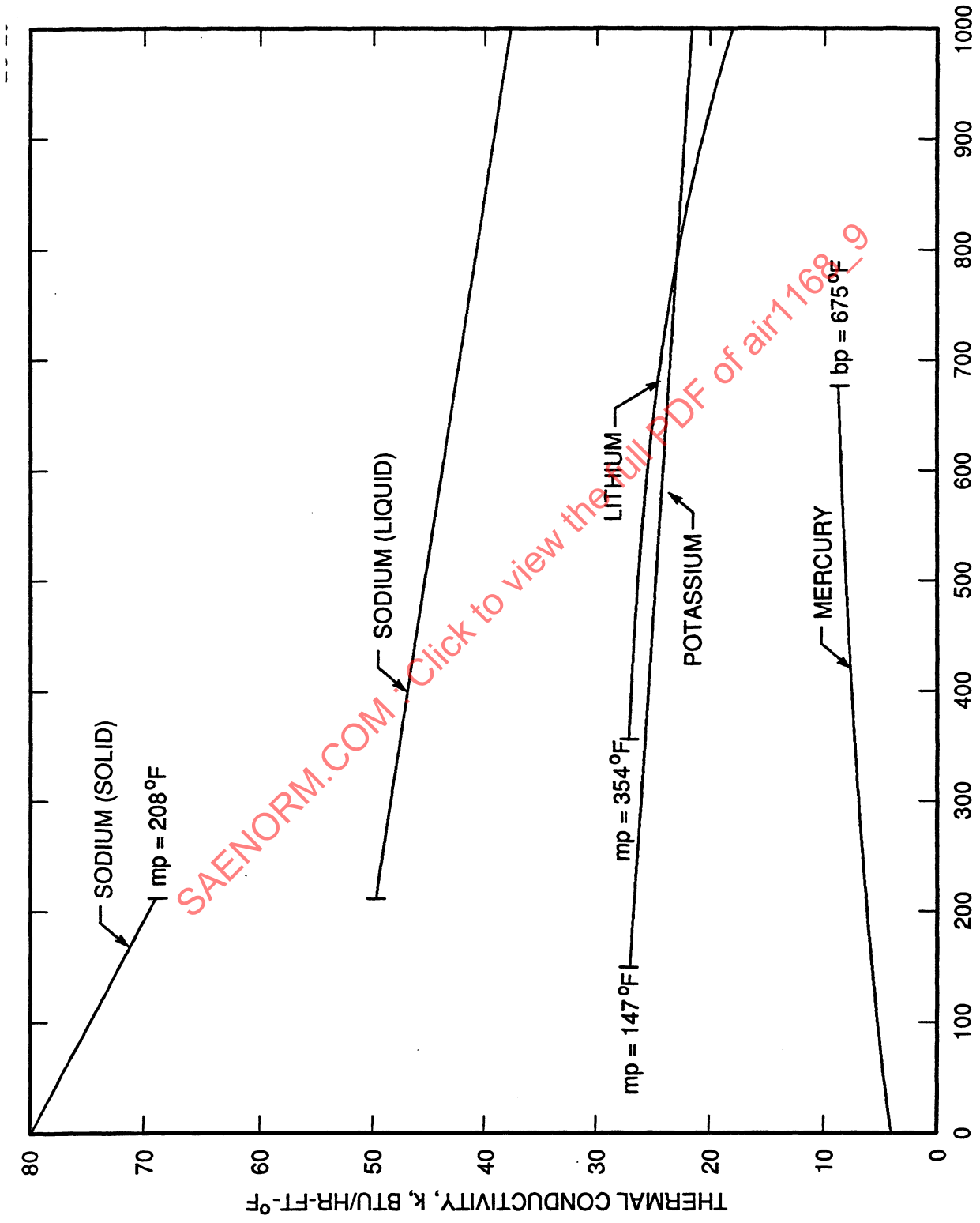


Figure 2C-29 - Thermal Conductivity of Liquid Metals. (Refs. 59, 70)

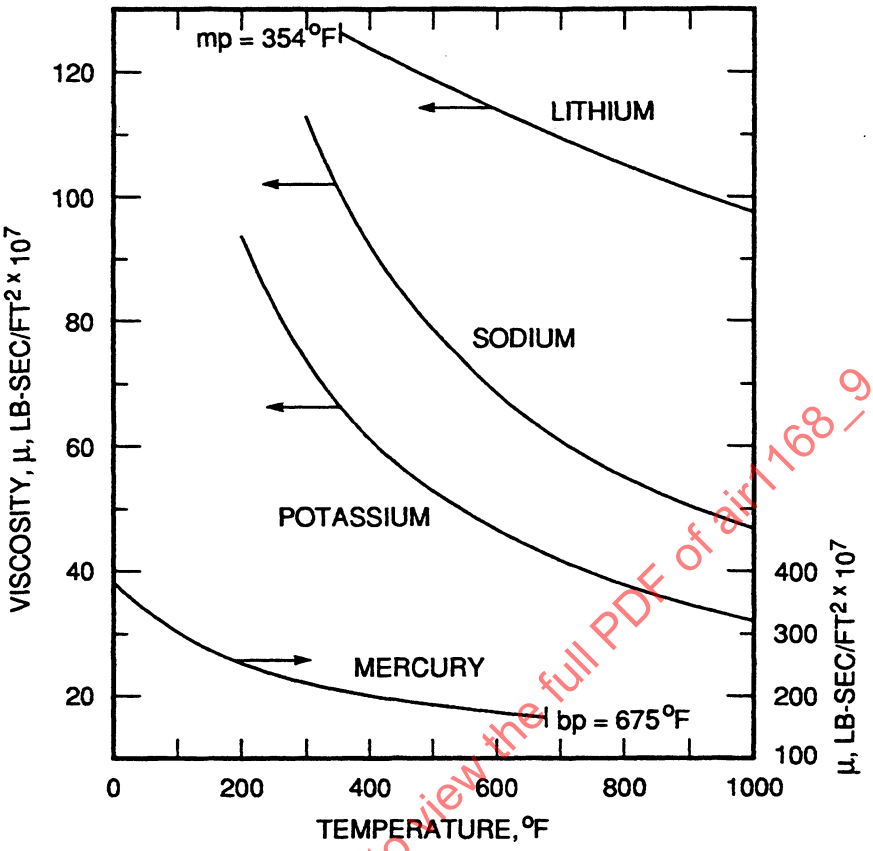


Figure 2C-30 - Viscosity of Liquid Metals. (Refs. 59, 70)

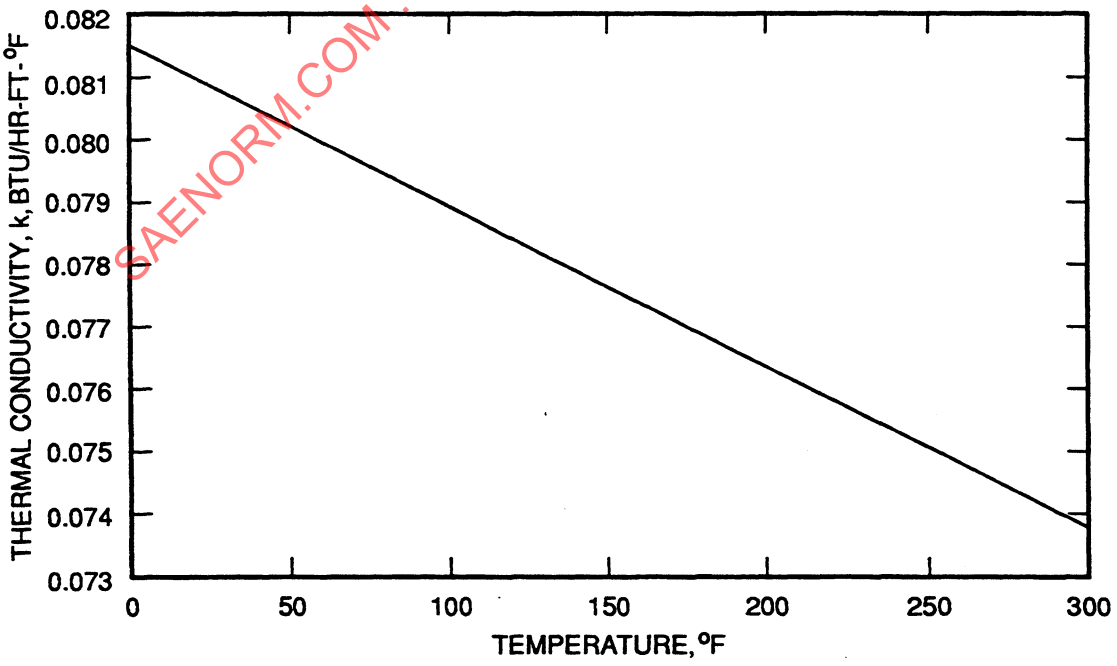


Figure 2C-31 - Approximate Thermal Conductivity of Fuels JP-4, JP-6, MIL-F-5572. (Refs. 24, 39)

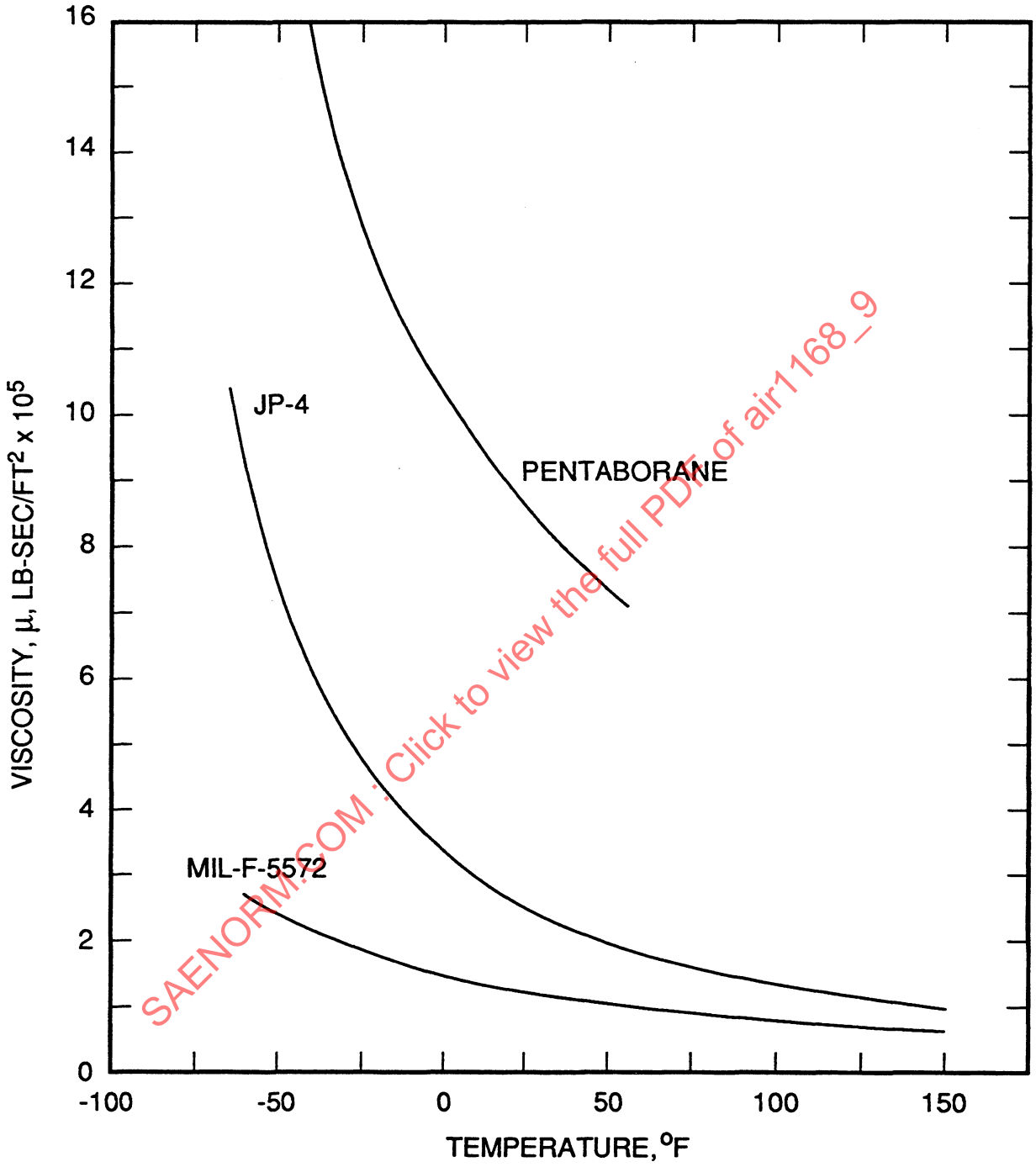


Figure 2C-32 - Viscosity of Fuels. (Refs. 24, 39, 77, 86)

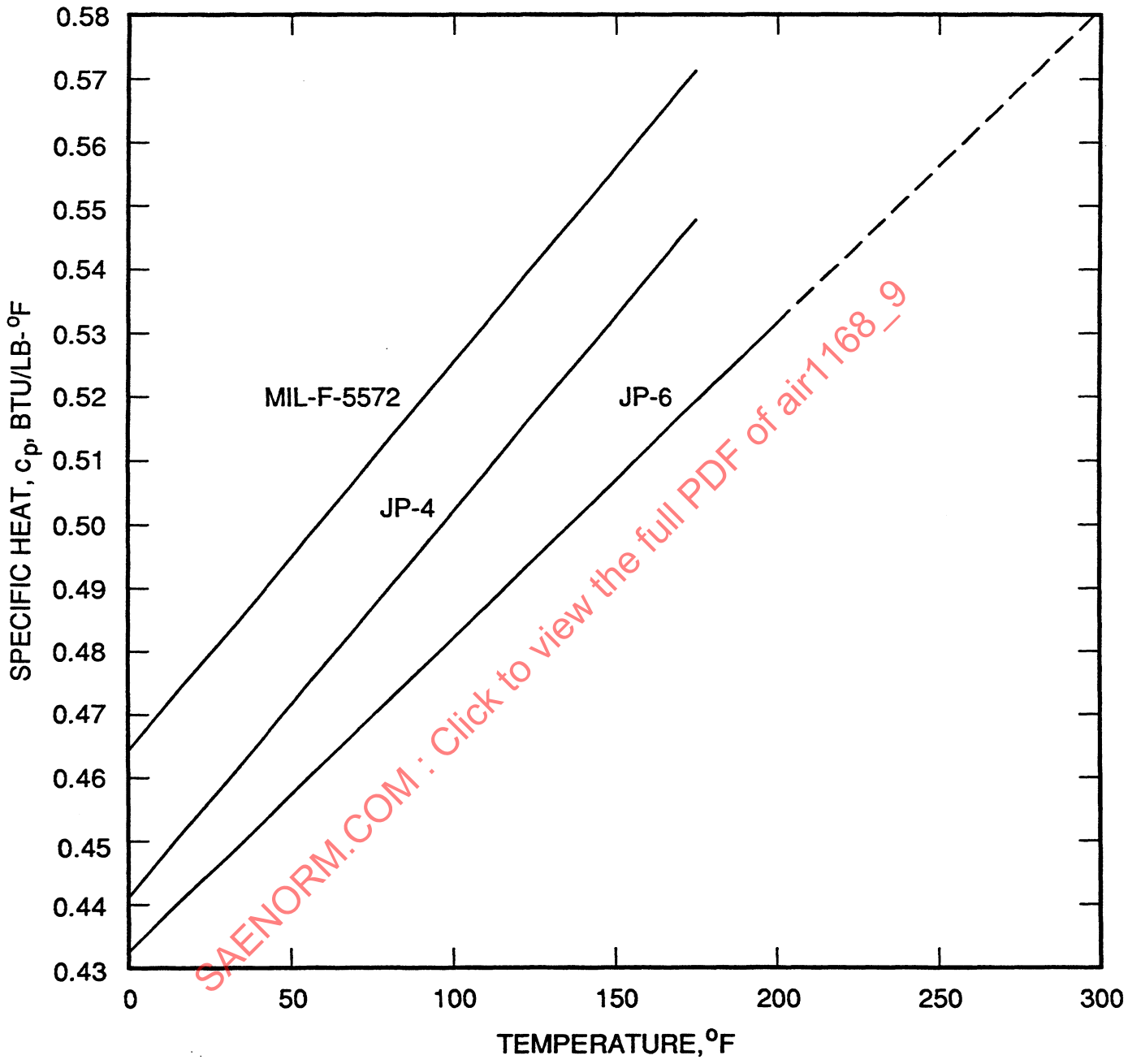
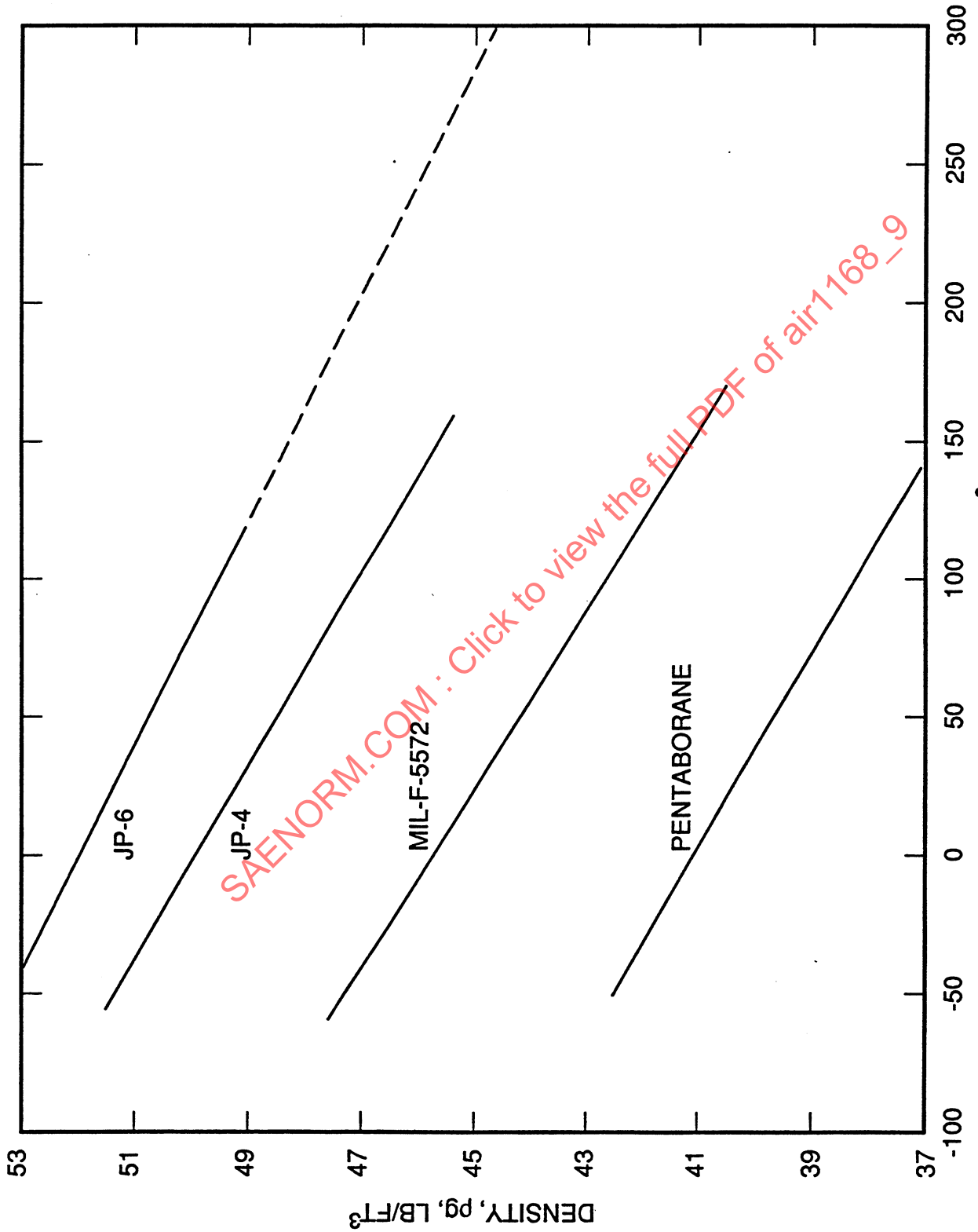


Figure 2C-33 - Specific Heat of Fuels. (Refs. 24, 39, 77, 86)



-f Fuels, JP-4, JP-6, MIL-F-5572, Pentaborane. (Refs. 24, 39, 77, 86)

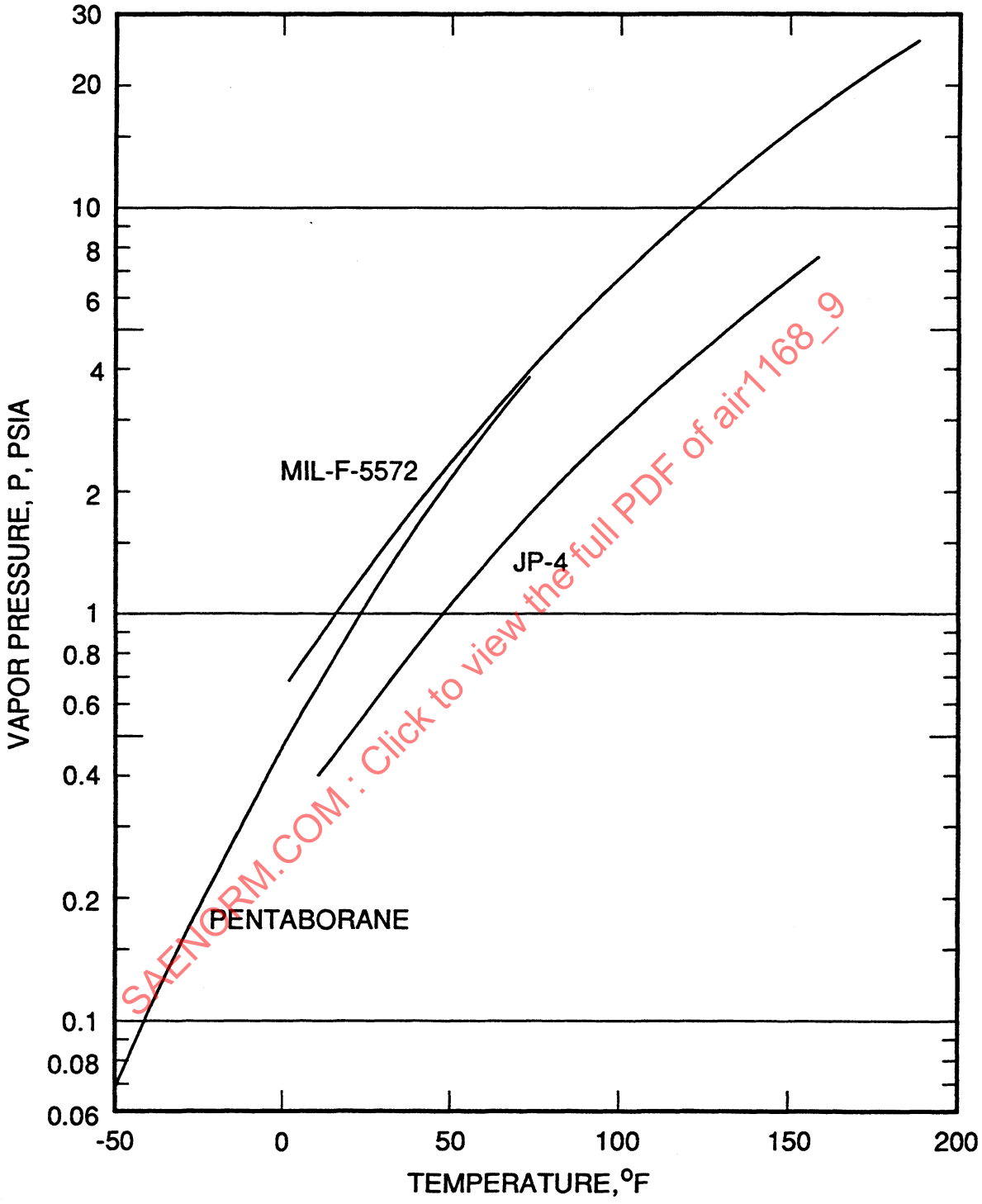


Figure 2C-35 - Vapor Pressure of Fuels JP-4, MIL-F-5572, Pentaborane. (Refs. 24, 39, 77, 86)

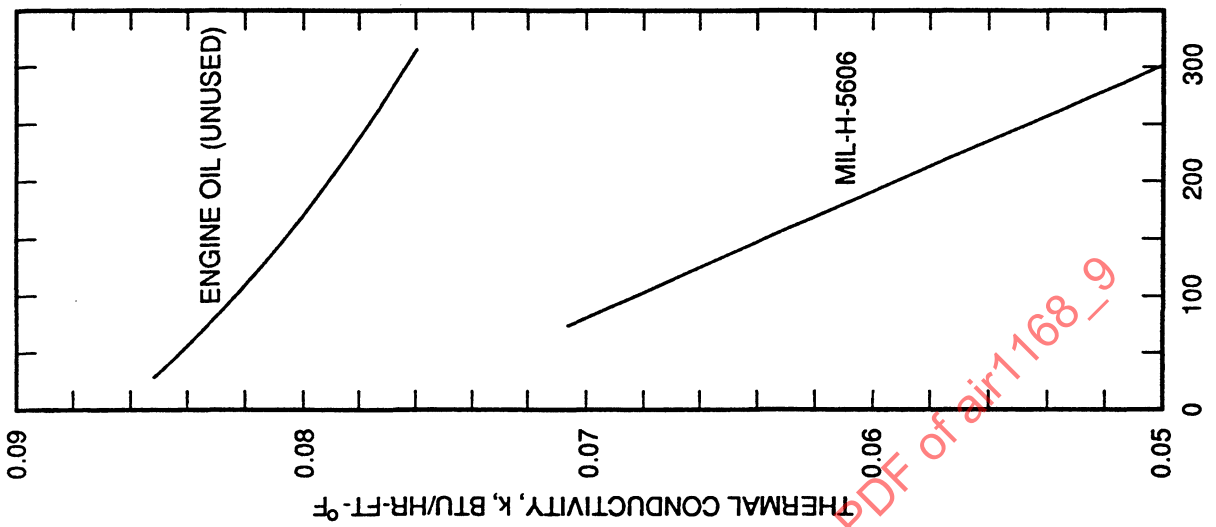


Figure 2C-37 - Thermal Conductivity of Oils. (Refs. 51, 66)

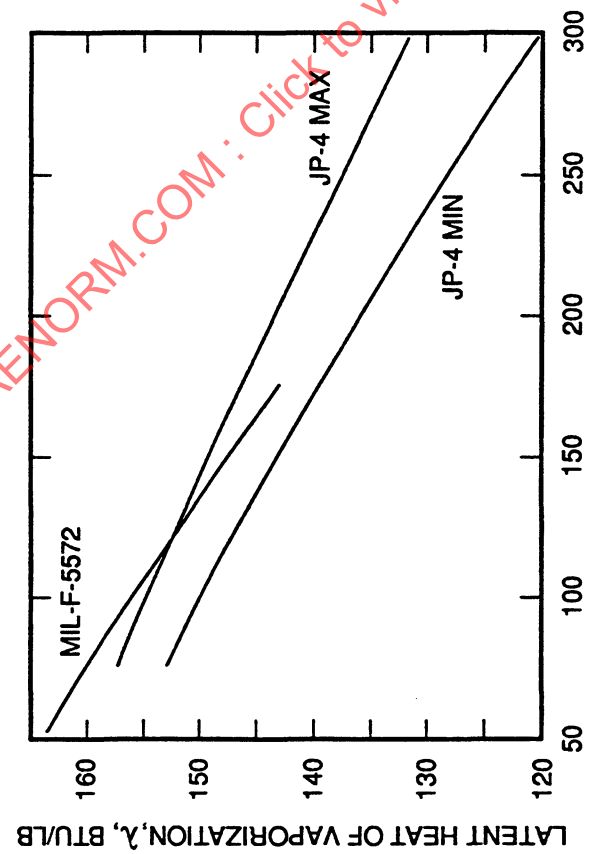


Figure 2C-36 - Latent Heat of Vaporization of Fuels. (Refs. 24, 39, 77, 86)

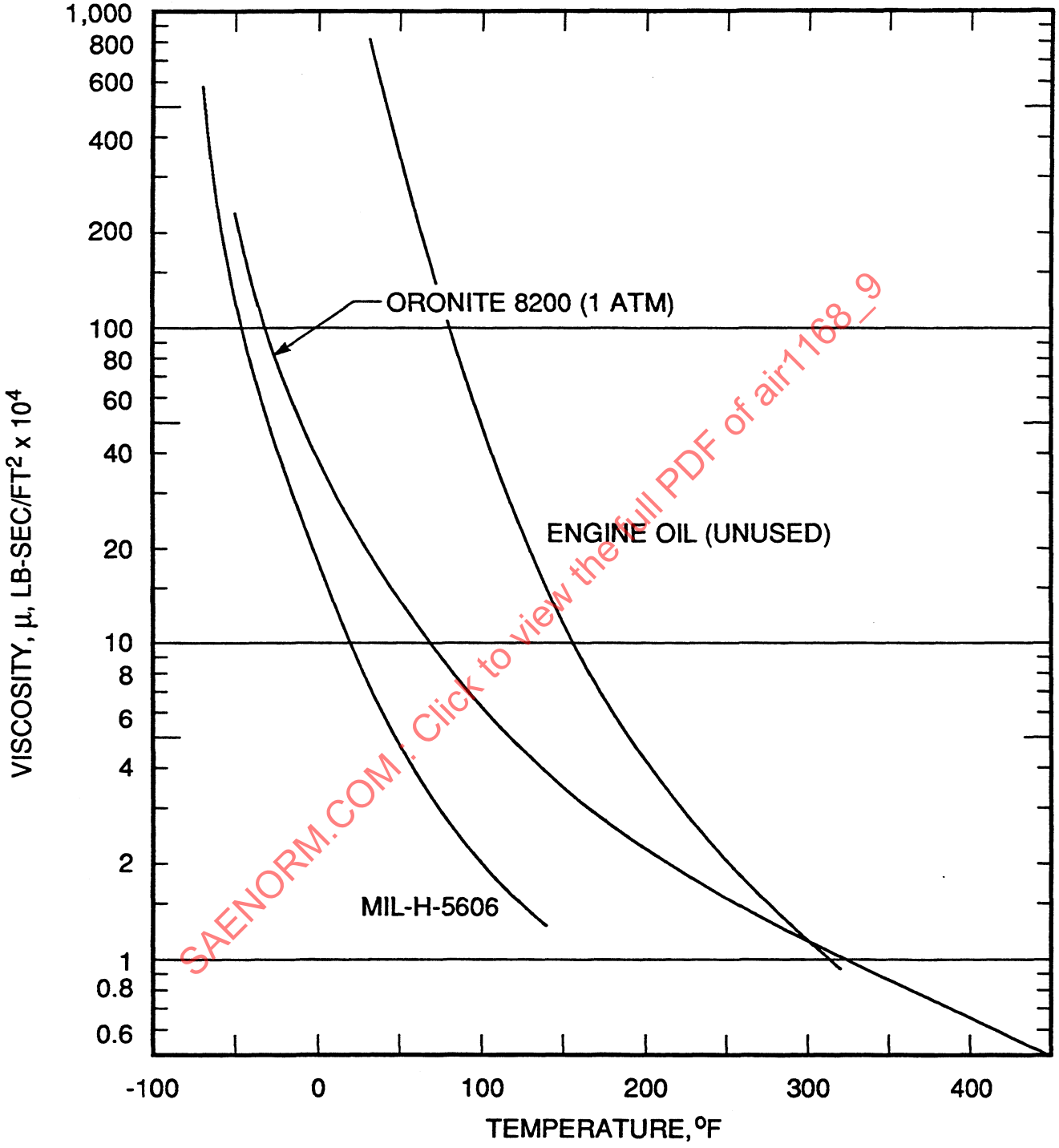


Figure 2C-38 - Viscosity of Oils. (Refs. 51, 66)

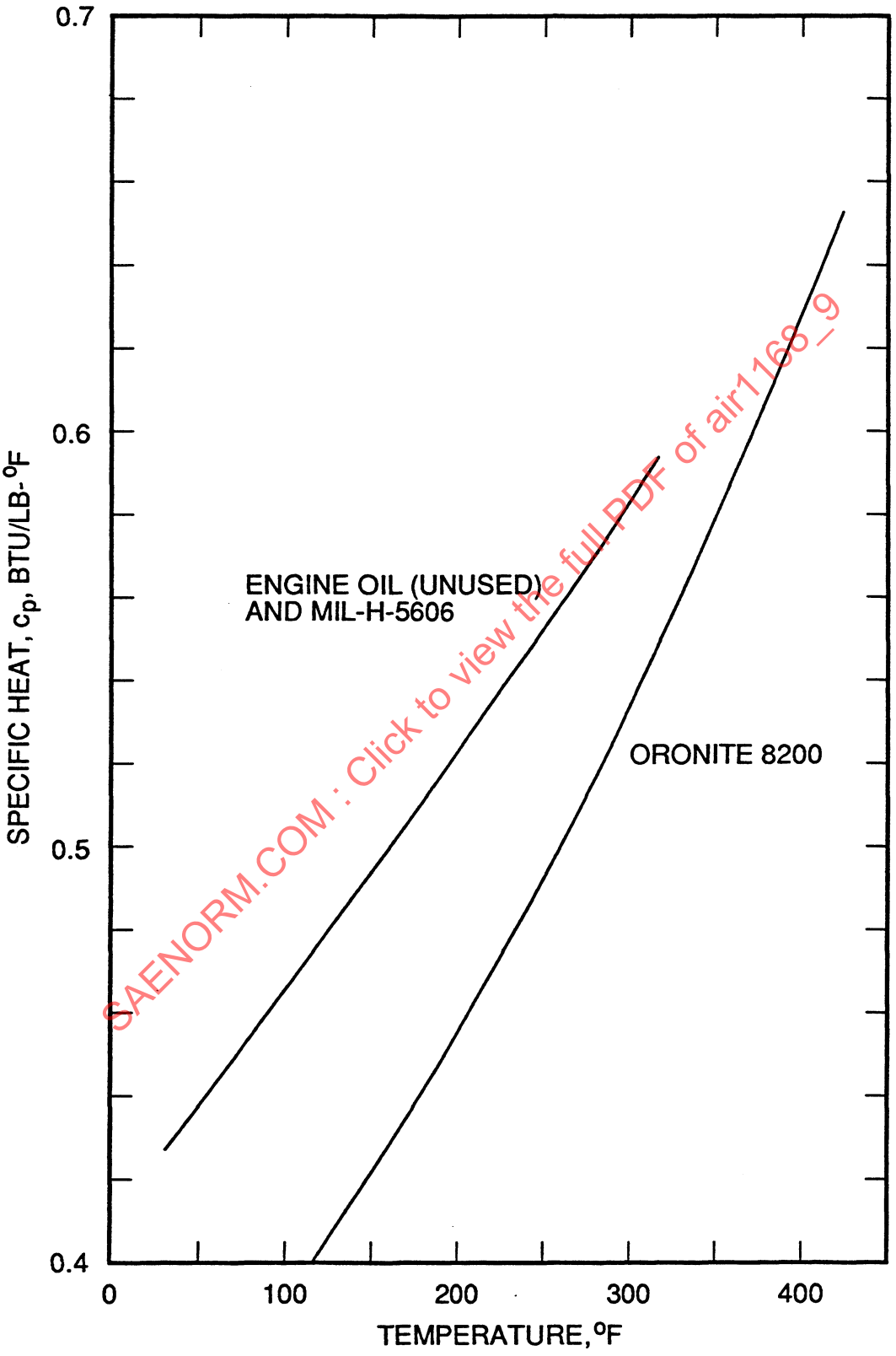


Figure 2C-39 - Specific Heat of Oils. (Refs. 51, 66)

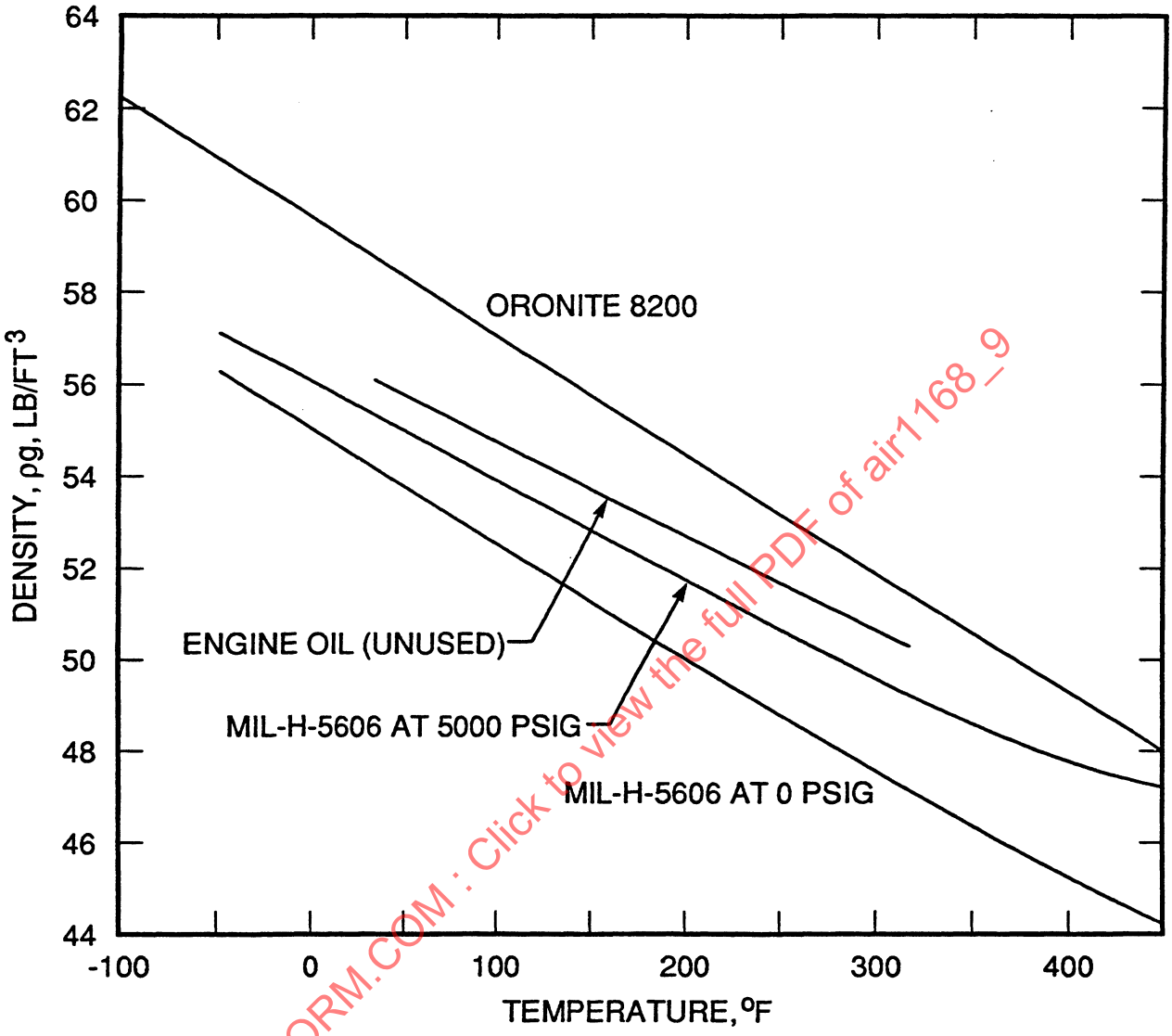


Figure 2C-40 - Density of Oils. (Refs. 51, 66)

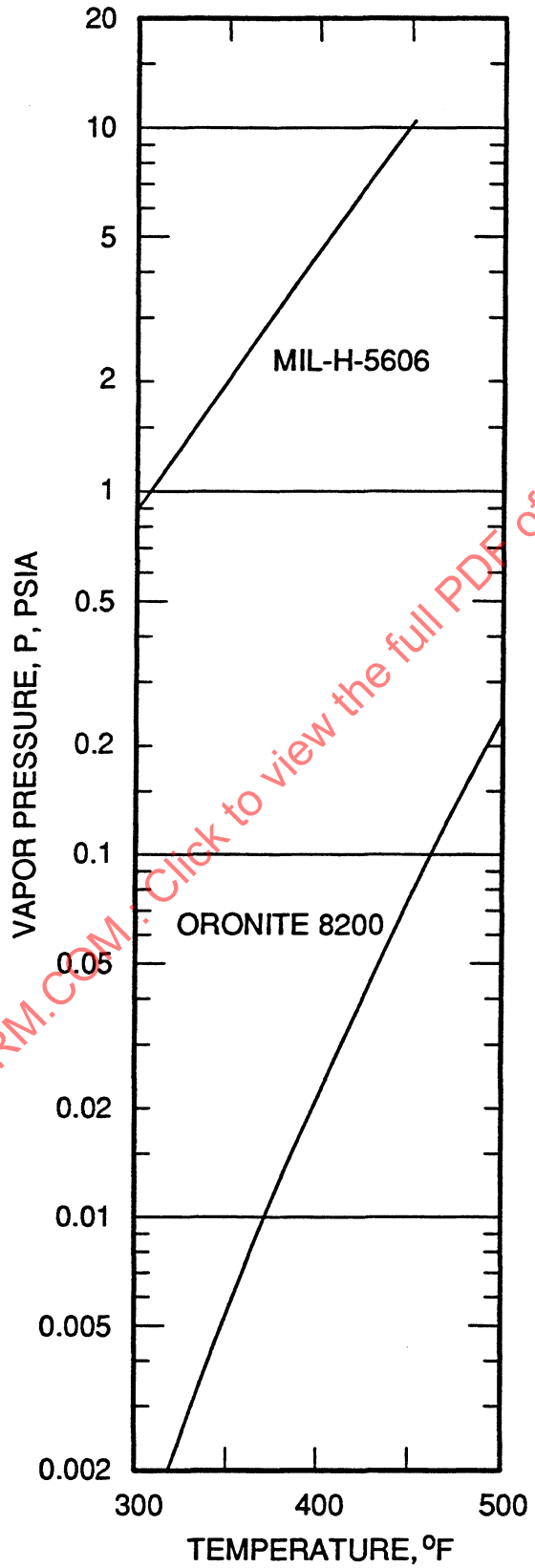


Figure 2C-41 - Vapor Pressure of Oils, MIL-H-5606, Oronite 8200. (Refs. 51, 66)

SECTION 2D - PROPERTIES OF SOLIDS

Table 2D-1 - Thermal and Physical Properties of Pure Metals

Metal	Atomic Weight	Melting Point °F	Melting Point ±°F	Heat of Fusion (Btu/lb)	Density, lb/ft³ At 32 °F	Density, lb/ft³ At Higher Temp.	Mean Coefficient of Linear Expansion[1] β × 10⁶, 1/°F, at Temp., °F 200	600	1000	1500	2000	3500
Aluminum, Al	26.97	1220.4	0.2	170.3	169	165[2]	13.3	14.2	15.7	...		
Beryllium, Be	9.02	2400	50	470	114	112[2]	6.3	8.1	9.0	9.6		
Columbium, Cb (Niobium), Nb	92.91	4380	30	...	537	...	3.4	3.4	3.4	3.4		
Copper, Cu	63.54	1981.4	0.2	91.1	560	550[2]	9.1	9.8	10.2	...		
Gold, Au	197.2	1945.4	0.0	29.0	1206	...	7.9	8.2	8.5	9.1		
Iridium, Ir	193.1	4449	5	...	1405	...	3.2					
Iron (Armco), Fe	55.85	2802	5	117.0	491	485[2]	6.8	8.6	9.2			
Lead, Pb	207.2	621.14	0.00	11.3	708	687[2]	14.7					
Lithium, Li	6.94	354	...	284.4	33.1	...	...					
Mercury, Hg	200.61	−37.95	0.00	5.04	846	...	...					
Molybdenum, Mo	95.95	4760	90	126	638	631[3]	...	...	2.85	...	3.04	3.90
Nickel, Ni	58.69	2651	2	133.2	556	540[3]	7.3	9.15	...			
Platinum, Pt	195.23	3224.3	1.8	49	1339	1322[2]	8.95	9.25	9.65			
Potassium, K	39.096	147	...	26.3	...	...	...	...	...			
Silver, Ag	107.88	1761.44	0.00	45	655	...	10.90	11.3	11.5			
Sodium, Na	22.997	208	...	48.69	60.6							
Titanium, Ti	47.90	3300	180	...	283	279[3]	4.8	5.3	5.5			
Tungsten, W	183.92	6170	35.0	79	1204	1194[3]	...	...	2.65	...	2.90	3.75
Zinc, Zn	65.38	787.1	0.0	43.4	446	...	...	22.8				

[1] From approximately room temperature to the temperature indicated.
[2] At 600 °F.
[3] At 1200 °F.

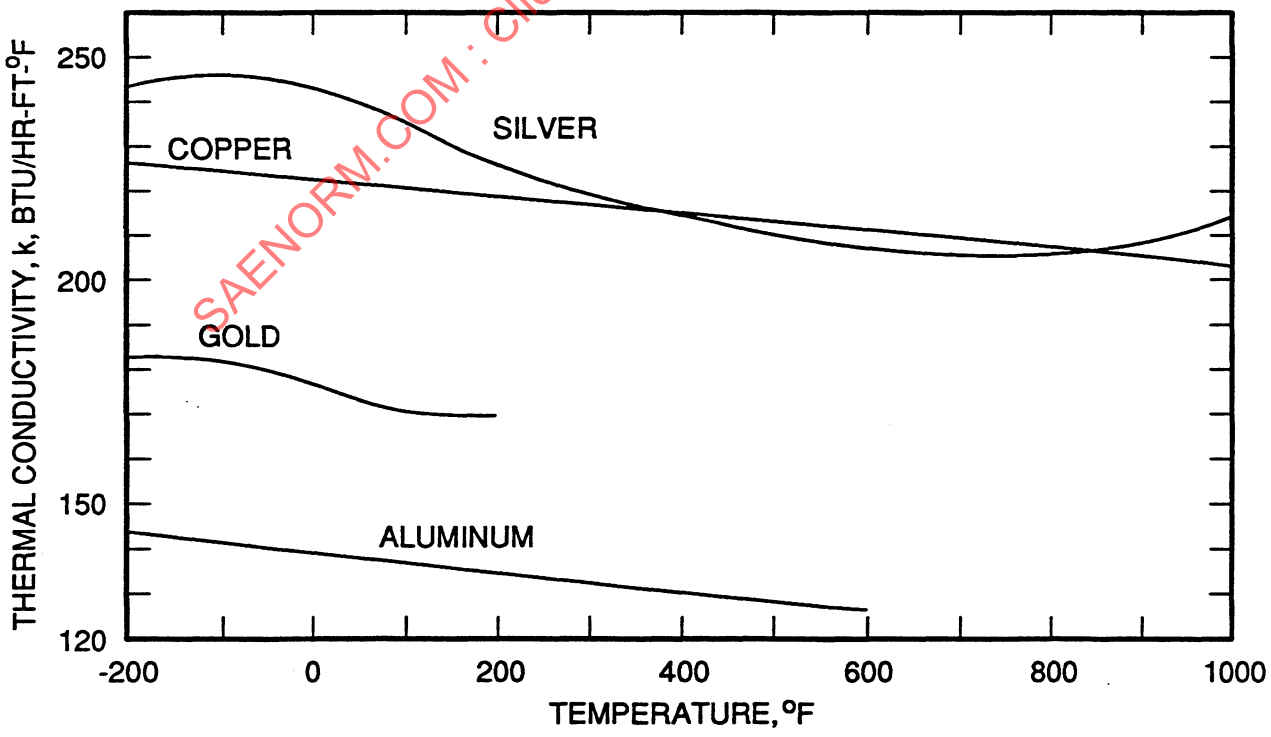


Figure 2D-1 - Thermal Conductivity of Pure Metals (Silver, Copper, Gold, Aluminum). (Refs. 1, 2, 33, 62, 70)

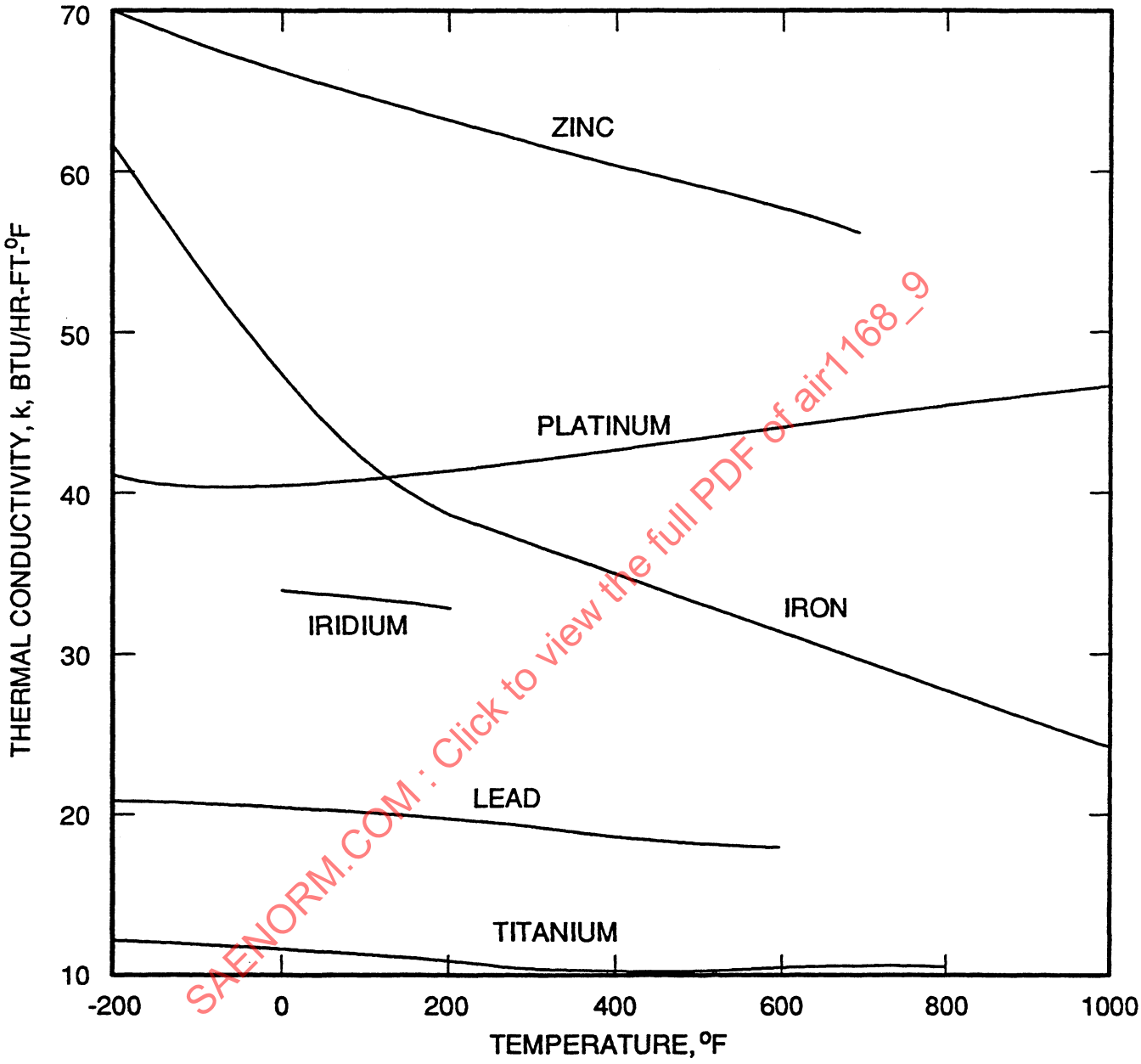


Figure 2D-2 - Thermal Conductivity of Pure Metals (Zinc, Platinum, Iron, Iridium,Lead, Titanium). (Refs. 2, 8, 17, 33, 40, 52, 70)

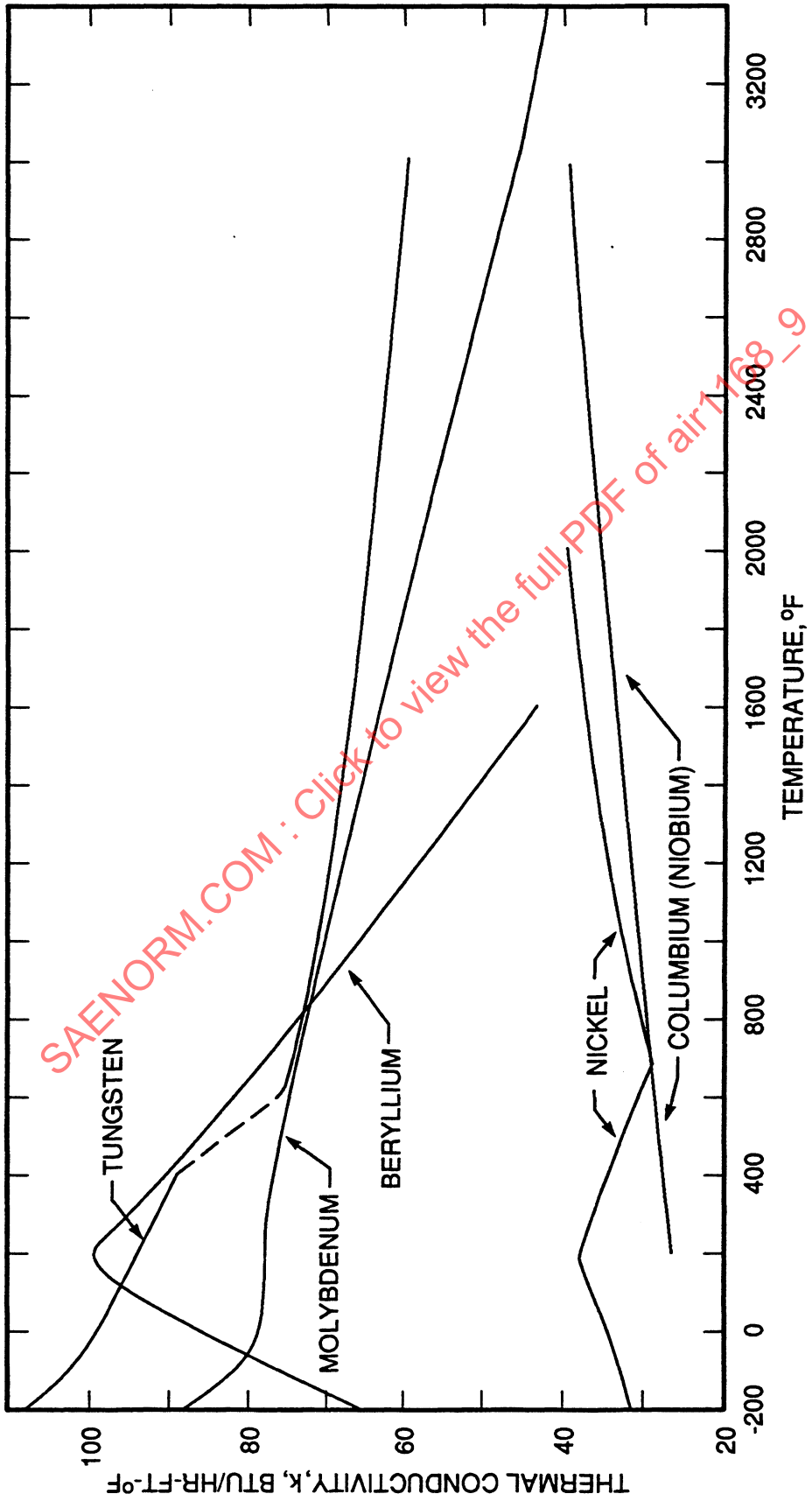


Figure 2D-3 - Thermal Conductivity of Pure Metals (Tungsten, Molybdenum, Beryllium, Nickel, Columbium). (Refs. 2, 25, 27, 33, 70, 80, 84)

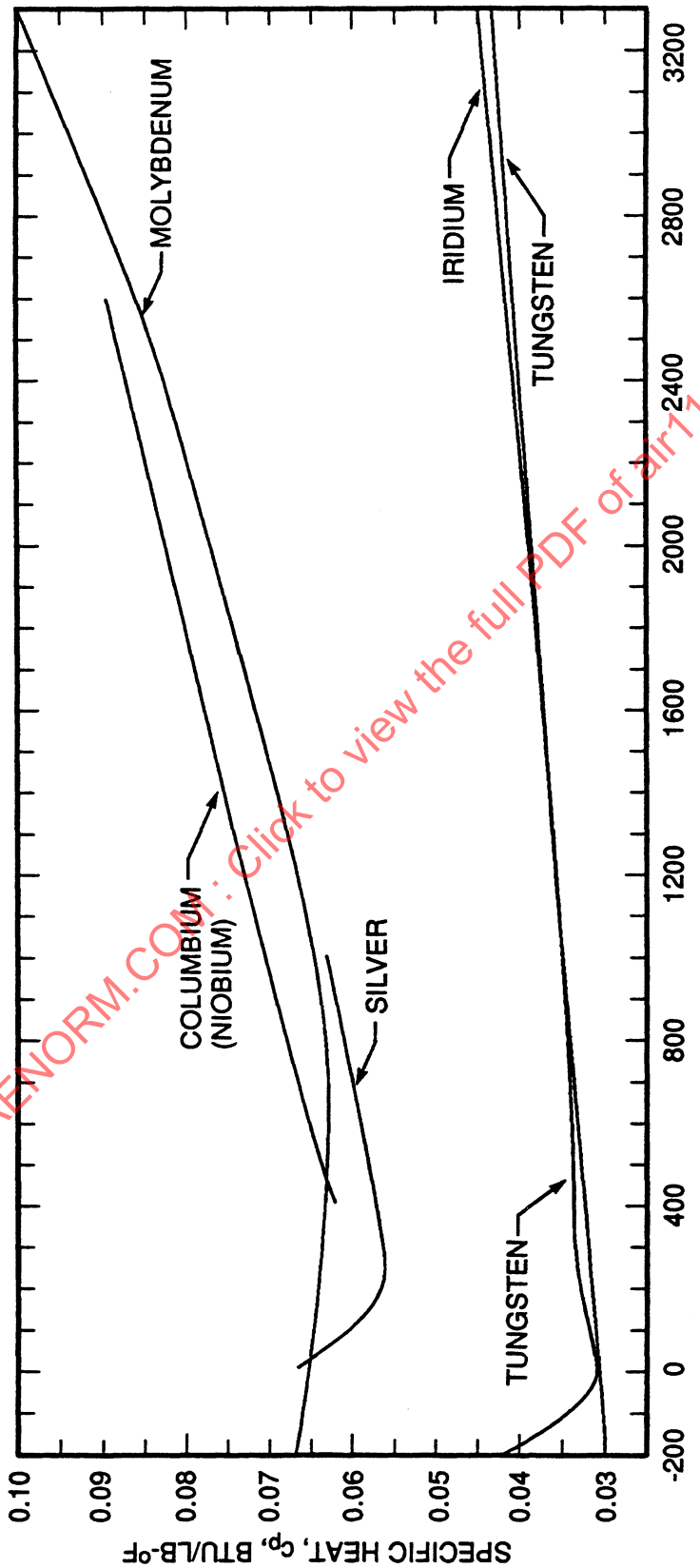


Figure 2D-4 - Thermal Conductivity of Pure Metals (Columbium, Molybdenum, Silver, Tungsten, Iridium).
(Refs. 1, 33, 34, 53)

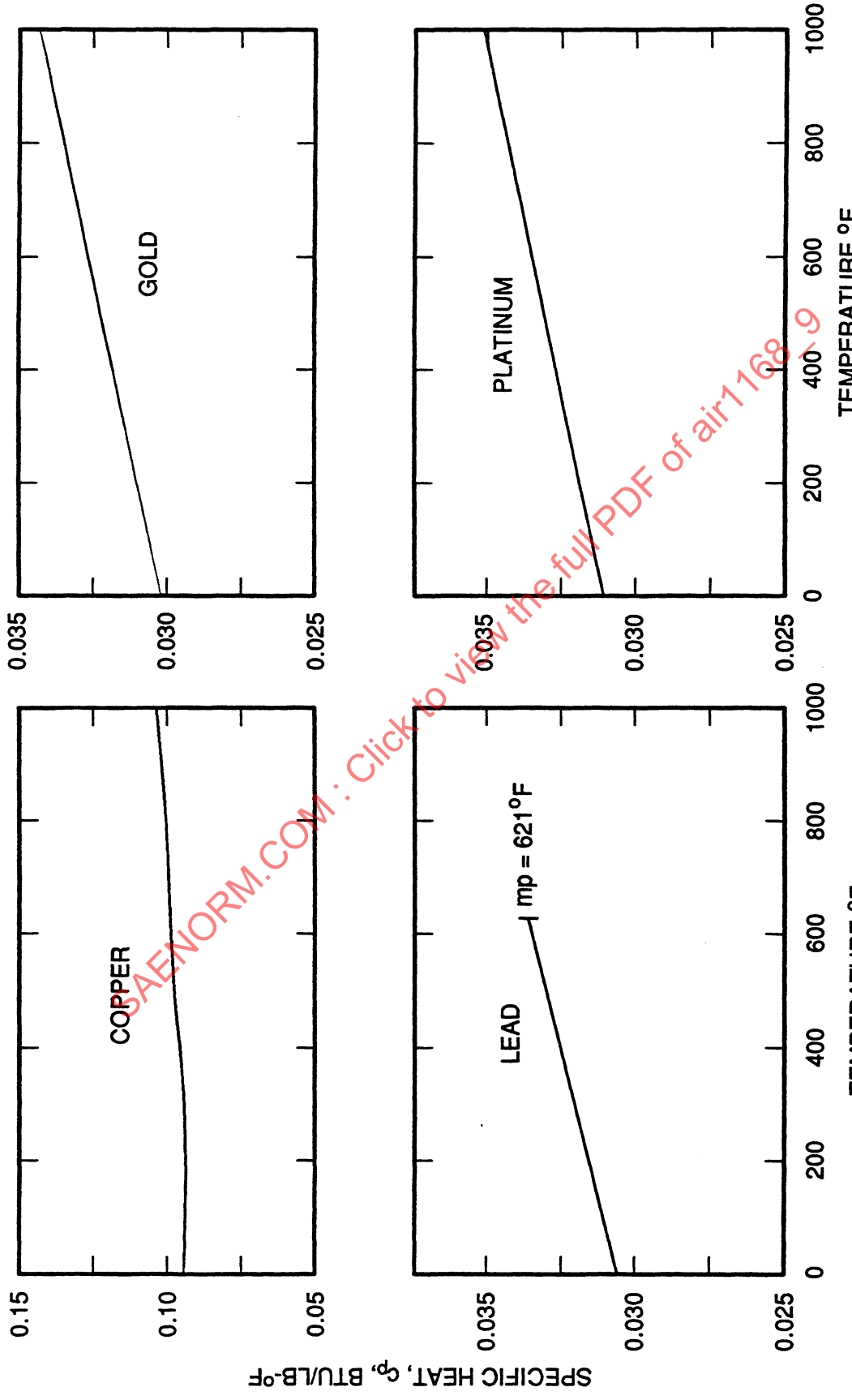


Figure 2D-5 - Specific Heat of Pure Metals (Copper, Gold, Lead, Platinum). (Refs. 33, 34, 62)

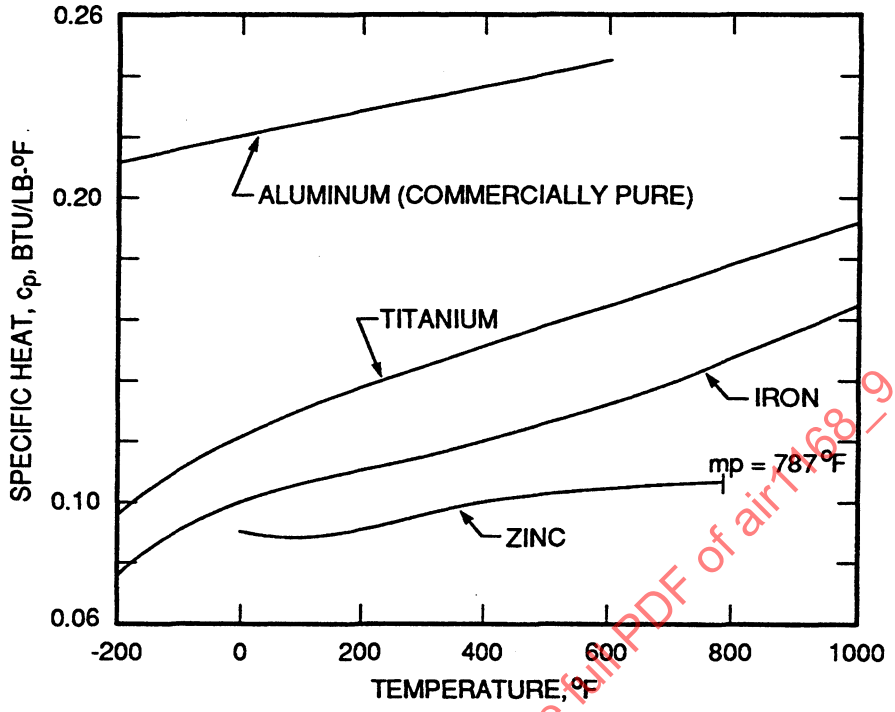


Figure 2D-6 - Specific Heat of Pure Metals (Aluminum, Titanium, Iron, Zinc). (Refs. 2, 33, 48, 62)

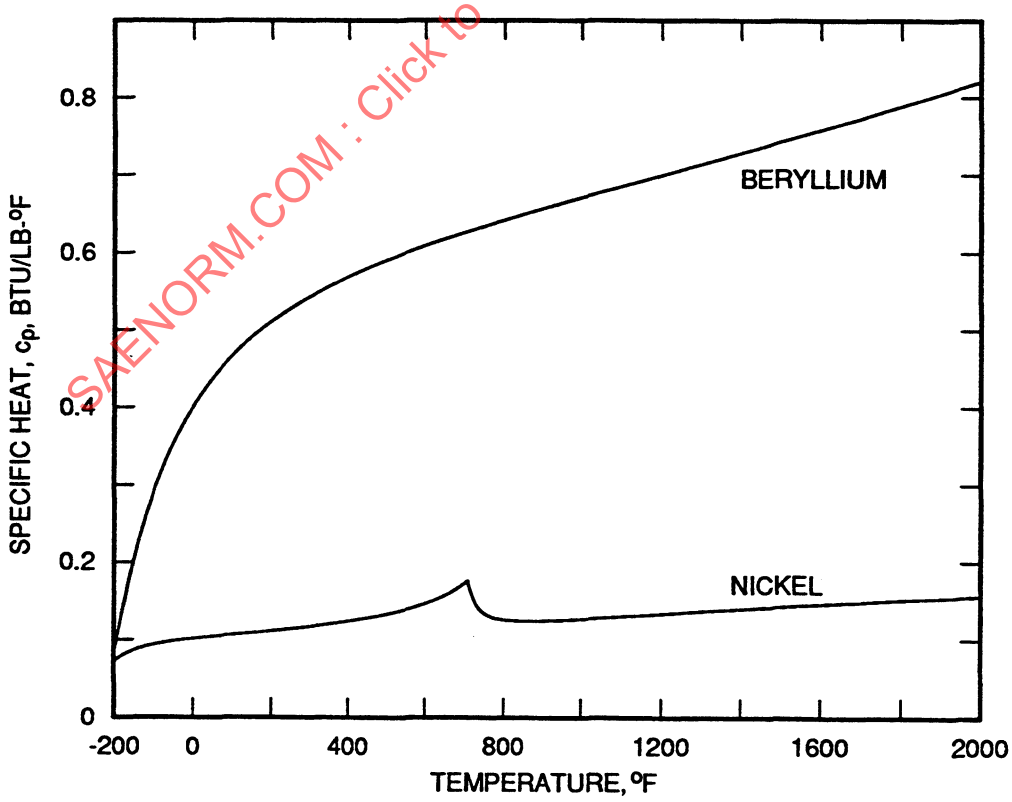


Figure 2D-7 - Specific Heat of Pure Metals (Beryllium, Nickel). (Refs. 1, 33)

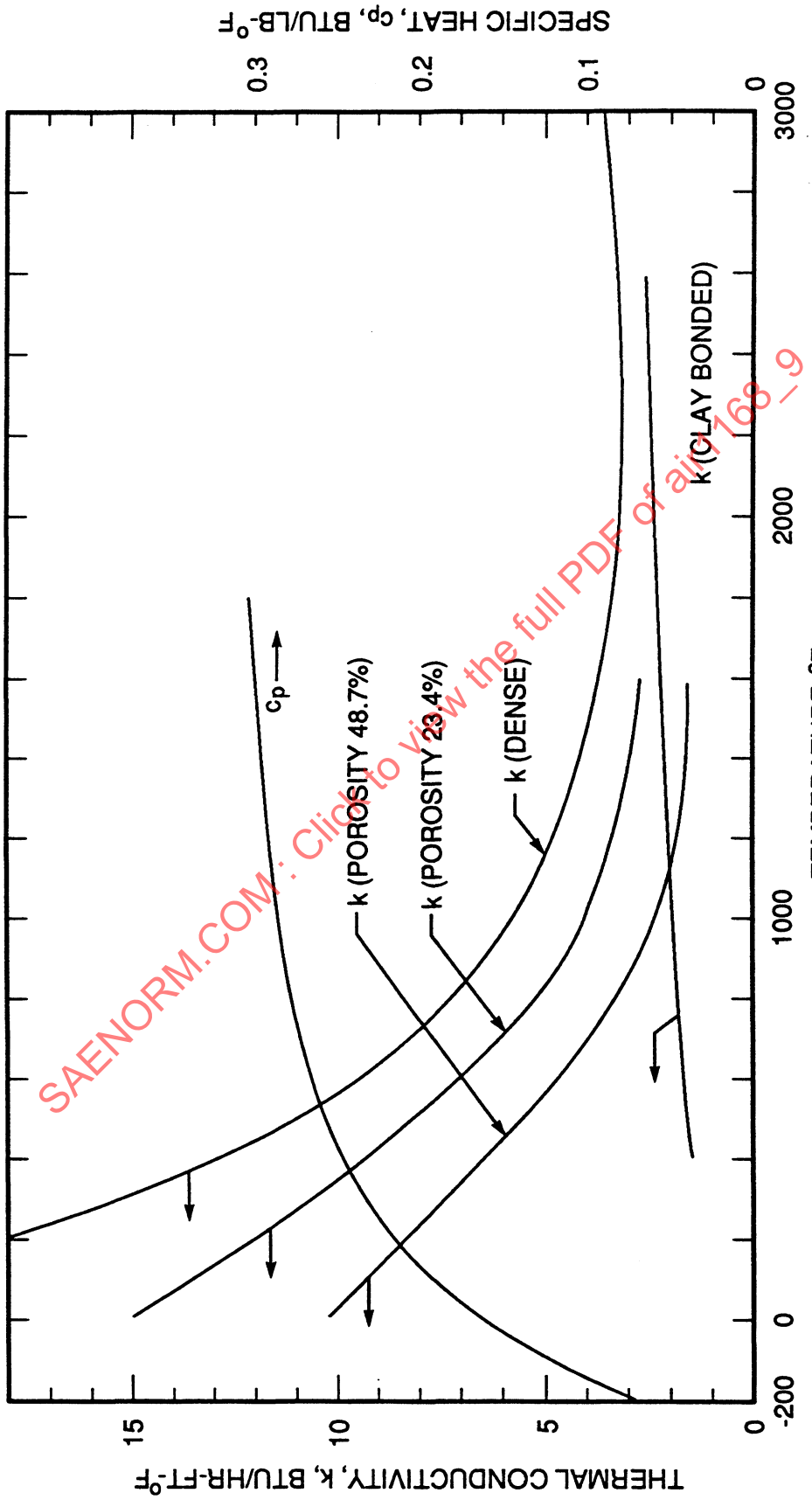


Figure 2D-4 - Specific Heat and Thermal Conductivity of Alumina. (Refs. 6, 27, 28, 68)

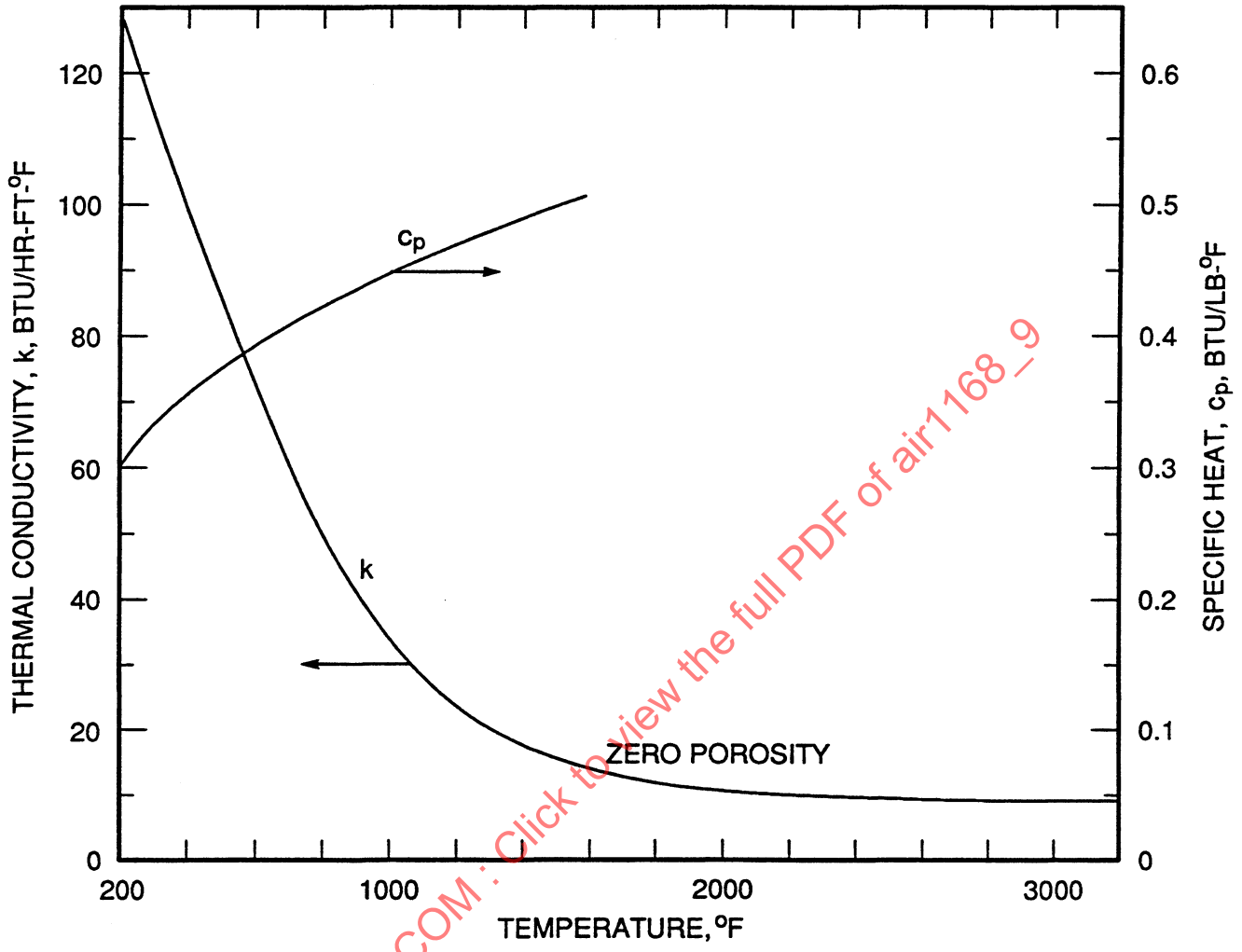


Figure 2D-9 - Beryllia Properties k, c_p. (Refs. 18, 48)

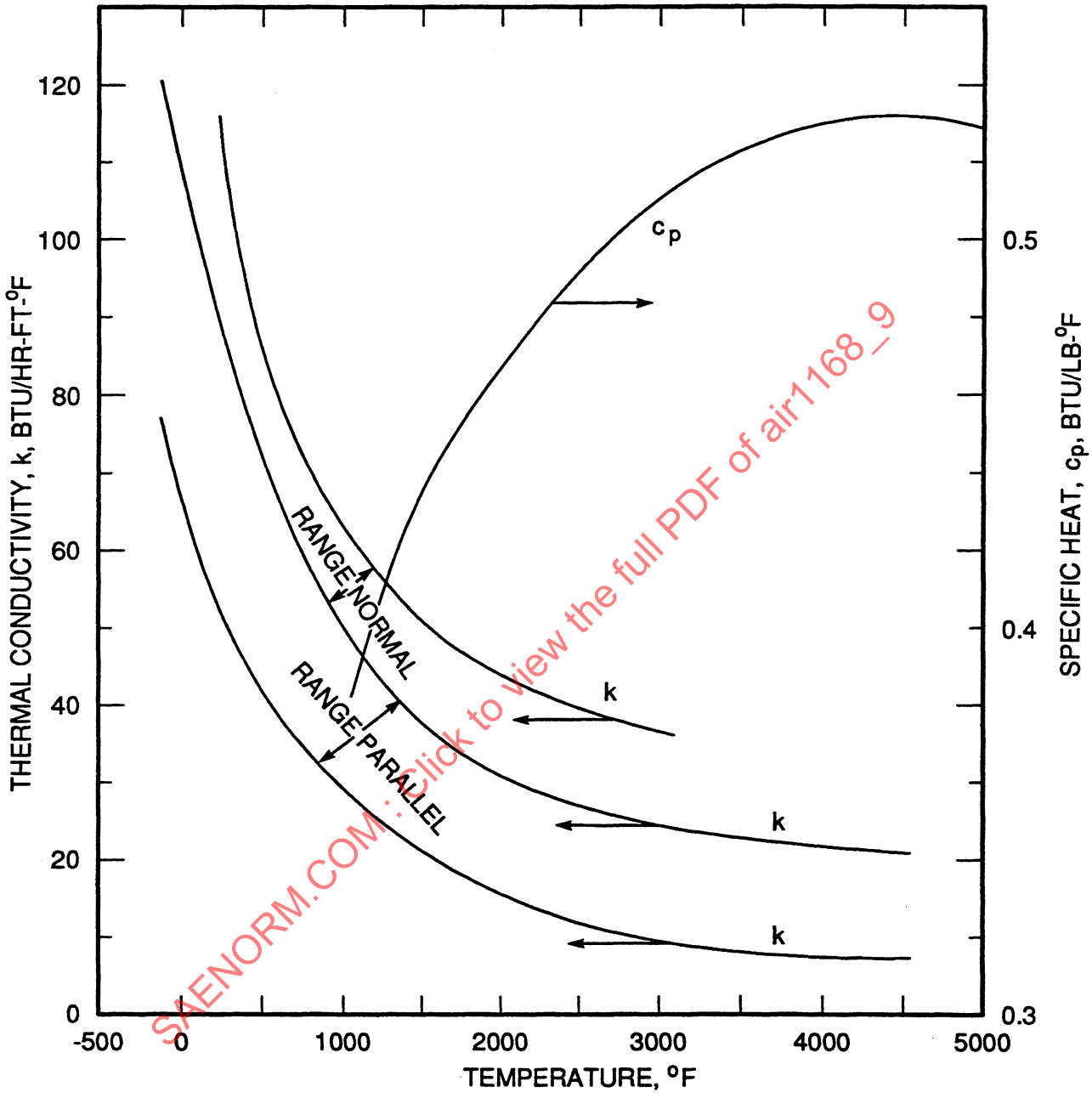


Figure 2D-10 - Graphite Properties k, c_p. (Refs. 18, 48)

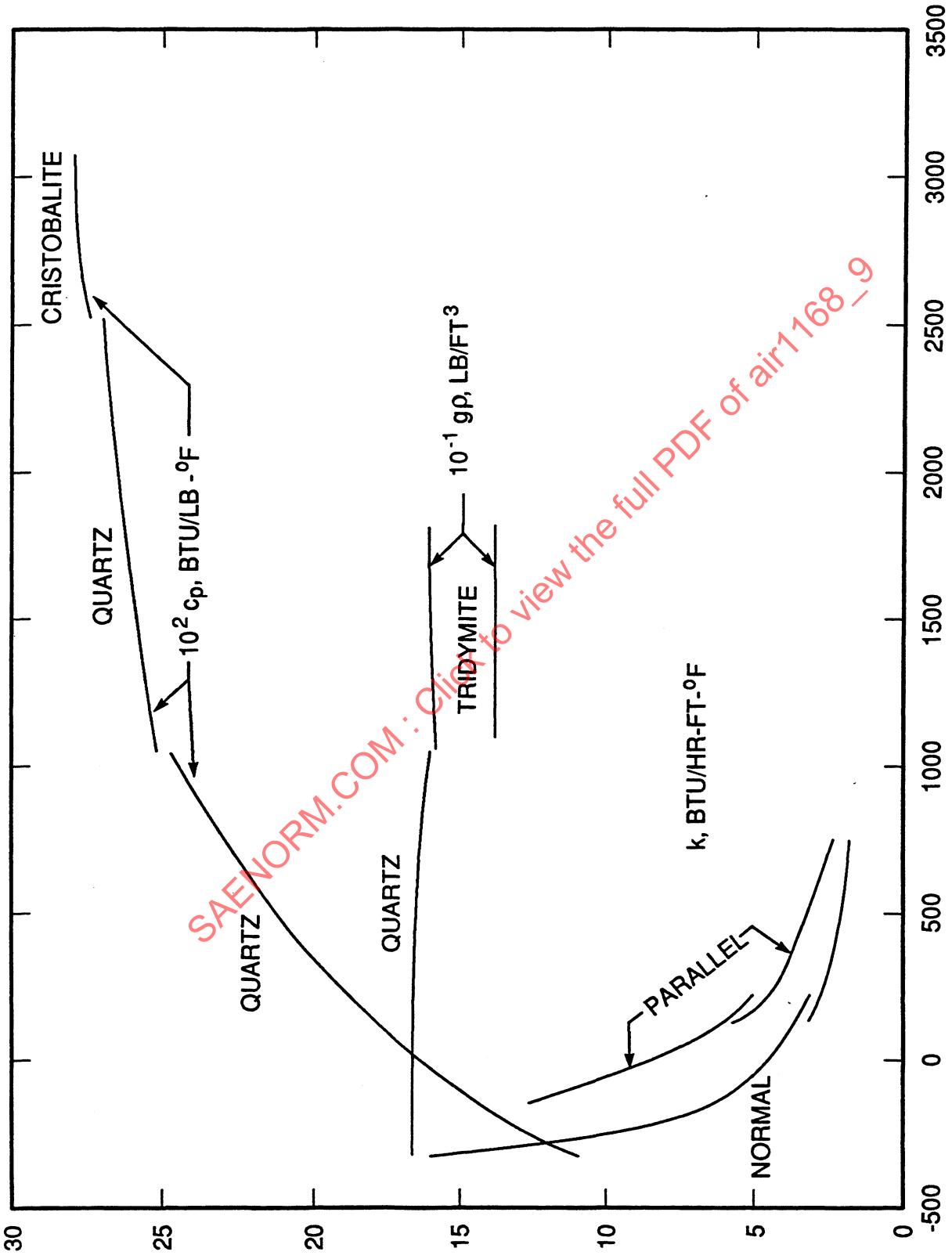


Figure 2D-11 - Quartz Properties k, c_p, gρ. (Ref. 78)

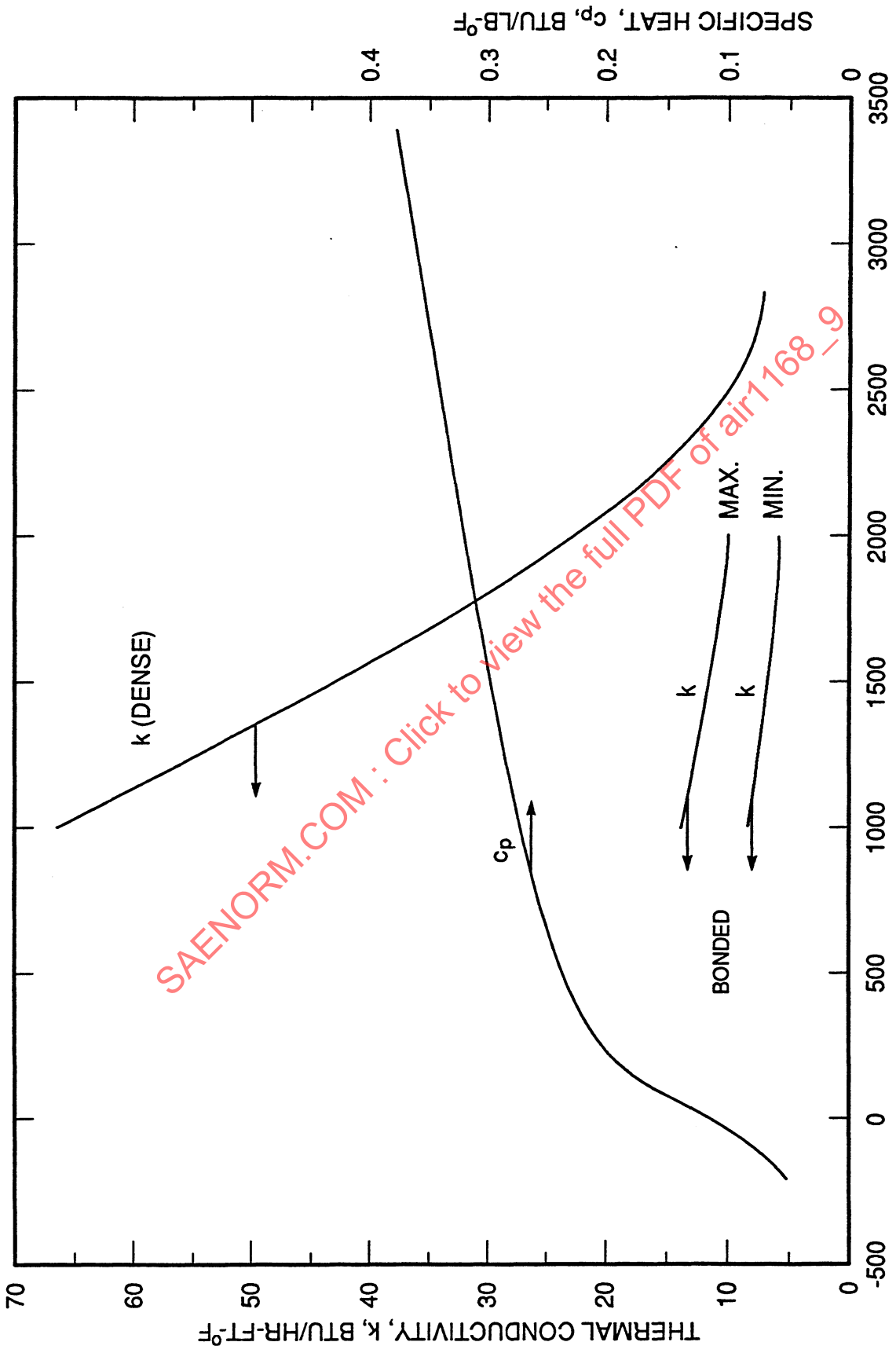


Figure 2D-12 - Silicon Carbide Properties k, c_p. (Refs. 1, 25, 48)

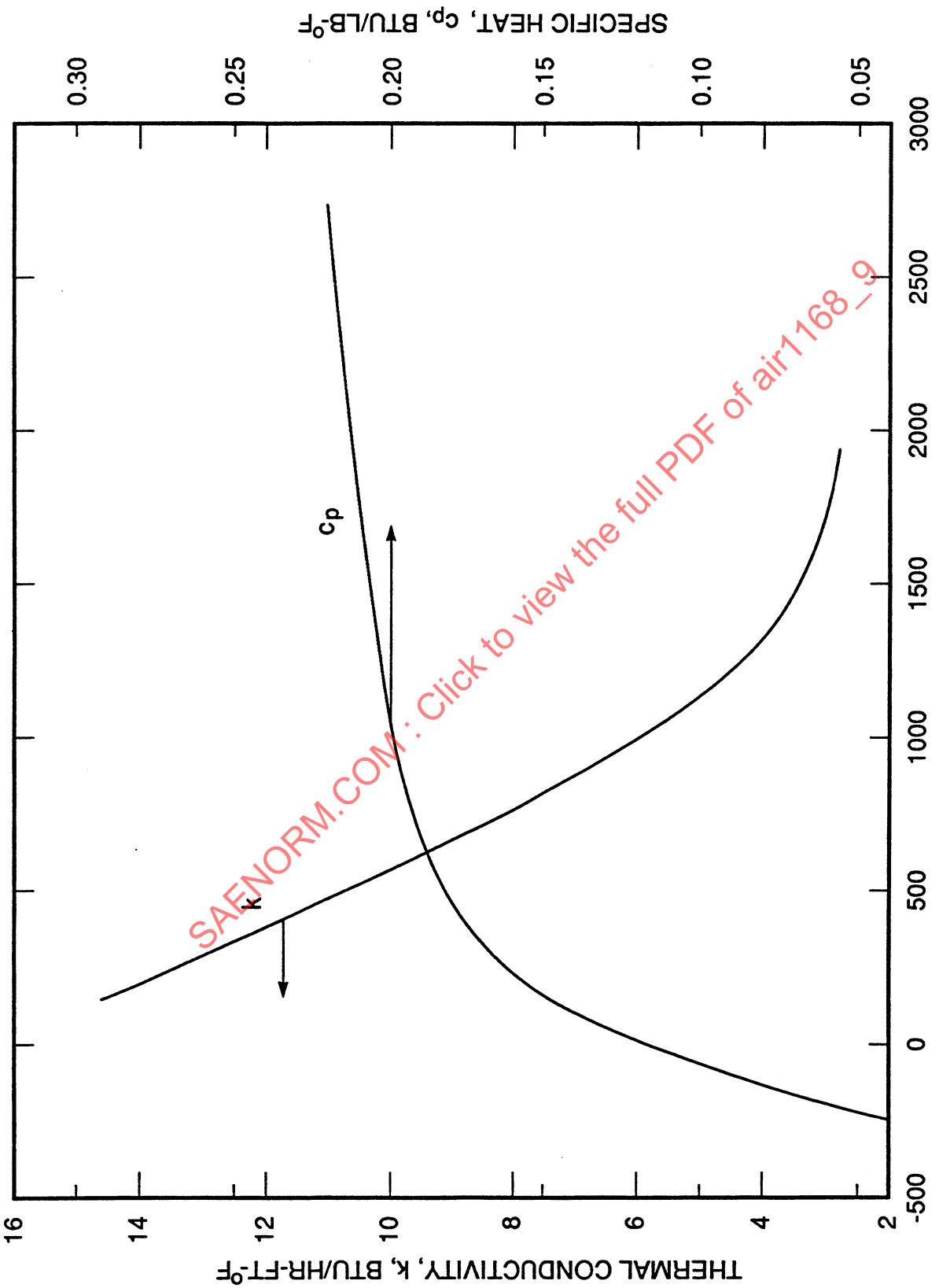


Figure 2D-13 - Titanium Carbide Properties k, c_p. (Ref. 33)

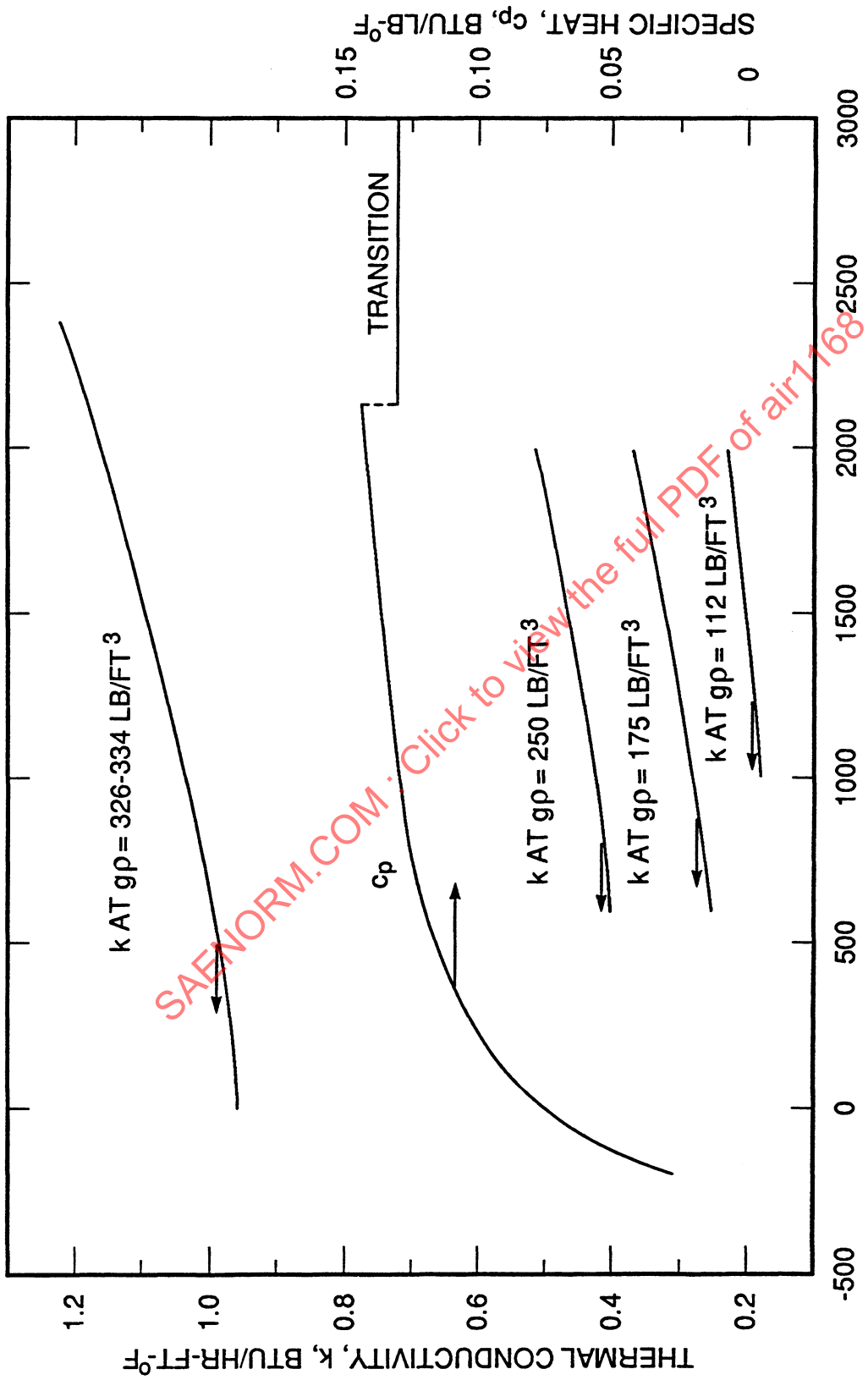


Figure 2D-14 - Zirconia Properties k, c_p, (Ref. 33)

Table 2D-2 - Thermal and Physical Properties of Alloys

Material	Melting from solidus	Range, °F to liquidus	Approx. Heat of Fusion, Btu/lb	Density at Approx. Room Temp., lb/ft³	Apparent Specific Heat Btu/lb-°F 200 °F	800 °F	Thermal Conductivity Btu/hr-ft-°F 200 °F	800 °F	[3]Mean Coefficient of Linear Expansion, β × 10⁶, 1/°F Temp., °F -200	200	600	1000	1500
Aluminum													
2S commercially pure	1215		167	169	0.223	...	121	132	...	13.2	14.2	15.7	
2024-0	936	1180	166	173	0.217	0.270	...	...	11.8	12.2	13.8		
2024-T4	936	1180	166	173	0.217	0.270	78[1] 107[2]	100	11.8	12.2	13.8		
6061-0	1099	1206	174	169	0.23	...	...	...	11.8	12.4	14.4		
6061-T6	1099	1206	174	169	0.23	...	...	...	11.8	12.4	14.4		
7075-0	889	1180	162	174	0.23	...	...	...	11.8	12.4	14.6		
7075-T6	889	1180	162	174	0.215	0.280	79[1] 102[2]	97	11.8	12.4	14.6		
7079-0	900	1180	...	...	0.23	...	...	...	11.8	12.4	14.3		
7079-T6	900	1180	...	...	0.23	...	...	...	11.8	12.4	14.3		
Brass													
Red, 85Cu-15Zw	1810	1880	84	546	0.095	0.098	...	...	...	...	...	10.4	
Cartridge, 70Cu-30Zw	1680	1750	77	532	0.095	0.099	74	...	...	...	...	11.1	
Muntz, 60Cu-40Zw	1650	1660	72	524	0.095	0.102	66.9	...	...	...	...	11.6	
Magnesium													
AZ31B	1049	1159	146	105	0.25	0.32	49.8	65.3	10.0[4]	14.5	15.6	16.8	
$HK_3$1A(H24)	1036	1204	140	112	0.25	0.31	67.7	77.4	10.0[4]	14.5	15.6	16.8	
Nickel													
Commercially pure	2649	2653	131	555	0.112	0.124	33.9	26.8	...	7.3	9.2		
A286	2500	2600	130	498	...	...	...	11.8	...	9.4	...	9.75	
Inconel-X	2540	2600	134	518	0.1095	0.123	7.4	10.0	6.6	7.0	7.5	8.1	9.1
Rene 41	...	...	134	...	...	...	...	7.9	...	6.6	7.0	7.5	8.4
Steel													
1095	2200	2700	116	489	0.119	0.153	33.5	25.8					
4340	...	...	118	489	0.119	0.150	19.7	20.3					
301	2550	2590	126	494	0.117	0.137	9.4	12.2	7.7	9.0	9.8	10.4	10.9
350 soln. ht. tr. 1710 F	2500	2550	...	487	0.12	...	8.87	11.7	...	6.0	6.7	7.1	7.0
17-7PH A	...	...	...	487	0.11	...	...	...	...	8.5	9.5	9.6	
TH1050	...	...	...	487	0.11	...	9.3	12.0	...	5.6	6.3	6.8	
PH15-7 Mo A	...	...	...	487	0.11	...	...	...	...	8.0	8.5	9.4	
TH1050	...	...	...	487	0.11	...	9.5	12.2	...	6.1	6.1	6.6	
Titanium													
Commercially (A55) pure (A70)	3135	...	...	282	0.130	0.151	10.9	10.5	...	4.8	5.4	5.5	5.75
	3135	...	...	282	0.130	0.151	9.8	10.0	...	4.8	5.4	5.5	5.75
6Al-4V	2786	2976	...	276	0.135	0.154	4.3	6.8	...	4.8	5.1	5.3	5.8

SOURCE: Ref. 8.
[1] As received.
[2] After heating to 575 °F.
[3] From room temperature to the temperature indicated.
[4] Local value.

Table 2D-3 - Normal Total Emissivity of Metals

Metal	Temperature,[1] °F	Emissivity
Aluminum		
Highly polished plate, 98.3% pure	440–1070	0.039–0.057
Polished	212	0.095
Rough polish	212	0.18
Commercial sheet	212	0.09
Aluminum Alloy 75 ST[2]		
A[3]	450–900	0.22–0.16
B_1[3]	450–800	0.20–0.18
C[3]	450–930	0.22–0.25
Aluminum Alloy 24 ST[2]		
A[3]	450–910	0.17–0.15
B_1[3]	450–940	0.20–0.16
C[3]	450–860	0.16–0.13
Brass		
Highly polished		
73.2Cu, 26.7Zn	476–674	0.028–0.031
62.4Cu, 38.8Zn, 0.4Pb, 0.3Al	494–710	0.033–0.037
82.9Cu, 17.0Zn	530	0.030
Rolled plate, natural surface	72	0.060
Rolled plate rubbed with coarse emery	72	0.20
Dull plate	120–660	0.22 · · ·
Oxidized by heating at 1110°F	390–1110	0.61–0.59
Columbium, unoxidized	2700–3600	0.19–0.24
Copper		
Carefully polished, electrolytic	176	0.018
Commercial emeried, polished, but pits remain	66	0.030
Commercial, scraped shiny, but not mirror-like	72	0.072
Plate heated long time, covered with a thick oxide layer	77	0.78
Molten copper	1970–2330	0.16–0.13
Gold		
Pure, highly polished	440–1160	0.018–0.035
Iron, cont.		
Polished	800–1800	0.144–0.377
Cast iron, polished	392	0.21
Cast iron, newly turned	72	0.435
Polished steel casting	1420–1900	0.52–0.56
Smooth sheet iron	1650–1900	0.55–0.60
Oxidized rolled sheet plate	70	0.657
Oxidized iron	212	0.736
Oxidized steel plate, rough	100–700	0.94–0.97
Galvanized sheet iron, fairly bright	82	0.228
Galvanized sheet iron, gray oxidized	75	0.276
18-8 stainless steel, sandblasted	180–350	0.50–0.50
18-8 stainless steel, oxidized at 1000°F	180–340	0.32–0.36
18-8 stainless steel, oxidized at 1500°F	165–330	0.63–0.69
18-8 stainless steel, chromic and sulfuric blackened	350	0.57
Lead		
Pure (99.96%) unoxidized	260–440	0.057–0.075
Gray oxidized	75	0.28
Oxidized at 300°F	390	0.63
Mercury	32–212	0.09–0.12
Molybdenum		
Filament	1340–4700	0.096–0.202
Massive, polished	212	0.071
Nickel		
Electroplated, polished	74	0.045
Technically pure (98.9% Ni and Mn polished)	440–710	0.071–0.087
Polished	212	0.072
Electroplated, not polished	68	0.11
Wire	368–1844	0.096–0.186
Plate, oxidized by heating at 1110°F	1110	0.48
Nickel alloys: Inconel X[2]		
Surface A, B_2, C	75	0.19–0.21
Surface A[3]	450–1620	0.55–0.78
Surface B_2[3]	450–1575	0.60–0.75
Surface C[3]	450–1650	0.62–0.73
Platinum		
Pure, polished plate	440–1160	0.054–0.104
Filament	80–2240	0.036–0.192
Strip	1700–2960	0.12–0.17
Wire	440–2510	0.073–0.182
Silver		
Polished, pure	440–1160	0.020–0.032
Polished	100–700	0.032–0.022
Polished	212	0.052
Tungsten		
Filament, aged	80–6000	0.032–0.35
Filament	6000	0.39
Polished coat	212	0.066
Zinc		
Commercial 99.1% pure, polished	440–620	0.045–0.053
Oxidized by heating at 750°F	750	0.11
Galvanized sheet iron, fairly bright	82	0.23
Galvanized sheet iron, gray oxidized	75	0.28
Zinc, galvanized sheet	212	0.21

SOURCE: Ref. 62.

[1]When temperatures and emissivities appear in pairs separated by dashes, they correspond; and linear interpolation is permissible.

[2]Identification of surface treatment; surface A, cleaned with toluene, then methanol; B_1, cleaned with soap and water, toluene, and methanol in succession; B_2, cleaned with abrasive soap and water, toluene, and methanol; C, polished on buffing wheel to mirror surface, cleaned with soap and water.

[3]Results after repeated heating and cooling.